Cognitive Neuroscience Society Annual Meeting Program 2008

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Millisecond Software
NordicNeuroLab
Northern Digital, Inc.
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Psychology Press
Psychology Software Tools, Inc.
Rogue Research, Inc.
Sinauer Associates, Inc.
The MIT Press
Wiley-Blackwell
Worth Publishing

Schedule of Events

Saturday, April 12

9:00 am - 5:00 pm	Satellites
12:00 - 5:00 pm	Exhibitor Check-In, *Pacific Concourse*
2:30 - 7:30 pm	On-site Registration & Pre-Reg Check In, *Grand Ballroom Foyer*
5:00 - 6:00 pm	Cake Reception
5:00 - 7:30 pm	Exhibits on Display, *Pacific Concourse*
5:30 - 7:30 pm	Poster Session A, *Pacific Concourse*

Sunday, April 13

7:30 am - 7:00 pm	On-site Registration & Pre-Reg Check In, *Grand Ballroom Foyer*
8:00 am	Coffee Service, *Pacific Concourse*
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Monday, April 14

8:00 am - 7:00 pm	On-site Registration & Pre-Reg Check-In, *Grand Ballroom Foyer*
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8:00 - 10:00 am	Poster Session H, *Pacific Concourse*
8:00 am - 7:00 pm	Exhibits on Display, *Pacific Concourse*
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12:00 - 1:00 pm	Lunch Break
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3:00 pm	Coffee Service, *Pacific Concourse*
3:00 - 5:00 pm	Poster Session I, *Pacific Concourse*

Mark your calendars now...
the 16th Annual Cognitive Neuroscience
Society Meeting will be held at the
Hyatt Regency San Francisco
March 21 - 24, 2009

George A. Miller Prize in Cognitive Neuroscience

Sunday, April 13, 2008
3:00 - 4:00 pm, Grand Ballroom

Award Winner:

Anne Treisman, Ph.D., *Princeton University*

The George A. Miller Prize in Cognitive Neuroscience was established in 1995 by the Cognitive Neuroscience Society and the James S. McDonnell Foundation to honor the career contributions of George A. Miller to cognitive neuroscience. The first 10 years of the prize were funded by generous support from the James S. McDonnell Foundation.

The prize is awarded to the nominee whose career is characterized by distinguished and sustained scholarship and research at the cutting-edge of cognitive neuroscience. Extraordinary innovation and high impact on international scientific thinking should be a hallmark of the recipient's work.

Each year a call for nominations for the George A. Miller Prize is made to the membership of the society. The recipient is selected by a committee with the approval of the society. The prize winner attends the annual meeting of the Cognitive Neuroscience Society and delivers the George A. Miller Lecture.

Young Investigator Award in Cognitive Neuroscience 2008

Sunday, April 13, 2008
3:00 - 4:00 pm, Grand Ballroom

The Young Investigator Awards in Cognitive Neuroscience recognize outstanding contributions by scientists early in their careers. Two awardees are named each year by the Award Committee, and are honored at the Annual meeting of the Cognitive Neuroscience Society. Each award includes $500 to be used by the awardees toward travel costs to the meeting, or for any other purpose.

2008 Winners of the Young Investigator Award:

Charan Ranganath Ph.D., *University of California Davis*

Kevin Ochsner Ph.D, *Columbia University* and **Rebecca Saxe Ph.D,** *Massachusetts Institute of Technology*

Reception to follow, 4:00 - 5:00 pm

CNS Symposia

session one The Power of Expectancy in the Human Brain

Sunday, April 13
10:00 am - 12:00 pm
Grand Ballroom A

Chair

Jack B. Nitschke, University of Wisconsin-Madison

Speakers

Brian Knutson, Daniela Schiller, Jack B. Nitschke, Jon-Kar Zubieta

Summary: Our expectations have an impact on our lives in multiple ways, including our perception of external events and our emotional responses to them. The impact can be positive, such as enhancing the pleasant emotions followig success or mitigating the negative emotional consequences following adversity. The placebo effect is a prime example of the positive effects that expectations can impart. The impact of expectancy can also be negative, as seen in individuals with anxiety disorders. For them, expectations about possible negative events in the future can result in debilitating levels of worry and distress. This symposium covers seminal research investigating the neural instantiation of such expectancy effects. The speakers address a wide range of topics where expectancy plays an important role, including financial risk, fear learning, anxiety disorders, and placebo. One emerging theme is that the anticipation of emotional events activates the same brain areas that are recruited when those events are experienced. In addition, the research showcased here indicates overlap in the brain areas recruited by anticipatory function across the various domains of investigation covered. Discovering the brain mechanisms for these expectancy effects is enhancing our understanding of the power of expectancy, which in turn may inform clinical applications.

A B S T R A C T S

NUCLEUS ACCUMBENS ACTIVATION MEDIATES THE INFLUENCE OF INCIDENTAL REWARD CUES ON FINANCIAL RISK-TAKING *Brian Knutson, Stanford University* – Increases in endogenous nucleus accumbens (NAcc) activity precede switches from financially risk-averse to risk seeking strategies (Kuhnen and Knutson, 2005), but exogenous control over this process has not yet been demonstrated. We used event-related functional magnetic resonance imaging (FMRI; GE 1.5 T scanner, voxel size = 4 mm cubic, TR = 2000 msec, spiral in/out pulse sequence) to determine whether anticipation of viewing erotic pictures would increase subsequent financial risk seeking in heterosexual males (n=15), and whether this effect would be mediated by increased NAcc activation. Anticipation of viewing erotic pictures increased subsequent financial risk taking, and this behavioral effect was mediated by anticipatory increases in NAcc activation. These results indicate that that exogenously-induced reward anticipation can increase financial risk taking, in part by increasing NAcc activation. The findings are consistent with the notion that incidental cues can influence financial decision-making by altering anticipatory affect.

OVERLAPPING NEURAL SYSTEMS MEDIATING EXTINCTION, REVERSAL AND REGULATION OF FEAR *Daniela Schiller, New York University* – Fear learning is one of the most rapid and persistent emotional learning processes. These characteristics are evolutionary beneficial in preventing the need to relearn about danger, as well as in promoting ways to escape and avoid threats. However, when circumstances change, it is also advantageous to flexibly readjust behavior, and a failure to do so might be the cause of anxiety disorders. We investigated 3 ways to modify fear learning: 1) Extinction - a process by which learned fear responses are no longer expressed after repeated exposure to the conditioned stimuli with no aversive consequences; 2) Reversal - fear responses are switched between two stimuli following a reversal of reinforcement contingencies; 3) Regulation - fear responses are diminished using a cognitive strategy of re-evaluation of the conditioned stimuli. In these studies, the fear measure was skin conductance responding, and we examined the underlying neural activation using fMRI. We observed two neural systems showing striking overlapping activation in the 3 tasks: a system learning responses to external stimuli that are predictive of aversive consequences, while another system readjusts these learned responses when environmental circumstances change. We will discuss differences and similarities in the neural mechanisms underlying these fear expectancy paradigms.

ANTICIPATING THE WORST: INVESTIGATING BRAIN MECHANISMS OF ANXIETY *Jack B. Nitschke, University of Wisconsin-Madison* – A common feature extending across all the anxiety disorders is the concern about something bad happening in the future. When extreme, this future-oriented concern or worry can have debilitating consequences for daily functioning and mental health. My laboratory has been developing and refining experimental paradigms for examining the neural concomitants of anticipating negative events. In our fMRI research with nonclinical healthy populations, we have shown how expectancy modulates neural responses to emotional events and influences perception and subsequent memory of those events. Our most recent studies have also investigated the impact of uncertainty and uncontrollability, because they are central to anticipatory anxiety. The primary areas implicated in this work with healthy volunteers include the amygdala, hippocampus, insula, and anterior cingulate. Finally, having determined the normative patterns of brain activation in anticipation of aversive events, we have begun to search for neural abnormalities of anticipatory processing in individuals with anxiety disorders, with differences thus far localized to the amygdala. This line of research on anxiety reflects a new approach in the study of psychopathology - one that emphasizes a focus on core constituent features, such as the anticipatory processes emphasized in our work - while along the way providing important lessons about how expectancy operates in the brain.

NEUROBIOLOGICAL MECHANISMS OF PLACEBO EFFECTS *Jon-Kar Zubieta, University of Michigan* – Expectations, positive or negative, are modulating factors influencing behavior. They are also thought to underlie placebo effects, additionally impacting perceptions and biological processes. Over the last decade we have been able to acquire biological evidence for the activation of specific circuits during placebo administration. In the cases studied so far (e.g., pain, affective regulation, Parkinson's disease, Major Depression), some overlap in the brain regions involved is becoming evident. We have utilized a sustained pain model to determine the development of both analgesia and affective changes with placebo administration in healthy humans. Subjects were informed that they could receive either an active agent or an inactive compound, creating some uncertainty in the subjects. Across studies, these instructions were associated with expectation of analgesia in the 50% range. Using three different samples and pain paradigms, we demonstrate the activation of endogenous opioid neurotransmission as measured with PET and the μ-opioid selective radiotracer [11C]carfentanil in anterior cingulate and prefrontal areas, insula, nucleus accumbens, amygdala, thalamus, hypothalamus and periaqueductal grey. These opioid data showed associations with reductions in pain report and negative affective state. Additional studies with the radiotracer [11C] raclopride, labeling dopamine D2/3 receptors, also demonstrate the activation of nucleus accumbens dopamine during placebo administration under expectation of analgesia, in a manner similar to data acquired in Parkinson's disease. Both dopamine and opioid neurotransmission were related to expectations of analgesia and deviations from those initial expectations. When the activity of the nucleus accumbens was probed with fMRI using a monetary reward expectation paradigm, its activation was correlated with both dopamine, opioid responses to placebo in this region and the formation of placebo analgesia. These data confirm that specific neural circuits and neurotransmitter systems respond to the expectation of benefit during placebo administration, inducing measurable physiological changes.

session two

Pattern-based fMRI analyses as a route to revealing neural representations

Sunday, April 13
10:00 am - 12:00 pm
Grand Ballroom B

Chair

Rajeev Raizada, University of Washington

Speakers

Jim Haxby, Nikolaus Kriegeskorte, Rajeev Raizada, Geoff Boynton

Summary: Within any active brain region, many neural representations are intermingled. Because these representations are spatially colocalised, they may elicit the same levels of local average activation, with the result that neuroimaging studies have difficulty telling them apart. Recent studies analysing multi-voxel spatial patterns of fMRI activity are starting to provide new methods for accessing such neural representations, and for relating them to behaviour. This symposium presents examples of such research, from diverse cognitive domains. Jim Haxby will describe how pattern-based analyses reveal distributed representations of objects in visual cortex. Drawing parallels between human and monkey studies, Nikolaus Kriegeskorte will show how information-based fMRI can reveal the structure of categorical representations of faces and objects in inferotemporal cortex. In the domain of speech perception, Rajeev Raizada will show how the distinctness of phonetic representations in the brain can predict people's ability to hear non-native speech contrasts. Moving beyond stimulus-driven neural responses, Geoff Boynton will describe how feature-based attentional signals can be decoded from distributed cortical activity.

ABSTRACTS

DISTRIBUTED NEURAL REPRESENTATION OF FACES AND OBJECTS IN VENTRAL TEMPORAL CORTEX *Jim Haxby, Princeton* – Functional brain imaging has revealed a complex, macroscopic organization in the functional architecture of the ventral object vision pathway. Numerous studies have found regions of ventral temporal cortex that consistently demonstrate category-related response preferences, most notably a region that responds maximally during face perception, the fusiform face area (FFA). Faces and numerous other object categories, however, also evoke distinct patterns of response across wider expanses of ventral temporal cortex, including distinct patterns of response in cortical regions that respond submaximally to the category being viewed, suggesting that the representations of faces and other objects extend beyond the regions defined by category preference. Methods for analyzing these patterns of response, which we call multi-voxel pattern analysis, represent a major departure from previous, standard methods for analyzing functional neuroimaging data. Whereas previous methods were designed to find clusters of voxels with similar response properties, topographic pattern analysis is designed to detect reliable patterns of differences among the responses of voxels. The information-carrying capacity of submaximal responses suggests that these patterns may reflect spatially distributed population responses in which both strong and weak responses play an integral role in the representation of complex percepts. Furthermore, the similarity of patterns of response to visual stimuli is correlated with psychological similarity, suggesting that these methods now allow us to use fMRI to investigate how neural representations of visual stimuli are structured.

EXPLOITING HI-RES FMRI AND RELATING MEASUREMENT MODALITIES WITH REPRESENTATIONAL SIMILARITY ANALYSIS *Nikolaus Kriegeskorte, NIH* – High-resolution functional magnetic resonance imaging (hi-res fMRI) promises to help bridge the gap of spatial scales between human low-resolution neuroimaging and animal invasive electrophysiology. I will discuss how the fine-scale neuronal-pattern information present in hi-res fMRI data can be exploited for neuroscientific insight by means of multivariate analysis. In particular, I will focus on the novel approach of "representational similarity analysis", which allows us (1) to combine evidence across brain space and experimental conditions to sensitively detect neuronal pattern information and (2) to relate results (a) between different modalities of brain-activity measurement, (b) between different species, and (c) between brain-activity data and computational models of brain information processing. I will illustrate this approach with a study combining human and monkey data from hi-res fMRI and single-cell recordings, respectively. We investigated response patterns elicited by the same 92 photographs of isolated natural objects in inferotemporal (IT) cortex of both species. Within each species, we compute a matrix of response-pattern similarities (one similarity value for each pair of images). We find a striking match of the resulting similarity matrices for man and monkey. This finding suggests very similar categorical IT representations and provides some hope that data from single-cell recording and fMRI, for all their differences, may consistently reveal neuronal representations when subjected to massively multivariate analyses of response-pattern information.

PREDICTING INDIVIDUAL DIFFERENCES IN SPEECH PERCEPTION USING PATTERN-BASED FMRI ANALYSIS OF PHONEMIC REPRESENTATIONS *Rajeev Raizada, University of Washington* – The brain's ability to discriminate stimuli depends on how fine-grained its stimulus representations are. This representational granularity can vary across individuals, as a function of factors such as sensory environment and learning history. A key goal of cognitive neuroscience has been to relate the properties of such representations in individuals' brains to their levels of behavioural performance. However, because the neural representations of different but related stimuli are typically colocalised within the same brain area, their distinctness from each other has been difficult for fMRI to measure. This problem has been overcome in low-level sensory cortices, where the representational grain can be calculated from well-defined spatiotopic maps, or from direct mappings between stimulus-energy and levels of neural activation. However, for all but the simplest stimuli, no such mappings are available. For example, different phonemes such as /ra/ and /la/ activate the same areas of cortex, but there is no known "phonotopic map" that might allow the distinctness of the evoked neural representations to be measured. I will describe how, by analysing the multi-voxel spatial fMRI patterns elicited by these stimuli in English and Japanese speakers, the statistical separability of such neural representations can be directly quantified. Moreover, in right primary auditory cortex, the separability of these fMRI patterns strongly predicted the degree to which subjects could behaviourally discriminate the stimuli that gave rise to them. This opens up a new method, which may have broad applicability, for relating neural representations in the human brain to levels of behavioural performance, and also reveals a hitherto unknown role played by right auditory cortex in processing speech.

PATTERN-BASED DECODING OF FEATURE-SPECIFIC VISUAL ATTENTION *Geoff Boynton, University of Washington* – When faced with a crowded visual scene, observers must selectively attend to behaviorally relevant objects to avoid sensory overload. Often this selection process is guided by prior knowledge of a target-defining feature (e.g., the color red when looking for an apple), which enhances the firing rate of visual neurons that are selective for the attended feature. Here, we used functional magnetic resonance imaging and a pattern classification algorithm to predict the attentional state of human observers as they monitored a visual feature (one of two directions of motion). We find that feature-specific attention effects spread across the visual field - even to regions of the scene that do not contain a stimulus. This spread of feature-based attention to empty regions of space may facilitate the perception of behaviorally relevant stimuli by increasing sensitivity to attended features at all locations in the visual field.

session three

A Common Role of Anterior Insula in Feelings, Empathy, and Risk?

Monday, April 14

10:00 am - 12:00 pm

Grand Ballroom A

Chair

Tania Singer, University of Zurich

Speakers

A. D. (Bud) Craig, Tania Singer, Christian Keysers, Kerstin Preuschoff

Summary: Recent studies in the emerging fields of social neuroscience and neuroeconomics have supported the view that anterior insula (AI) plays a crucial role in the processing of subjective feelings, empathy, and risk. The symposium provides an overview of different lines of research and suggests a common underlying role of insular cortex for these seemingly different capacities. Bud Craig reviews

structural and functional evidence for a role of AI in interoceptive awareness, bodily states, and subjective feelings. Christian Keysers and Tania Singer then link this stream of research to recent empathy research in social neuroscience that suggests that AI plays an important role in the processing of pain, taste, and disgust in oneself as well as when one is empathizing with other people experiencing pain, taste, or disgust. Finally, Kerstin Preuschoff summarizes the latest findings of fMRI studies on risk in the context of economic decision making which indicate that AI plays an important role in the processing of subjective risk. The speakers discuss their findings in light of a common underlying function of AI as interoceptive cortex, in other words, as cortex serving to integrate information about contextual and internal bodily states into representations of subjective feeling states.

A B S T R A C T S

THE NEUROANATOMICAL BASIS FOR HUMAN AWARENESS OF INTEROCEPTIVE FEELINGS FROM THE BODY *A. D. (Bud) Craig, University of Arizona* – Experimental anatomical and physiological evidence will be presented that identifies a phylogenetically unique homeostatic afferent pathway to the insular cortex of humanoid primates representing the interoceptive sense of the condition of the body. Evidence in humans will be described supporting the view that multiple re-representations of this interoceptive pathway in an integrative progression culminating in the anterior insula seem to form the basis for human feelings, music, and time. These findings provide an anatomical basis for bidirectional interactions between emotions and bodily feelings that could underlie somatisation. The insula, as the limbic sensory cortex, is integral for subjective feelings and acts in concert with the anterior cingulate, or limbic motor cortex, which is integral for volition and agency. This view fits with recent work on the "Von Economo neurons" that are uniquely present in the fronto-insular and anterior cingulate cortices of humanoid primates, which may provide the interconnections between these two regions that were vital for the evolution of advanced emotional communication. Finally, this interoceptive view of awareness also leads to a new proposal for the forebrain asymmetry of emotion in the anterior insula and anterior cingulate cortices of the left and right sides of the human brain.

THE ROLE OF ANTERIOR INSULA IN EMPATHY IN HEALTHY ADULTS, PATIENTS WITH AUTISTIC SPECTRUM DISORDER AND ALEXITHYMIA, AND BUDDHIST COMPASSION MEDITATORS *Tania Singer, University of Zürich* – I will summarize results from functional imaging studies suggesting an important role of anterior insula (AI) for the representation of one's own as well as others' feelings. I will focus on fMRI studies on empathy for pain that suggest an important role of AI when one shares the suffering of others. I will then show results of two studies exploring the relationship between interoceptive awareness and empathy in patients with alexithymia and autistic spectrum disorder (ASD). These results provide evidence supporting the suggestion that deficits in understanding one's own emotions - a symptom observed in alexithymia - are associated with hypoactivation in AI and impaired empathy, but not impaired cognitive perspective taking, the latter frequently being observed in patients with ASD. Finally, I will present initial results from real-time fMRI studies in which we are exploring AI functions by asking a long-term meditation practitioner (a Buddhist monk) to up- and down-regulate activation in AI using online feedback based on activation in AI while he is engaging in different mental techniques, in specific different forms of empathy and compassion meditation.

THE INSULA'S FUNCTION AND CONNECTIVITY DURING EMPATHIC OBSERVATION, IMAGINATION, AND EXPERIENCE OF EMOTIONS *Christian Keysers, University Medical Center Groningen, The Netherlands* – The anterior insula and the adjacent frontal operculum (IFO) appear to play a critical role both in our experience of emotions and in our understanding of other individuals' emotions. To further our understanding of this function, I will present data showing that the IFO is involved in the experience and observation of other individuals' emotions and in our voluntary imagination of similar emotions and that not only negative, but also positive emotions recruit the IFO. Diffusion tensor imaging (DTI) and effective connectivity reveal that this convergent function appears to be achieved using distinct networks. During emotion observation, connections with BA45 involved in facial motor control dominate, confirming a functional link between emotional contagion and facial mimicry. During imagination and experience, much broader networks involving basal ganglia, SMA, and somatosensory areas were effectively connected with the IFO. Together, this data suggests that the IFO may be essential for adding "gut feelings" to our facial mimicry of other individuals' facial expressions, to our own emotional experiences, and to the imaginary scenarios words can conjure.

THE ROLE OF ANTERIOR INSULA IN DECISION MAKING UNDER UNCERTAINTY *Kerstin Preuschoff, California Institute of Technology* – In addition to its role in processing emotions, anterior insula has recently been implied in processing uncertainty and risk. In economic decision making risk is a crucial factor in determining the value of an outcome or action. Organisms must therefore track the level of risk associated with predictions of probabilistic reward, monitor the errors in those risk predictions, and update these in light of new information. I will explore the neural basis of such risk predictions by applying a quantitative framework provided by financial decision theory. Using behavioral and functional imaging data from simple gambling tasks, I will show that activation in the human insula correlates significantly with risk prediction and risk prediction errors and that these signals are consistent with a role in anticipation of upcoming probabilistic rewards and reward learning. Together with previous studies involving complexity, ambiguity, and uncertainty, these findings indicate that our understanding of the role of anterior insula needs to be expanded to include processing of risk.

session four Temporally Selective Attention

Monday, April 14
10:00 am - 12:00 pm
Grand Ballroom B

Chair

Lisa D. Sanders,University of Massachusetts, Amherst

Speakers

Anna Christina Nobre, Angel Correa, Kathrin Lange, Lisa D. Sanders

Summary: Decades of research have culminated in highly accurate and detailed models of the neural mechanisms that support spatially selective attention. However, selecting stimuli for preferential processing based on location is useful when more information than can be processed in detail is presented simultaneously and spread out in space. Much less is known about how perceptual systems deal with overwhelming amounts of information presented rapidly at a single location. Recent evidence indicates that temporally selective attention plays an important role in perception under these conditions. In this symposium, the effects of temporally selective attention on visual and auditory processing will be discussed. Further, data that detail the relationship between temporal and spatial expectations and compare the effects of endogenous and exogenous attention will be presented. The session will end with evidence that listeners employ temporally selective attention during speech processing. Overall, this research indicates that temporally selective attention plays a critical role in perception and comprehension of complex environments and suggests the extent to which temporally and spatially selective attention rely on shared neural systems.

ABSTRACTS

THE EFFECTS OF TEMPORAL AND SPATIAL EXPECTATIONS ON BRAIN ACTIVITY *Anna Christina Nobre, University of Oxford* – Temporal expectations are a vital ingredient to how the brain anticipates events that are relevant to the current task goal and motivational state of the individual, to tune the relevant perceptual and motor machinery accordingly. Temporal predictions are continuously formed and updated, both implicitly and explicitly. These interact with expectations about other relevant attributes of events, in order to optimize our interaction with unfolding sensory stimulation. We have shown that temporal and spatial expectations operating in isolation modulate evoked potentials linked to different stages of perceptual and motor analysis. However, when these expectations are combined synergistic effects are obtained during perceptual analysis. Analysis of the frequencies of neural activity induced during the anticipation of temporally predictable versus unpredictable events now reveals clear modulation of the time-course of oscillatory activity linked to perceptual and motor functions according to the specific intervals predicted.

TEMPORAL ORIENTING OF ATTENTION ENHANCES PERCEPTUAL SENSITIVITY AND STEADY-STATE VISUAL EVOKED POTENTIALS *Angel Correa, University of Granada and University of Oxford* — Pioneer research assigned motor preparation as the main effect of temporal orienting on stimulus processing. Later studies challenged this conclusion by showing that temporal orienting can also produce perceptual preparation under conditions of high perceptual demands. By using a perceptually-demanding unspeeded task, in which stimuli appeared in rapid serial visual presentation (RSVP), we found that temporal orienting enhanced visual processing as indexed by amplifications of both perceptual sensitivity (d') and steady-state visual evoked potentials (SSVEPs) recorded at occipital electrodes. The findings provide converging psychophysical and electrophysiological evidence that temporal orienting enhances perceptual processing.

STIMULUS-DRIVEN TEMPORAL ATTENTION ATTENUATES EARLY BRAIN CORRELATES OF AUDITORY PROCESSING *Kathrin Lange, Heinrich-Heine-University, Düsseldorf* – Event-related potential (ERP) studies have shown that orienting attention voluntarily to a point in time enhances both early and late auditory brain responses. The present study used ERPs to investigate how auditory processing is modulated when attention is driven by temporal regularities of the presented stimuli. A tone sequence with either a regular or an irregular time structure was presented prior to a critical tone, which had to be evaluated for the presence of a short gap. It was assumed that the regular but not the irregular time structure would guide attention to the time of the critical tone. Participants responded faster when the time of the critical tone was attended compared to when it was unattended. Contrary to findings from voluntary temporal attention, the N1 to the critical tone was attenuated rather than enhanced by attention. Consistent with findings from voluntary temporal attention, a late positivity was enhanced by attention. It thus seems that temporal attention can be both under voluntary control and driven by stimulus properties. Evidently, voluntary and stimulus-driven processes have opponent effects on early ERP correlates of auditory processing, while they exert comparable effects on ERP signs corresponding to later processing steps.

LISTENERS DIRECT SELECTIVE ATTENTION TO TIME SCALES AND TIME POINTS DURING SPEECH PERCEPTION. *Lisa D. Sanders, University of Massachusetts, Amherst* – Listeners can attend to relatively fast (40 ms) or slow (500 ms) time scales and doing so modulates auditory evoked potentials (AEPs) elicited by physically identical sounds. Further, listeners can attend to specific time points (500, 1000, or 1500 ms after cue onset) resulting in a larger amplitude auditory onset component (N1) for sounds presented at attended times. Directing selective attention to time scales and time points also plays an important role in speech perception. Specifically, asking listeners to respond to the change in pitch (fast scale) or the average pitch (slow scale) of a syllable affects AEPS. Native speakers of a tone language in which pitch change is a lexical attribute show larger amplitude differences when attending to the fast time scale. When native English speakers are asked to listen to a narrative in English for comprehension, attention probes that occur at or shortly after word onsets elicit larger N1s. This finding indicates listeners are selectively attending to the times during which beginnings of words are presented. Directing temporally selective attention to word onsets may reflect the relative unpredictability and importance of the initial portions of words.

session five The rise and fall of cognitive control: Lifespan development

Monday, April 14
3:00 - 5:00 pm
Grand Ballroom A

Chairs

Denise Head, Washington University and Cindy Lustig, University of Michigan, Ann Arbor

Speakers

Cindy Lustig, Adele Diamond, Ulman Lindenberger, Bradley L. Schlaggar

Summary: Increases in the power and sophistication of cognitive control and executive function are a critical part of intellectual and social development as children move through infancy, adolescence and early adulthood. On the other end of the age spectrum, breakdowns in these control functions are often blamed for older adults' difficulties in memory, attention and other domains. This symposium brings together leading researchers who have examined the development of cognitive control throughout the lifespan. A question of specific interest is how the brain deals with challenges to control at all stages of development. The heuristic "last in, first out" has been used to describe the development of cognitive control and its putative substrate, the prefrontal cortex. Does this heuristic hold true when applied to more specific executive functions (orienting, inhibition, task-switching) and their associated brain networks?

Children and older adults sometimes show similar behavioral patterns on tests of cognitive control - how similar is the underlying brain function? These questions are of interest both from a lifespan perspective, and for understanding the basic taxonomy and functional anatomy of cognitive control.

A B S T R A C T S

AGE IN THE BALANCE: INTERACTIONS BETWEEN LIFESPAN DEVELOPMENT AND CONTROL DEMAND ON FRONTAL ACTIVATIONS AND DEFAULT-NETWORK DEACTIVATIONS *Cindy Lustig, PhD, University of Michigan, Ann Arbor* – In young adults, demands for cognitive and executive control generally result in increased frontal activations, accompanied by more pronounced deactivation of default-network regions associated with task-unrelated processing. How does the balance between frontal and default-network activity, and the response to control demands, change across the lifespan? We addressed this question in a large lifespan fMRI study (n = 239, age 9-97 yrs) of controlled semantic retrieval, episodic memory, and a task-switching procedure that varied control demands. The relationship between frontal activations and default-network deactivations differed depending on whether it was examined from the perspective of demand or development. Increases in task-related control demand were associated with increases in frontal activation and (for children and young adults) more pronounced default-network deactivation. By contrast, across tasks, increasing age was associated with frontal activations that were greater and more sensitive to control demand, whereas default-network deactivations were generally smaller and less sensitive to control demand. Speculatively, development from childhood into young adulthood may be characterized by an increased ability to engage frontal regions associated with cognitive control, whereas development from young adulthood through old age may be associated with an increased need to exert control in order to compensate for default-network dysfunction.

DIFFERENTIAL DIFFICULTY OF INHIBITORY CONTROL AND MEMORY LOAD AT DIFFERENT PERIODS OF LIFE *Adele Diamond, PhD, University of British Columbia, BC Children's Hospital, Vancouver* – Increasing demands on inhibition are disproportionately more difficult for children aged 4-9 than are increasing demands on how much information they need hold in mind (2 to 6 items). The reverse is true for young adults; increasing memory load is disproportionately more difficult for adults than increasing inhibitory demands. Adults may not appreciate how inordinately difficult inhibition is for children because it is less taxing for adults. Also, adults have little difficulty exercising inhibition in single-task blocks, but children show a cost of doing so. For example, adults perform comparably on spatially compatible and incompatible single-task blocks. Only when these trials are intermixed do adults show a significant Simon effect. For children under age 10, however, exercising inhibition, even in steady state, is sufficiently difficult to elicit a cost. In mixed blocks, taxing cognitive flexibility and inhibition is not that hard for adults if memory demands are minimal. For children, that is difficult even if memory demands are minimal.

EPISODIC MEMORY ACROSS THE LIFESPAN: DISSOCIATING STRATEGIC AND ASSOCIATIVE COMPONENTS *Ulman Lindenberger, PhD, Center for Lifespan Psychology, Max Planck Institute for Human Development* – We propose to distinguish between strategic and associative components to capture the reorganization of episodic memory from middle childhood to old age. The associative component refers to mechanisms that bind features into compound episodes. The strategic component refers to control processes selecting, manipulating, and elaborating these features. Based on available neuronal and behavioral evidence, we predict (a) that the development of the associative component precedes the development of the strategic component in children and adolescents, reflecting the progression of maturation from medio-temporal to prefrontal brain regions; (b) that both components undergo decline in late adulthood. To test these predictions, we conducted a recognition-memory study assessing item and pair recognition memory by associative demand (German-German vs. German-Malay word pairs) and strategy instructions (item, pair, or elaborative imagery) in 171 participants aged 10-11, 13-14, 20-25 and 70-75 years. Children's difficulties in episodic memory were primarily due to initially lower levels of strategic functioning. In contrast, older adults' deficits in episodic memory not only reflected impaired strategic functioning, but also deficits in the associative component, such as high false alarm rates for rearranged pairs. Results support the hypothesis of a lifespan dissociation between associative and strategic components of episodic memory.

MATURATION OF CONTROL AND DEFAULT NETWORKS THROUGH SEGREGATION AND INTEGRATION *Bradley L. Schlaggar, MD PhD, Washington University School of Medicine, St. Louis Children's Hospital* – Recent evidence suggests that adults depend on distinct frontoparietal and cinguloopercular networks for adaptive online task control versus more stable set control, respectively. Several perspectives exist regarding the role of the brain's default network in cognition including, but not limited to: self-referential thought, episodic memory, and theory of mind. During development, both experience dependent evoked activity and spontaneous waves of synchronized activity are thought to support the formation and maintenance of neural networks. Such mechanisms may encourage tighter "integration" of some regions into networks over time while "segregating" other sets of regions into separate networks. To investigate the maturation of distinct control and default networks we used resting state functional connectivity MRI, which measures correlations in spontaneous BOLD signal fluctuations between brain regions, to compare network architecture between children and adults. We find that development of the proposed adult control networks involves both segregation (i.e., decreased short-range connections) and integration (i.e., increased long-range connections) of the brain regions that comprise them. At early school age, the brain's default regions are only sparsely functionally interconnected; over development, these regions integrated into a cohesive network. Delay/disruption in the processes of segregation and integration may play a role in developmental disorders of cognition.

session six Cognitive neuroscience of visual short-term memory

Tuesday, April 15
10:00 am - 12:00 pm
Grand Ballroom A

Chairs

Pierre Jolicouer, University of Montreal

Speakers

Edward K. Vogel, René Marois, Yaoda Xu, Pierre Jolicoeur

Summary: We examine recent results from behavioral and neuroimaging studies that elucidate the functional and neural basis of visual short-term memory (VSTM). Although the storage capacity of VSTM is limited to about three objects, passage of information into this system appears critical for conscious awareness and cognitive control from visual input. We review research using a variety of methods including psychophysics, electrophysiology (EEG) and event-related potentials (ERPs), magnetoencephalography (MEG), wavelet analysis, and fMRI, that reveal the nature of the representations in VSTM and their role in cognition. Speakers in the symposium will address issues such as the basic unit of storage in VSTM, individual differences in storage capacity and attentional control, the neural loci and temporal dynamics of regions partcipating in the VSTM network, the involvement of VSTM in the attentional blink, memory for colours, shapes, letters, and words, and memory for content versus memory for spatial location (what vs.where). We will also examine encoding, retention, and retrieval using behavioral and neuroimaging methods.

A B S T R A C T S

SHORT-TERM MEMORY CAPACITY AS AN INDEX OF ATTENTIONAL CONTROL: A NEURALLY-BASED INDIVIDUAL DIFFERENCES APPROACH *Edward K. Vogel, University of Oregon* – The capacity of visual working memory is well known to be highly limited, but it is also known to vary considerably across individuals. Individual differences in memory capacity appear to be a stable trait of the observer and are often positively correlated with many high-level aptitude measures such as fluid intelligence and reasoning. In this presentation, I will describe recent work from my laboratory in which we examine the relationship between an individual's visual working memory capacity and their ability to control the focus of selective attention. In particular, we use a new event-related potential technique that allows us to measure the active representations of objects within the focus of attention across different task conditions and is highly sensitive to individual differences in memory capacity. In general, we have found that low memory capacity individuals are substantially poorer than high capacity individuals across several tasks in which they must exert attentional control over what information is stored in memory. These results suggest a tight relationship between the constructs of memory capacity and the control of attention.

THE NEURAL SUBSTRATES OF VISUAL SHORT-TERM MEMORY *René Marois, Vanderbilt University* – Visual short-term memory (VSTM) is thought to be essential for conscious perception and coherent interaction with the visual world. Yet, despite a ubiquitous role in cognition, VSTM is severely capacity-limited. This capacity limit is not only apparent in the amount of information that can be held in VSTM, but also in the rate of encoding information in VSTM. In this talk, I will describe experiments comparing and contrasting the neural basis of encoding and maintening information in VSTM with standard and time-resolved fMRI studies. I will also present studies describing the interdependence of attention and VSTM during encoding and maintenance of information in VSTM.

DISSOCIABLE PARIETAL MECHANISMS SUPPORTING VISUAL SHORT-TERM MEMORY FOR OBJECTS. *Yaoda Xu, Yale University* – Using visual information to guide behavior requires storage in a temporary buffer, known as visual short-term memory (VSTM), that sustains attended information across saccades and other visual interruptions. I will present fMRI data showing that VSTM storage is mediated by distinctive posterior brain mechanisms, such that VSTM capacity is determined both by a fixed number of objects and by object complexity. Specifically, while the inferior intra-parietal sulcus (IPS) selects a fixed number of about 4 objects via their spatial locations, the superior IPS encodes the features of a subset of the selected objects in great detail. Thus the inferior IPS selects visual object by individuating them, and the superior IPS participates in subsequent object identification. Consistent with this idea, object individuation in the inferior IPS is sensitive to perceptual grouping cues between objects, and object representations in the superior IPS may play a key role in the binding of multiple independent object features. These findings not only advance our understanding of the neural mechanisms underlying VSTM, but also have interesting implications for cognitive theories and brain mechanisms supporting visual object perception.

ELECTROMAGNETIC EXPLORATIONS OF THE TEMPORAL DYNAMICS OF VISUAL SHORT-TERM MEMORY *Pierre Jolicoeur, University of Montreal* – By combining and contrasting results using behavioral, ERPs, MEG, and fMRI, under single-task and dual-task conditions, members of my laboratory are piecing together various aspects of the functional and neuronal basis of VSTM. In this talk I will focus on induced alpha-band oscillatory activity observed in MEG recordings during retention in VSTM. Bilateral alpha power, in parietal cortex, increased with increasing memory load, but without clear lateralization to the hemisphere contralateral to the encoded stimuli in contrast with observed event-related magnetic(and electric) fields. Changes in alpha activity associated with VSTM retention was also found in frontal areas. Even-related magnetic fields also showed a load-related bilateral decrease in field amplitudes, which I will compare with observed decreases in BOLD signal change in companion fMRI experiments.

session seven

The anterior temporal lobes and semantic memory: Putting everything together

Tuesday, April 15

10:00 am - 12:00 pm

Grand Ballroom B

Chair

Timothy T. Rogers, University of Wisconsin-Madison

Speakers

Matthew Lambon Ralph, Eric Halgren, Timothy T. Rogers, Richard Wise

Summary: Essentially all current theories about the neural basis of semantic knowledge agree that much of the content of our semantic memory is represented in brain regions that overlap with, or even correspond to, the regions responsible for perceiving and acting. The more global neuroanatomical organization of the semantic system remains, however, something of a mystery. One position holds that anterior temporal lobe (ATL) regions play a critical role in mapping between different sensory, motor, and linguistic representations distributed widely in cortex. This view originated with studies of patients with semantic dementia (SD), a disorder in which progressive impairment to semantic knowledge across all modalities of reception and expression is accompanied by progressive gray-matter loss and hypometabolism localized within anterior temporal regions. This view from neuropsychology seemingly contrasts, however, with findings from functional neuroimaging studies of healthy individuals, which routinely report semantic activation in posterior temporal, temporo-parietal, and prefrontal regions, but only rarely in ATL regions. This symposium aims to reconcile the apparent contradiction, through presentation of new evidence from converging methods, including rTMS, intracranial EEG, anatomically

constrained MEG, functional and metabolic neuroimaging, comparative patient studies, and computational modeling.

ABSTRACTS

THE CONTRASTIVE ROLES OF THE ANTERIOR TEMPORAL LOBES AND OTHER REGIONS IN SEMANTIC COGNITION. *Matthew Lambon Ralph, University of Manchester* – While semantic dementia (SD) apparently implicates bilateral anterior temporal lobes in amodal semantic representation, the case for the critical role of this region is still in doubt. fMRI studies of semantic processes only highlight ATL activation in a handful of studies, but consistently activate prefrontal and temporoparietal areas. Such regions align with the lesions found in patients with transcortical sensory aphasia (TSA), a fluent aphasia characterized by poor comprehension and preserved repetition. Using a convergence of neuroscience techniques, it becomes apparent that there is a solution for this apparent discordance. We propose that semantic cognition is made up of two interactive components: semantic representations (the database of semantic knowledge) and semantic control (attentional-executive mechanisms that shape or manipulate semantic knowledge to make verbal and nonverbal behaviour task- and time-appropriate). Converging evidence for the role of the ATL in normal semantic processing comes in the form of i) new fMRI studies utilizing a correction for the field inhomogeneities that plague the inferior aspects of the ATL, and ii) novel rTMS studies in normal participants. In addition, direct comparisons between SD and TSA suggest that SD patients have a degradation of core amodal representations while TSA patients have impaired semantic control.

ELECTROPHYSIOLOGY OF SEMANTIC RESPONSES IN THE ANTERIOR TEMPORAL LOBE (ATL) *Eric Halgren, University of California, San Diego* – The ATL is a common target of intracranial electrodes placed for pre-surgical localization of the seizure focus. The most prominent responses during tasks that invoke semantic processing peak at ~400 and 600ms after stimulus onset. In some ATL sites, the N400/P600 represents an entrained theta-delta rhythm that envelopes gamma activity and information-specific firing, and becomes phase-locked with other cortical regions during tasks. The laminar distribution of transmembrane currents during the N400/P600 suggests alternating feedforward/feedback processing. Within a given location, responses are typically highly similar to words presented in the auditory versus visual modalities, or to faces versus words. Lateralization is weak. Across such manipulations as repetition and cloze probability, the 400ms response changes in a manner similar to the scalp N400 event-related potential component, which appears to index semantic contextual integration. Distributed anatomically-constrained MEG source estimation places the N400m in the ATL. Although both MEG and intracranial recordings indicate that the ATL is not unique in generating N400/P600 activity, nor in showing similar responses across sensory modalities and semantic systems, ATL responses are generally stronger and more reliable than elsewhere. In summary, electrophysiological evidence suggests a core role for the ATL in relating stimulus meaning to cognitive context during event-encoding.

DIFFERENT FORMS OF ANTERIOR TEMPORAL PATHOLOGY CAN PRODUCE QUALITATIVELY DIFFERENT SEMANTIC SYNDROMES. *Timothy T. Rogers,University of Wisconsin-Madison* – Semantic dementia (SD) and herpes simplex viral encephalitis (HSVE) are both associated with bilateral anterior temporal pathology, and both diseases produce impairments to semantic memory, but with substantially different profiles: whereas patients with SD show profound impairments for all semantic categories, patients with HSVE often show degraded knowledge of living things, with comparatively spared or even normal knowledge of manmade objects. Recent structural imaging studies comparing SD and HSVE patients have shown that i) there is considerable overlap in the distribution of pathology in ATL regions and ii) the pathology in HSVE can be more widespread, sometimes completely encompassing ATL regions affected in SD. These comparative studies pose a mystery: If HSVE affects the same ATL regions as SD, and additional regions besides, how can knowledge of manmade objects be relatively spared in this disease, but seriously degraded in SD? One possibility is that the two diseases produce qualitatively different kinds of functional disruption within ATL regions. Computer simulations show that different forms of disruption to the same locus can produce model analogs of the two syndromes. The simulations predict further counterintuitive differences between the groups which have recently been tested in a case-series comparison of SD and HSVE.

THE ANTERIOR TEMPORAL LOBES DURING THE NORMAL COMPREHENSION AND PRODUCTION OF LANGUAGE: CONVERGING ACTIVITY. *Richard Wise, Imperial College London* – Functional imaging studies have emphasized the roles of posterior temporal and inferior frontal cortex in speech comprehension and production. These studies have predominantly used magnetic resonance imaging (fMRI), a technique that returns a relatively low signal-to-noise ratio in anterior temporal cortex. Positron emission tomography (PET) does not have this disadvantage. Across a number of studies, using a range of different study designs that involved normal speech comprehension, reading comprehension, propositional speech production and narrative writing, PET has demonstrated strong converging activity in anterior temporal cortex. Language comprehension, irrespective of modality, results in symmetrical activity between the hemispheres, whereas language production is associated with greater activity on the left. The comprehension of speech is associated with strong functional connectivity between the two anterior temporal lobes, a connectivity that is not present when subjects listen to acoustically matched but unintelligible spectrally-rotated speech. More recent fMRI studies are now also demonstrating language-related signal in anterior temporal cortex. Interpretation of these functional imaging studies is made in the light of what is known of impaired and preserved language and memory functions in patients with semantic dementia. Together, the data provides very powerful evidence that anterior temporal cortex is implicated in semantic memory.

session eight

The relationship between social cognition and emotion

Tuesday, April 15
1:00 - 3:00 pm
Grand Ballroom A

Chair

Kevin N. Ochsner, Columbia University

Speakers

Daniella Schiller and Elizabeth Phelps, Jennifer S. Beer, Christian Keysers, Kevin N. Ochsner

Summary: It has been said that humans are the Social Animal, and that what sets us apart from other species is the complexity of our social relationships and the culture it makes possible. To understand the neural mechanisms underlying these social abilities, recent functional imaging work has attempted to clarify the neural mechanisms underlying various socially-relevant behaviors, ranging from person perception to self-regulation, empathy and imitation. Despite mounting evidence that that the neural bases of social cognition are quite similar to those of emotion, little work has attempted to explain what this similarity might mean. Each talk in this symposium will shed light on this issue. Two talks (Schiller & Phelps, Beer) will show that brain systems typically associated with emotion - the amygdala and orbitofrontal cortex - are essential for person perception, because targets for social judgments - including ourselves - have affective relevance. Two other talks (Keysers, Ochsner) will show that interactions among regions involved in motor control, affect, and mental state attribution underlie our tendency to take on the emotions of others and empathize with them. Taken together, these talks suggest that social cognition and emotion share common mechanisms that interact to support social behavior in multiple contexts.

ABSTRACTS

THE NEURAL CORRELATES OF FIRST IMPRESSIONS *Daniella Schiller and Elizabeth Phelps, NYU* – Evaluating others requires processing of complex information. Nevertheless, during an initial encounter we can rapidly form an opinion of a certain individual, these opinions may vary across individual although the same information is provided. The present study investigated the brain mechanisms giving rise to the impressions formed upon meeting a new person. We measured brain responses using fMRI during exposure to different person profiles. Each profile consisted of varying degrees of positive and negative information. Subjects were requested to form an impression of each person using an evaluation scale. Based on subjects' responses, we determined which information was subjectively significant, influencing their impressions (evaluation-relevant), and which was disregarded (evaluation-irrelevant). We then looked for brain areas responding differentially to these two types of information. Results revealed that responses in two brain regions typically associated with emotion - the amygdala and the posterior cingulate cortex (PCC) - were stronger while encoding social information that was relevant, relative to irrelevant to subsequent evaluations. In addition, these responses scaled parametrically with the strength of evaluations. These findings provide the first evidence for encoding difference based on subsequent evaluation ("the DE effect"), suggesting a key role for the amygdala and PCC in forming first impressions.

EMOTIONS OFTEN DEPEND ON SELF-EVALUATION ACCURACY *Jennifer S. Beer, University of Texas at Austin* – The neural overlap between systems of emotion and social cognition (both self-perception and perception of others) is unsurprising from the perspective of appraisal theories of emotion. From this perspective, emotion and social cognition share underlying appraisals. For example, an event or stimulus should not elicit emotion unless is it appraised as relevant to the goals of the self or another person. To address this issue, research in our lab has examined orbitofrontal cortex involvement in relation to emotion and self-evaluation. Studies of patients with orbitofrontal damage show that self-evaluations are impacted much more than emotions. Although orbitofrontal patients often exhibit typical reactions to emotional stimuli, their impaired emotions arise from unrealistically positive self-evaluations. An fMRI study supports these data by showing that the orbitofrontal cortex is recruited to support accurate self-evaluations. Together these studies suggest that although the orbitofrontal cortex is often conceptualized as an emotional region, it is critically involved in self-evaluations that have a downstream effect on emotion and social behavior.

INTEGRATING MOTOR AND EMOTIONAL CONTAGION *Christian Keysers, University Medical Center Groningen* – Psychology proposes that our response to the facial expressions of others depend on two mechanisms but their causal relationship remains unclear: (a) Facial Mimicry: the vision of emotional facial expressions triggers congruent facial expressions in the observer and (b) Emotional Contagion: the observation of emotions triggers a similar emotional state in the observer. Here I show that the vision of facial expressions, be they emotional or not, triggers activity in regions involved in the production of facial expressions (BA45), providing a neural substrate for facial mimicry. Emotional facial expressions additionally trigger activity in the anterior insula/frontal operculum (IFO) involved in experiencing similar emotions, in particular in empathic individuals, providing a neural substrate for emotional contagion. Using effective connectivity, I will show that while viewing emotional facial expressions, the IFO's become strongly connected with BA45, suggesting that a link between facial mimicry and emotional contagion indeed exists, illustrating how emotional and motor simulation combine in the social brain. Importantly, this data helps explain why facial EMG is not predictive of emotional understanding: covert motor simulation in premotor structures not overt mimicry in primary motor or somatosensory regions seem most directly linked to emotional contagion in the IFO.

UNPACKING THE MECHANISMS OF EMPATHY AND EMPATHIC ACCURACY *Kevin N. Ochsner, Columbia University* – Imaging studies of empathy have shown that first person experience activates some of the same neural systems activated by perception of others having the same experience. These data have been taken to suggest that the ability to empathically connect with and understand other's emotions depends upon the ability to automatically "share" their emotional responses. Problematic for this view, however, are the facts that 1) medial PFC regions associated with understanding other's mental states are seldom active in the contrasts analyses used in such studies, and 2) 40 years of behavioral studies show that affect sharing does not predict accurate understanding of other's emotions. Here we 1) present data from an imaging study of pain empathy showing that interactions between medial PFC and regions representing "shared emotions" can be detected using functional connectivity, but not contrast, analyses, and 2) present behavioral data showing that a person's tendency to empathically share emotion can, in fact, predict their ability to accurately judge other's emotions, but only if we take into account the emotional expressivity of the judgment target. In other words, empathic accuracy is not a property of a perceiver, but of their interaction with an emotionally expressive target.

session nine Sleep, memory and plasticity: From molecules to mind

Tuesday, April 15
1:00 - 3:00 pm
Grand Ballroom B

Chair

Matthew Walker, University of California, Berkeley

Speakers

Marcos Frank, Gina Poe, Matthew Walker, Robert Stickgold

Summary: The function(s) of sleep remain largely unknown, a surprising fact given the vast amount of time that this state takes from our lives. One of the most exciting, and contentious, hypotheses suggests that sleep is critical for learning and brain plasticity. Over the last decade, a large number of studies have begun to provide a substantive body of evidence in support of such sleep-dependent memory processing. This symposium offers a synthesis of this rich array of experimental evidence from leading international experts, spanning phylogeny and descriptive levels, ranging from molecules and cells, to networks, systems and cognitive neuroscience. We believe the symposium would offer fertile ground for lively discussions regarding the role of sleep in 1) memory encoding, consolidation, integration and association, and 2) the underlying brain basis of these effects; sleep-dependent plasticity.

A B S T R A C T S

SLEEP-DEPENDENT CORTICAL PLASTICITY IN VIVO: AN INTEGRATIVE APPROACH TO UNDERSTANDING SLEEP FUNCTION *Marcos Frank, University of Pennsylvania* – Converging findings from studies in humans and animals strongly suggest that sleep facilitates memory consolidation. However, the precise cellular mechanisms governing this process are unknown. We have shown that sleep consolidates a canonical form of in vivo synaptic plasticity (ocular dominance plasticity: ODP). This consolidation is blocked when sleep is prevented, or when neural activity in the sleeping brain is reversibly inhibited. We are now beginning to reveal the underlying, activity-dependent mechanisms that alter synaptic strength during sleep. Because the study of ODP has provided insights into plasticity more generally, our findings will uncover basic rules that explain how experience and sleep work in concert to produce long-lasting modifications of cortical circuitry.

PHYSIOLOGICAL PHENOMENA FOR REM SLEEP DEPENDENT MEMORY CONSOLIDATION *Gina Poe, University of Michigan* – The hippocampus is the assembly place, but not final storage site, of complex, associative memories in the brain. During complex associative learning, neurons in the hippocampus are active in a manner consistent with forming new memory networks. Consolidation is the process where temporary hippocampal memories are transferred to long term storage sites throughout the neocortex. Rapid Eye Movement Sleep (REM) has been implicated in the consolidation of many types of memories and learning tasks. It is our hypothesis that the neurochemical milieu of REM creates a unique environment that allows REM sleep brain activity patterns to serve a function for memory consolidation that cannot be fulfilled under normal circumstances during waking. Specifically, in addition to strengthening newly formed synapses, REM sleep allows for synaptic depotentiation of consolidated memories and the erasure of extraneous synapses. We have shown hippocampal reactivation patterns during REM sleep consistent with strengthening novel memories and weakening synapses of consolidated memories, and saw that the reactivation pattern, called theta phase reversal, occurred over the period of 5-7 days consistent with the time course shown for memory consolidation. Further REM deprivation and REM augmentation studies have supported the importance of hippocampal reactivation patterns for learning and memory consolidation.

TO SLEEP…PER CHANCE TO LEARN? SLEEP-DEPENDENT MEMORY AND PLASTICITY IN THE HUMAN BRAIN *Matthew Walker, University of California, Berkeley* – Building on the cellular and network-foundation presentations in this session, I will discuss complimentary evidence of sleep-dependent memory processing in the human brain at a systems and cognitive level. I will begin with an overview of the question what is the relationship between sleep, memory and the brain plasticity, and how do we test it? This will be followed by a selection of behavioral and neuroimaging studies describing 1) the essential need for sleep before learning in preparing the brain for initial memory formation/encoding, 2) the critical need for sleep after learning for the subsequent neuroplastic consolidation of memory, and 3) a novel role for sleep in the development of associational links between recently learning information - potentially the ultimate goal of memory storage. I will conclude with a conceptual framework of how sleep may facilitate the processes underlying the acquisition, consolidation, integration and possibly erasure of human memories.

SLEEP, MEMORY AND DREAMS: BEYOND CONSOLIDATION *Robert Stickgold, Harvard Medical School* – There is now considerable evidence for sleep's role in the consolidation of various forms of memory, from procedural skill learning to word pair recall. But beyond simple consolidation, sleep can also facilitate the integration of new information with older memories and the extraction of patterns from multiple exemplars, even when there is only a probabilistic relationship between exemplar and class. Evidence of these more sophisticated forms of memory processing during sleep will be presented, and the possible relevance of dreaming to these processes discussed.

Graduate Students Present

Monday, April 14, 2008
3:00 - 5:00 pm, Grand Ballroom B

The Graduate Students Present is a forum enabling students to present their research to the general audience in ten-minute intervals. Nine abstracts were chosen in a blind review, from nearly 300 abstracts submitted. Each recipient is awarded a $500-travel award.

The session will be moderated by Reiko Graham, Ph.D., Texas Sate University. Questions will be at the discretion of each individual speaker.

Speakers:

Idil Kokal, *University of Groningen, the Netherlands*

Namhee Kim, *The Ohio State University*

Isabelle Pelletier, *Centre de recherche du Centre Hospitalier Universitaire Mère-Enfant (Sainte-Justine) and Université de Montréal*

Aaron Boes, *University of Iowa Carver College of Medicine*

Jai-Min Bai, *UCSD*

Pamela Perschler, *Southern Illinois University*

Elliot Berkman, *UCLA*

Sabrina Segal, *University of California, Irvine*

Keiko Yamazaki, *Hokkaido University*

Graduate Students Present

INVESTIGATING JOINT ACTIONS WITH FMRI *Idil Kokal[1,], Valeria Gazzola[1], Christian Keysers[1]; [1]BCN Neuroimaging Center, University Medical Center Groningen, University of Groningen, the Netherlands* – Recent studies suggest that the capacity to coordinate one's actions with others' relies on the mirror neuron system (MNS). With fMRI we scanned participants engaging in joint actions with the experimenter. The task involved moving one of the two sticks of a clock-like device singly as well as creating a particular shape jointly with the experimenter. In the straight condition, the participant had to move his stick to the opposite side where the experimenter moved hers; in the angle condition, to the same side. In the control conditions, the participant had to (a) passively watch the experimenter's movements or (b) move his stick alone. The MNS, involved in (a) and (b) included: the opercular part of the left inferior frontal gyrus (IFG) and the left inferior parietal lobule (IPL). The regions that are more active during joint actions compared to a+b were adjacent but anterior to the MNS regions in the IFG and IPL and additional activities in the left posterior superior temporal sulcus, right precenues and bilateral lingual gyrus were found. The straight condition recruited the right superior frontal gyrus more strongly than the angle condition, possibly to inhibit the predominant response to move in the same direction as the experimenter. The bilateral temporal parietal junction (TPJ), a region involved in perspective taking and theory of mind, was activated only in the angle condition. Our results suggest that dynamically coupling one's actions to those of others' involves a circuitry that goes beyond the classical mirror system.

THE EFFECT OF L-DOPA ON FMRI OF LANGUAGE PROCESSING *Namhee Kim[1], Madalina Tivarus[2], Prem Goel[1], David Beversdorf[3]; [1]The Ohio State University, Department of Statistics, , [2]University of Rochester, Department of Imaging Science and the Rochester Center for Brain Imaging Rochester, NY, [3]The Ohio State University, Department of Neurology* – L-dopa, which is a precursor for dopamine, acts to amplify strong signals, and dampen weak signals as suggested by other studies. The effect of L-dopa on language processing has been demonstrated in language studies, suggesting restriction of the semantic network. In this study, we aimed to examine the effect of L-dopa on language processing with fMRI. Two types of language tasks (phonological and semantic categorization tasks) were tested under two drug conditions (placebo and L-dopa) in 16 healthy subjects. Independent Component Analysis (ICA) was used to select task-relevant (positive) sources. Group ICA of fMRI Toolbox (GIFT) was implemented to generate 25 sources for each subject for the four conditions and the sources were classified into task-relevant source groups by correlation criterion. We found that the highly task relevant brain regions Left Inferior Frontal Gyrus (LIFG), Left Fusiform Gyrus (LFUS), and Middle Temporal Gyrus (MTG) showed distinct activation patterns with L-dopa treatment as compared to placebo for both tasks. We also found out that the thalamus was activated in language processing with placebo but was not significant with L-dopa treatment. Further research will be necessary to better understand how findings relate to the semantic effects on L-dopa. However, the lack of thalamic activation with L-dopa suggests that L-dopa allows semantic processing to occur with less influence from thalamic feedback.

FUNCTIONAL MAGNETIC RESONANCE IMAGING STUDY OF LANGUAGE LATERALIZATION IN ACALLOSAL PATIENTS. *Isabelle Pelletier[1,2], Isabelle Rouleau[4], Christine Rosa[1], Katja Valois[4], Frederic Andermann[5], Dave Saint-Amour[1,2,3], Franco Lepore[1,2], Maryse Lassonde[1,2]; [1]Centre de recherche du Centre Hospitalier Universitaire Mère-Enfant (Sainte-Justine), [2]Centre de Recherche en Neuropsychologie et Cognition, Département de psychologie, Université de Montréal, [3]Département d'ophtalmologie, Université de Montréal., [4]Centre de Neuroscience de la Cognition, Département de psychologie, Université du Québec à Montréal, [5]Department of Neurology, Montreal Neurological Institute* – Since the seminal work of Broca in 1861, it is well acknowledged that language is related to left hemisphere functions, at least in adults. However, the origins of this hemispheric specialization are more controversial. Some authors posit that language is genetically-coded while others have suggested that hemispheric specialization develops over time. Tenants of the latter view have further suggested that the adult pattern of left hemispheric specialization is achieved through callosal inhibition of the homologous right speech areas. According to this hypothesis, it follows that language could develop bilaterally in the acallosal brain (callosal agenesis, ACC). A functional magnetic resonance imaging (fMRI) study of a single case of ACC suggests that this might be the case (Riecker et al., 2007). Considering the important variability of reorganization patterns in ACC, this finding needs to be replicated in a larger sample of subjects. In the present study, six ACC individuals underwent a language lateralization fMRI protocol comprising both a syntactic decision task as well as a subvocal verbal fluency task. Some of the ACC individuals showed a clear hemispheric specialization whereas others displayed a more bilateral speech representation. While these results indicate that various patterns of brain reorganization may be occurring in ACC, they also suggest that the corpus callosum does not play a necessary role in the cerebral development of lateralized linguistic representation.

RIGHT VENTROMEDIAL PREFRONTAL CORTEX: A NEUROANATOMICAL CORRELATE OF IMPULSIVENESS AND HYPERACTIVITY IN BOYS *Aaron Boes[1,2], Daniel Tranel[3], Steve Anderson[3], Antoine Bechara[4], Lynn Richman[5], Peg Nopoulos[1]; [1]Department of Psychiatry, University of Iowa Carver College of Medicine, Iowa City, Iowa, [2]Medical Scientist Training Program, University of Iowa Carver College of Medicine, Iowa City, Iowa, [3]Department of Neurology (Division of Behavioral Neurology and Cognitive Neuroscience), University of Iowa, Iowa City, Iowa, USA, [4]Institute for the Neurological Study of Emotion and Creativity, Department of Psychology, University of Southern California, Los Angeles, California, [5]Department of Pediatrics, University of Iowa Carver College of Medicine, Iowa City, Iowa* – Emerging data on the neural mechanisms of impulse control have highlighted brain regions involved in emotion and decision making, including the ventromedial prefrontal cortex (VMPC), anterior cingulate cortex (ACC), and amygdala. We have previously hypothesized that variations in the development of these regions may influence one's propensity for impulsivity and, by extension, one's vulnerability to disorders involving poor impulse control (e.g. substance abuse). Here we test the hypothesis that poor impulse control is associated with structural deficits in this emotion processing circuit in a group of normal healthy boys. Also, we hypothesized that right-sided structures would preferentially predict poor impulse control. In a sample of 61 boys, age 7 - 17, we assessed parent- and teacher-reported behavioral ratings of impulse control (non-planning and hyperactive behavior) in relation to volume of the VMPC, ACC and amygdala, measured using structural MRI and FreeSurfer. A regression analysis showed that, as a group, right-sided regions of interest (ROIs) significantly predicted impulse control ratings, with the VMPC as an individually significant predictor. Follow-up correlation tests revealed a significant correlation for poor impulse control and low right VMPC volume, which is more robust in the medial sector of the VMPC. A comparison a right VMPC volume between boys with high and low impulsiveness\hyperactivity revealed significantly lower right VMPC volume in the former group. These results are consistent with the notion that right

VMPC provides a neuroanatomical correlate of the normal variance in impulse control observed in boys.

ELECTROPHYSIOLOGICAL ANALYSIS OF EMPATHY AND THEORY OF MIND FUNCTION IN CHILDREN WITH AUTISM SPECTRUM DISORDER *Jai-Min Bai[1,5], Derrik Asher[1], Oriana Aragon[1,3], Tom Gamage[6], Yasmin Ghochani[1], Stephen Johnson[1], Steve Gilmore[1], Matt Erhart[1], Heather Pelton[1], Ernesto Enrique[4], Dane Chambers[1], Jaime Pineda[1,2]; [1]Department of Cognitive Science, UCSD, [2]Neuroscience Department, UCSD, [3]Cal State University, San Marcos, [4]San Diego State University, [5]University of Illinois, Champaign-Urbana, [6]Virginia Commonwealth University* – Previous research has identified the mirror neuron system (MNS) as a collection of neurons involved in the integration of observation and execution into a matching system. MNS activity monitored by EEG has been indexed through power suppression from 8-13Hz (mu rhythms) over the sensorimotor cortex. Typically developing (TD) individuals show mu power suppression during goal oriented actions in observation and execution. Individuals with autism spectrum disorder (ASD) show suppression only in goal oriented actions involving execution and not observation. Our research focused upon two methods for analyzing social cognition through observation of visual stimuli, empathy and theory of mind (ToM). The ToM method revealed results that reinforced a previous study that dissociates ToM into two subcomponents. The empathy study applied to TD children revealed mu power suppression to emotional faces. In contrast, children with ASD showed similar mu power across different conditions. This result suggests that children with ASD do not engage the mirror neuron system in face emotion processing as do TD children. In addition, TD children show higher mu power suppression in the right hemisphere than in the left. However, children with ASD showed no mu power difference between hemispheres. Therefore, the electrophysiological data collected through these two methods contribute to the theory that children with ASD are deficient in their ability to suppress mu rhythms. These results provide a fundamental basis for an ongoing study that is investigating whether the electrophysiological discrepancies in ASD are functional, structural or both.

MODULATION OF NEURAL ACTIVITY IN THE LEFT INFERIOR FRONTAL GYRUS AS A FUNCTION OF PRIOR AND SUBSEQUENT ASSOCIATIVE LEARNING *Pamela Perschler[1], Reza Habib[1]; [1]Southern Illinois University, Carbondale* – The subsequent memory (SM) paradigm is used to identify differences in activity during encoding that predict whether a stimulus will be subsequently remembered. Here, we asked whether performance during a previous memory test will modulate activity during subsequent encoding. Neural activity was measured with functional MRI during the encoding phase of a multi-trial associative learning paradigm. Over the course of 7 trials, subjects learned and recalled 40 unrelated word pairs. Cued recall performance on trials 1-6 was used to categorize encoding activity on trials 2-7 into: 1) Rc11 (successful recall on the previous and current trial), Rc01 (unsuccessful recall on the previous trial but successful recall on the current trial), and Rc00 (unsuccessful recall on the previous and current trial). The comparison between Rc01 and Rc00 corresponds to the standard SM analysis and identified greater activity in the left inferior frontal gyrus (LIFG) and right parahippocampal gyrus. The comparison between Rc11 and Rc01 identifies regions whose activity is modulated by whether an item has been previously learned. Activations were observed in the left superior temporal, medial frontal, and parahippocampal gyri; a deactivation was observed in the same LIFG region identified in the standard SM analysis. This result indicates that activity of the LIFG is greater in the Rc01 condition than either the Rc00 or the Rc11 condition, suggesting that this region is critical for for transforming an item from an unlearned state to a learned state; once an item is learned, activity in this region is reduced.

CROSS-DOMAIN INHIBITION: INTENTIONAL MOTOR INHIBITION PRODUCES INCIDENTAL LIMBIC INHIBITION *Elliot Berkman[1], Lisa Burklund[1], Matthew Lieberman[1]; [1]UCLA Department of Psychology* – Neurocognitive studies have consistently observed rIFG involvement in inhibition across a number of domains (e.g. motor, cognitive, affective), however there has been no systematic investigation of whether there is a common inhibitory mechanism in rIFG that produces similar effects in each domain. The present study used an emotional go/no-go task that produces prepotent responses in both the motor and affective domains, but with intentional inhibition in only one domain (motor) and affective responses being incidental to the task. We found support for the hypothesis that rIFG serves as a common inhibitory mechanism across multiple psychological domains. We observed increased rIFG and reduced amygdala activity when participants engaged in response inhibition during the presentation of negatively-valenced stimuli. Across trials with negatively-valenced stimuli, functional connectivity analyses revealed significantly greater inverse correlations between the time courses of rIFG and amygdala during no-go trials than go trials, suggesting that when participants intentionally inhibited a motor response in the presence of an affective cue that would typically activate the amygdala, amygdala activity was dampened to the extent that the rIFG response was higher. Thus, intentional inhibition in the motor domain produced unintended inhibitory consequences in the affective domain.

ENDOGENOUS NORADRENERGIC ACTIVATION AND MEMORY FOR EMOTIONAL MATERIAL IN MEN AND WOMEN *Sabrina Segal[1], Larry Cahill[1]; [1]University of California, Irvine* – Abundant evidence in animal studies suggests that noradrenergic activity is related to memory, particularly for emotional material. The salivary enzyme, alpha-amylase is known to be highly correlated with norepinephrine and is a biomarker for the sympathetic nervous system response (Chatterton, et. al 1996). This measurement was used to study the relationship between endogenous noradrenergic activation and memory in healthy men and women. Subjects viewed images from the International Affective Picture Set (IAPS) that ranged from neutral to emotional. Saliva samples were collected at baseline, immediately after viewing the slides, and then 3, 8, 18, and 28 minutes after the slide show. Subjects returned one week later for a surprise memory recall test. The most notable results were with respect to the women who displayed an increase in salivary alpha-amylase (sAA) immediately after versus before viewing the pictures ($n= 21$). There was a highly significant correlation between the increase in sAA immediately after viewing the pictures, and the percent of emotional slides those subjects recalled ($r = 0.73$, $p < 0.01$). There was no correlation between the increase in sAA immediately after viewing the slides and the number of neutral slides recalled ($r= 0.30$, $p> 0.05$). The difference between these correlation coefficients closely approached significance ($p < 0.06$). These results are the first of which we are aware, to provide evidence that endogenous noradrenergic release is correlated with enhanced memory for emotional material in women. Further studies will determine whether this relationship extends to men and memory for emotionally arousing material.

EARLY VISUAL COMPONENT OF ERP REFLECTS THE SEQUENTIAL PROCESS OF MENTAL IMAGERY GENERATION *Keiko Yamazaki[1], Jun'ichi Katayama[2]; [1]Graduate School of Education, Hokkaido University, [2]Faculty of Education, Hokkaido University* – We examined the brain activity related to the mental imagery of sequentially memorized shape using ERP. Four kinds of shape were named "a", "b", "c", and "d", two of which were SIMPLE shape composed of three segments, and the others were COMPLEX shape of five segments. Participants memorized these shapes with order of the segments to be drawn. In the experiment, 5 x 5 grids with the name of shape in the central cell, and with an "X" probe mark in another cell, were presented. Participants decided whether or not the probe mark fell on the visualized shapes. Half of the trials were ON trials where the mark fell on the shape. Half of the ON trials were EARLY trials when the marks placed on a segment drawn early in the order to be memorized, and the other half were LATE trials. Choice reaction time for the ON trials was shorter in the EARLY than in the LATE, and shorter in the SIMPLE than in the COMPLEX trials. These results show that participants visualized shapes in the order to be memorized. ERP effects were observed on the positive component over the posterior site around 200 ms after the stimulus (P200). The peak amplitude of this component was larger for the COMPLEX than for the SIMPLE in EARLY trials over the right parieto-occipital site. We concluded that imagery generation process is involved in visual areas activated in early latency range, and that P200 reflects sequential process of mental imagery generation.

Poster Abstracts

Poster Session	Date & Time	Set-up Begins	Session Begins	Session Ends	Take-down Complete
A	Saturday 4/12/08	5:00 pm	5:30 pm	7:30 pm	8:00 pm
B	Sunday 4/13/08	*7:30 am	8:00 am	10:00 am	11:30 am
C	Sunday 4/13/08	11:30 am	1:00 pm	3:00 pm	3:30 pm
D	Sunday 4/13/08	3:30 pm	5:00 pm	7:00 pm	7:30 pm
E	Monday 4/14/08	*7:30 am	8:00 am	10:00 am	11:30 am
F	Monday 4/14/08	11:30 am	1:00 pm	3:00 pm	3:30 pm
G	Monday 4/14/08	3:30 pm	5:00 pm	7:00 pm	7:30 pm
H	Tuesday 4/15/08	*7:30 am	8:00 am	10:00 am	12:30 pm
I	Tuesday 4/15/08	12:30 pm	3:00 pm	5:00 pm	5:15 pm

* Please note that only scheduled poster presenters may enter the exhibit hall during the early morning set-up time. All other attendees may only enter when the exhibit hall opens at 8:00 am.

The presenting author must be present at least one full hour during the assigned session and the other authors should be present during the remaining time. You may post your materials on the board assigned to you at any time after the "Set-up Begins" time (listed above), but before the beginning of the assigned poster session. You must remove your poster promptly no later than the time listed above in "Take-down Complete." Any posters left up after the "Take-down Complete" time may be discarded. Do not leave personal items in the poster room.

On Saturday, the doors to the poster room close and lock at 8:00 pm. On Sunday-Monday the doors close and lock at 7:30 pm. On Tuesday, the doors close and lock at 5:15 pm. No attendee or exhibitor will be allowed to enter the exhibit hall once the doors are locked.

Poster Session A

Higher level cognition: Executive functions

A1

EFFECTS OF PRIOR PROBABILITY ON THE DECISION CRITERION: AN FMRI STUDY *Kathleen Hansen[1], Sarah Hillenbrand[1], Leslie Ungerleider[1]; [1]NIMH/NIH* – Most models of decision-making include several theoretical steps: sensory data are analyzed to yield evidence supporting one or more alternatives; biases are introduced to reflect each alternative's prior probability (PP) and value; and the biased outputs are weighed against each other to produce a decision. Research in our laboratory investigates whether specific brain regions implement these theoretical steps. Here, we identify regions associated with the effect of explicit PP on the decision criterion (Green and Swets, 1966). Subjects categorized parametrically-defined abstract shapes (after Loffler et al., 2003) as belonging to set A or set B, during each of two explicitly-cued PP conditions (50% vs. 80% chance that a stimulus would be of set B). During scanning, all 14 subjects responded "B" more frequently in the 80% than in the 50% PP condition. We reasoned that in the brain region(s) mediating this behavioral decision criterion shift, individual differences in fMR signal level change across PP conditions should predict individual differences in criterion shift across PP conditions. We tested this hypothesis with an analysis of covariance, using fMR signal changes and decision criterion shifts across PP as fixed effects and subjects as a random effect. Significant regions were found in prefrontal cortex (including dorsolateral prefrontal cortex, DLPFC), insula and visual cortex. The regions in visual cortex also responded to a stimulus vs. blank catch trial contrast, but several DLPFC regions did not. Thus, the DLPFC appears to participate in using PP information during decision-making.

A2

NEURONAL CORRELATES OF "IF" AND "WHEN" DECISIONS FOR ACTION *Stephen Heinen[1], Helen Hwang[1], Shun-nan Yang[1]; [1]Smith-Kettlewell Eye Research Institute, [2]Care of the Elderly* – We recently showed that neurons in the supplementary eye field (SEF) encode the rule governing the "if" decision (whether to act) in a go/nogo baseball simulation, in which eye movements indicate the decision. However, these neurons continue to reflect the correct rule on error trials, suggesting that the SEF does not make the go/nogo decision. Here we examine whether SEF neurons encode the timing decision (when to move) in a modified version of "ocular baseball." In the task, monkeys fixate in the center of a visible square ("plate") as a target approaches and intersects it. The target moves at one of two different speeds, and therefore intercepts the plate at two different times. The monkey must pursue the target with an eye movement within 200 ms after it intersects the plate, forcing the animal to anticipate the plate-crossing time. We found that in correct trials, the peak activity of SEF neurons preceded and was time-locked to both plate intersection and movement onset at both target speeds. However, in slow trials, often the movement was erroneously initiated too early. In these trials, SEF activity peaked earlier too, and now coincided more with movement onset than with plate intersection, suggesting the neurons trigger the movement. In support of this, muscimol inactivation of the SEF produced errors in pursuit initiation timing. Therefore, the SEF may provide a necessary timing signal for pursuit initiation, whereas other structures may make the decision to pursue in the context of the ocular baseball rule.

A3

RELATIONAL INTEGRATION AND ROSTROLATERAL PREFRONTAL CORTEX: A COMBINED FMRI AND RTMS STUDY *Espen Helskog[1,2], Carter Wendelken[1], Julie Duque[1], Silvia Bunge[1], Tor Endestad[2]; [1]UC Berkeley, [2]University of Oslo* – Brain imaging studies indicate that the rostrolateral PFC (RLPFC; lateral Brodmann area 10) is engaged during performance of a number of complex cognitive tasks. One specific hypothesis holds that RLPFC is primarily involved in relational integration, and this hypothesis is supported by imaging results, including a relational matching task in which RLPFC is activated consistently on a group- and individual level with a high degree of consistency (Smith, Keramatian, & Christoff, 2007). In this study, we seek to use repetitive transcranial magnetic stimulation techniques (r-TMS) to provide evidence that RLPFC is necessary for relational integration. We will localize RLPFC on an individual level using a modified version of the previously employed relational matching task, and then use the acquired functional MRI images laid over individual anatomical MR images to guide TMS of RLPFC during performance of the same task. In the experimental condition, participants must evaluate the dimension of difference between one pair of objects, and decide whether a second pair of objects differs along the same dimension as the first pair. This higher-order relational comparison consistently engages RLPFC relative to trials on which one must indicate whether two items match in terms of a specific feature. This study will provide the first empirical test of RLPFC's causal role in relational integration

A4

LEARNING FROM ERRORS: ERROR-RELATED NEURAL ACTIVITY PREDICTS IMPROVEMENTS IN FUTURE INHIBITORY CONTROL PERFORMANCE *Robert Hester[1], Janelle Madeley[1], Jason Mattingley[1]; [1]Queensland Brain Institute and School of Psychology, University of Queensland, St Lucia, Queensland, Australia* – The magnitude of error-related neural activity, particularly in the anterior cingulate cortex (ACC), has been shown to relate to adaptive post-error changes in response behaviour. These studies have focused on immediate changes in response behaviour, typically response times for the trial immediately following an error. Here, we examine the neural mechanisms underlying delayed adaptive changes in performance that avoided repetition of an error up to 15 trials into the future. We administered a go/no-go response inhibition task during fMRI data collection that presented random letters of the alphabet (no-go trials were repetitions of any letter, e.g., E,G,U,I,O,P,P). Participants were instructed that no-go trial performance influenced the trial sequence, whereby 50% of commission errors would be followed (2 to 15 trials later) by another no-go trial presenting the same stimulus letter. Behavioural data supported a 'learning from errors' effect, with no-go trial accuracy following a commission error significantly better when the same stimulus was presented (68%) than those presenting a different stimulus letter (57%). Error-related neural activity was examined for those regions that were predictive of improved performance on the following no-go trial – the regions associated with learning from an error. Greater activity in the dorsal ACC, left inferior frontal gyrus, right cerebellum and significant deactivation in the posterior cingulate and left temporal cortices predicted subsequent improvements in inhibition performance. These data suggest that error-related ACC activity is predictive of improvements in future performance, potentially by influencing other cortical regions critical to task performance.

A5

FITNESS EFFECTS ON THE EXECUTIVE CONTROL OF RELATIONAL MEMORY IN PREADOLESCENT CHILDREN *Charles Hillman[1], Sarah Buck[2], Neal Cohen[1]; [1]University of Illinois at Urbana-Champaign, [2]Chicago State University* – Investigations of fitness on cognition in humans and non-human animal models have determined that cognitive abilities associated with prefrontal cortex and the hippocampus are responsive to the effects of exercise. Whereas studies in humans have predominantly examined executive control functions mediated by a neural network involving prefrontal structures, work with non-human animal models has focused predominantly on memory functions associated with the hippocampus. The purpose of this investigation was to bridge these two models through examination of fitness on the executive control of memory. Preadolescent children (9-10 years) served as study participants in order to examine the influence of fitness on cognition during development. High- (n=22) and low- (n=24) fit children were grouped according to their performance on a VO2 max test, which measures cardiorespiratory fitness. A memory task was performed in which participants had to either encode faces and houses individually (i.e., non-relationally) or form relations between the faces and houses during (relational) encoding for later recollection. At test, participants saw previously studied pairs and pairings of completely new items, permitting both item and relational memory to affect judgments of previous occurrence. Findings revealed better performance at test for items studied relationally, disproportionately for high-fit relative to low-fit children. But no effects of fitness were observed for items studied non-relationally. Thus, the effects of aerobic fitness during development were related to the match between the nature of the original encoding and the cues available at test, implicating executive control or flexible use of memory presumptively based on prefrontal-hippocampal interactions.

A6

MULTIMODAL AND UNIMODAL BRAIN AREAS FOR RULE BASED BEHAVIOURAL CONTROL *Timothy Hodgson[1], Benjamin Parris[1]; [1]Exeter Centre for Cognitive Neuroscience, School of Psychology, University of Exeter, United Kingdom* – Event related fMRI was used to investigate which brain regions showed activity related to rule based processes independent of response mode and which areas instantiate specific stimulus to motor response mappings required for task execution. 14 participants performed a rule switching task using either saccadic or press button manual responses. The colour of a centrally presented visual cue indicated whether a response to the left or right was required on each trial. Following response execution, feedback indicated whether the subject had made a correct or incorrect response and whether the rule linking the colour with the correct response would reverse ("flip") or stay the same ("hold") on the next trial. Rule changes occurred every 3 to 8 trials and each experimental block comprised 21 trials. Prior to each block the subjects were instructed which response mode to use ("respond with eyes" / "respond with hands") and four blocks were run in total. Results showed that identical areas of the dorsal anterior cingulate gyrus and lateral prefrontal cortex showed activity correlated with the "flip" instruction for both manual and saccadic blocks. In contrast, the same event generated activity within the ventral anterior cingulate and subcortical regions which varied in exact location and extent with response. The results indicate that the same regions of prefrontal cortex mediate rule based processes regardless of the actual motor responses to be executed. Actual associations between stimulus and response are instantiated within sub-cortical and limbic structures.

A7

REDUCED SEMANTIC INHIBITION IN SCHIZOPHRENIA DURING CONTEXT-BASED LEXICAL AMBIGUITY RESOLUTION: ERP EVIDENCE FROM A NOVEL RESPONSE-FREE PARADIGM *Klaus Hoenig[1], Susanne Hellwig-Brida[1], Christoph Bux[1], Dobrila Klein[1], Markus Kiefer[1]; [1]University of Ulm, Germany* – Schizophrenic patients exhibit difficulties in inhibiting contextually inappropriate information in a number of experimental paradigms. In the vast majority of these experiments, however, inhibition was related to the suppression of a motor response. Evidence for semantic inhibition in schizophrenia is hitherto only scarce and inconclusive. The case of lexico-semantic ambiguity is an excellent tool to directly investigate the semantic inhibition of contextually inappropriate homonym meanings. The current ERP study provides a novel experimental approach that allows for assessing behavioral target interference from residual activation of an irrelevant homonym meaning without requiring any response to the homonym. Behavioral interference can then be related to differences in brain activation pertaining to disambiguation of a prior homonymy. Our task asked schizophrenic patients and healthy controls to decide whether a target noun (GARDEN or ACE) fits the semantic field spanned by two preceding nouns (BUCKET-SHOVEL), with the second one being ambiguous in half the trials (SPADE). Semantic verifications to ambiguous trials were slower and less accurate compared to unambiguous ones in schizophrenic patients than in control participants reflecting increased interference from the irrelevant meaning of the preceding homonym. Analysis of the ERP time-courses to the second word (ambiguous vs. unambiguous) revealed group differences over fronto-temporal brain areas. These findings are interpreted in terms of an inhibitory attentional impairment in schizophrenia. The semantic inhibition deficit in schizophrenic patients is suggested to ensue from differences in the fronto-temporal circuitry that underlies effective inhibitory control over contextually inappropriate homonym meanings in service of attentional selection.

A8

COGNITIVE NEUROSCIENCE IN EDUCATIONAL SETTINGS: PERFORMANCE MEASURES VERSUS TEACHER AND PARENT RATINGS OF EXECUTIVE FUNCTION? *Mariette Huizinga[1], Anouk van Loon[1], Maurits van der Molen[1]; [1]University of Amsterdam* – Advances in cognitive neuroscience are highly relevant in educational settings. In addition, educational settings have shown great interest in advances in cognitive neuroscience. Child neuropsychologists are often asked to evaluate a child's executive function competence in real-world (e.g., academic) settings. Executive function refer to cognitive processes that subserve goal-directed behavior, and is especially important in novel or demanding situations which require a rapid and flexible adjustment of behavior to the changing demands of the environment. The slow development of executive function has been attributed to the protracted maturation of the prefrontal cortex. The literature has emphasized the need to examine executive function in children using multiple sources, including performance-based measures and parent/teacher ratings. In the current study, the Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000) was used as parent/teacher rating index, and consists of two composites: Regulation Index (BRI) and the Metacognition Index (MI). It was administered to teacher and parents of children 7-8-, 11-12-, and 15-16 year-old. Alongside, the children performed on commonly used domain-specific performance measures related to several subdomains of the BRI and MI. The measures included various computerized inhibition, shifting and planning tasks. Results indicated considerable agreement between parent/teacher ratings and performance-based measures across age groups. Outcomes on the BRIEF were interpreted in terms of (age-related) outcomes of performance-based measures. Follow-up studies from a neuroscience perspective will provide insight in the neurocognitive underpinnings of executive function development. Implications of the current results for cognitive neuroscience and educational settings are discussed.

A9

DISSOCIABLE CONTRIBUTION OF DORSAL ANTERIOR CINGULATE AND LATERAL PREFRONTAL CORTICES TO TASK-SWITCHING *Alexandre Hyafil[1], Christopher Summerfield[1], Etienne Koechlin[1]; [1]Ecole Normale Supérieure, Paris, France* – Switching between tasks incurs a cognitive cost that is reflected in a slowing of responses immediately following the switch. Competing theories have attributed this slowing to either the resolution of interference from the previously active task, the demands of configuring the appropriate action-outcome contingencies for the new task, or both. However, the brain regions subserving these two processes are currently unknown. To address this question, we acquired functional magnetic resonance images (fMRI) from human subjects performing a 'spatial' version of the Stroop task, in which congruent or incongruent spatial and verbal task cues prompted joystick responses in one of four directions. This allowed us to compare brain activity elicited by 'switch' trials (e.g. from the spatial task to the verbal task) and 'stay' trials (e.g. spatial to spatial) on the basis of current and previous trial congruency. The dorsal anterior cingulate cortex (dACC) exhibited greater activity on switch than stay trials irrespective of current and previous trial congruency, whereas the left caudal dorsolateral prefrontal cortex (dlPFC) exhibited a neural switch cost only when the previous task had to be 'de-selected', i.e. on the second of two successive incongruent trials. These results argue for dissociable and yet complementary roles for the dACC and dlPFC in the flexible scheduling of successive tasks, with the dACC configuring the appropriate association between action and outcome, and the lateral PFC responsible for resolving proactive interference from previously active task sets.

A10

ABNORMAL REWARD CIRCUITRY IN COCAINE ABUSERS – AN FMRI BASED STUDY *Jennifer Hylton[1], André Thomas[1], Shashwath Meda[1], Melissa Andrews[1], Michael Stevens[1,2], Godfrey Pearlson[1,2,3]; [1]Olin Neuropsychiatry Research Center, Institute of Living at Hartford Hospital, Hartford CT, [2]Yale University School of Medicine, New Haven CT, [3]Johns Hopkins University, Baltimore MD* – Background: We compared fMRI patterns between cocaine abusers and controls during a monetary incentive delay (MID) task. We hypothesized deficient nucleus accumbens (NAcc) activation during reward anticipation in cocaine subjects and explored correlations with impulsivity behavioral measures. Methods and Materials: 24 cocaine dependent individuals (19 male) and 33 controls (12 male) competed for rewards in a modified MID task that included reward Prospect, reward Anticipation and reward/losses Outcome. Two-sample t-tests in SPM2 compared fMRI group differences across task phases. We also correlated fMRI signal during reward anticipation and impulsivity scores (Experiential Discounting Task EDT, Balloon Analog Risk task BART). A small volume correction identified significant differences/correlations in regions of interest: NAcc, amygdala, ventral tegmental area (VTA), mesial PFC, caudate, putamen, hippocampus, anterior cingulate, insula and OFC. Results: During reward anticipation, cocaine users underactivated L NAcc; (0.05 FWE corrected), R Caudate (p=0.01 uncorrected) and over-activated L and R Putamen (p=0.016 FWE and .057 FWE respectively). During reward outcome, users activated the VTA more than controls (p=0.051 FWE corrected), and underactivated L Putamen (p=0.007 uncorrected). During loss outcome, users underactivated R NAcc (p=0.01 uncorrected). A significant positive correlation (p=0.007) was found between insula fMRI response and BART scores and a significant negative correlation between EDT scores and OFC activation (p=0.01), left (p=0.005) and right insula (p=0.028). Conclusions: Substance abusers showed impaired activation of NAcc during reward anticipation; current users activated VTA > controls during outcome of wins. Additionally supporting the reward deficit hypothesis are correlations between impulsivity scores and fMRI activation patterns.

A11

NARROWING ATTENTION IN THE STROOP TASK *Koki Ikeda[1], Toshikazu Hasegawa[1]; [1]University of Tokyo* – In the Stroop task, cognitive control is assumed to resolve the conflict between task-relevant (e.g. color) and -irrelevant (e.g. word) dimensions of stimuli by modulating the focus of attention to the task-relevant one. However, there have been little direct evidences that showed how attention was modulated during cognitive control. Previous studies using color-word Stroop task showed that when the range of spatial attention was narrowed by experimental manipulations, then the Stroop interference was reduced, possibly by blocking word recognition (e.g. Besner and Stolz 1999). Yet, none of those studies directly tested that such attention narrowing was adopted during the actual execution of Stroop incongruent task. Therefore, we conducted an ERP experiment to examine whether cognitive control in the color-word Stroop task was actually accompanied by narrowing of spatial attention. A white circle was presented in the peripheral visual field as a probe, following the Stroop stimuli presented foveally, with varying SOA (50ms, 150ms, 250ms). The P1 component evoked by the probe was compared between congruent and incongruent trials. Results showed that P1 amplitude was larger in the congruent trials than the incongruent, suggesting that attention was indeed narrowed spatially under cognitive control. Temporal characteristics of cognitive control will also be discussed.

A12

ECONOMICS, EMOTION, AND ELECTROENCEPHALOGRAPHY: ERP CORRELATES OF DECISION-MAKING IN THE ULTIMATUM GAME *Noah J. Isserman[1], Shauna Gordon-McKeon[1], Tara B. Frady[1], Jane W. Couperus[1]; [1]Amherst College, Hampshire College* – This study explored the electroencephalographic (EEG) correlates of decision-making in the Ultimatum Game (UG), an economic game thought to induce conflict between emotion or concepts of fairness and economically optimal decision-making. Using methodology based on a 2003 fMRI study (Sanfey et al.), EEG data were recorded while subjects accepted or rejected offers from human and computer proposers in a sham UG network. The protocol elicited typical behavioral results, allowing the subsequent analysis of event-related potentials (ERP), which provide greater temporal resolution than previous studies. The decision-making process evinced an early (120-170ms) pre-frontal cortex negativity with greater amplitude elicited by offers from human proposers (electrodes FT7-8, p = .003). This difference supports previous fMRI data on the role of the PFC in UG decision-making (Knoch et al. 2006, Sanfey et al. 2003) that suggest greater emotional involvement in the anticipation and reaction to human players' offers. In contrast, a parietal P300b showed significantly greater activation to unfair offers (p = .044, CZ, CPZ, and PZ 400-600ms) but was not influenced by the type of proposer.

A13

ONE'S OWN GOOD REPUTATION IS PROCESSED IN A SIMILAR MANNER TO MONEY IN THE STRIATUM *Keise Izuma[1,2], Daisuke Saito[1,3], Norihiro Sadato[1,2,3]; [1]National Institute for Physiological Sciences, [2]The Graduate University for Advanced Studies, [3]Japan Science and Technology Agency / Research Institute of Science and Technology for Society* – Despite increasing attention toward the neural basis of decision-making in neuroscience, little attention has been paid toward decision-making in social settings. On the other hand, although social decision-making have been a center of attention in social psychology, neural explanations for observed findings have been ignored. In bridging this gap and constructing a more accurate model of social decision-making, we investigated whether the acquisition of one's own good reputation by others, important incentive for human social behaviors, activates the same reward circuitry as monetary reward. A total of 19 subjects participated two fMRI experiments (monetary and social reward experiments) across two-separate days. After participating the Monetary Reward experiment in the first day, subjects answered several personality questionnaires and introduced themselves in front of a video-camera. Then, in the Social Reward experiment, they were presented with their impressions formed by other persons based on answers in the questionnaire and video-recorded self-introduction. We found that the acquisition of one's good reputation robustly activated reward-related brain areas, notably the striatum. Furthermore, activations in the striatum overlapped with areas activated by monetary reward, and both types of rewards were characterized by a similar activation pattern especially in the anterior part of the striatum including left caudate nucleus and bilateral putamen. Thus, our findings bear strong support for the idea of "common neural currency" for rewards and provide the important first step toward neurally explaining complex social decision-making and behaviors.

A14

NEURAL CORRELATES OF SPECIFIC TRAINING EFFECTS AND TRANSFER *Susanne Jaeggi[1,2], Martin Buschkuehl[1,2], Oliver Markes[2], Walter Perrig[2], Thomas Koenig[2]; [1]University of Michigan, Ann Arbor, MI, [2]University of Bern, Switzerland* – In this study, we investigated the outcome of a demanding working-memory training in terms of task-specific improvements but also in terms of treatment effects on tasks that were not trained (transfer effects). The 4-week training was designed adaptively by matching the participants' individual capacity limit. In a pre- and post-test design, we collected behavioral and EEG data for the training task as well as for the transfer tasks. Preliminary data with 16 participants indicate that compared to the control group (N= 8; no training), the training group (N= 8) significantly improved performance in the trained task, but also in two transfer tasks (episodic memory and fluid intelligence). This performance increase was correlated with a power-increase in the lower alpha band in the training task. Moreover, in the resting-state EEG, the training group showed a power increase in the upper alpha band which was not observed in the control group. We conclude that these results reflect neural correlates of an improvement in processing efficiency associated with training.

A15

FUNCTION AND STRUCTURE OF RESPONSE INHIBITION IN THE RIGHT INFERIOR FRONTAL CORTEX: A MODEL-BASED APPROACH *Sara Jahfari[1], K. Richard Ridderinkhof[1], Uta Wolfensteller[2], Wery P. M. van den Wildenberg[1], H. Steven Scholte[1], Birte U. Forstmann[1]; [1]University of Amsterdam, the Netherlands, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – The right inferior frontal cortex (rIFC) is known to play an important role in implementing inhibitory control. In a functional magnetic resonance imaging (fMRI) study, for instance, Forstmann et al. (in press) showed that activation in rIFC covaried with response time distribution parameters that are believed to reflect selective response inhibition. The goal of the present study is to elucidate the functional and structural role of the rIFC in selective response inhibition by means of a model-based analysis. Fourteen participants took part in an fMRI experiment while performing a cueing version of the Simon task, and also underwent diffusion tensor imaging (DTI). The analyses aimed to quantify the extent to which model-based measures of response inhibition are associated with individual differences in both rIFC function and rIFC coherency of white matter tracts. Preliminary results revealed a strong correlation between the model-based measures of response inhibition and both functional and structural indices of the rIFC.

A16

DIRECTED FORGETTING PERFORMANCE CORRELATES WITH PSYCHOLOGICAL RESPONSES TO PAIN *Kristin Janschewitz[1], Barbara Knowlton[1]; [1]University of California, Los Angeles* – Psychological reactions to pain may contribute to several chronic disorders, including irritable bowel syndrome and fibromyalgia, in which somatic symptoms occur in the absence of organic disease. In this study, we investigated whether pain catastrophizing is associated with a general deficit in cognitive control for negative information as measured by the directed forgetting paradigm. Subjects studied a list of negative valence words and were subsequently told that this list was just for practice and that they should try to forget it. They were then given a second list of negative words to remember. Later, subjects were asked to recall all of the words. Subjects scoring high on the Pain Catastrophizing Scale showed significantly less directed forgetting as measured by the ratio of to-be-forgotten words to to-be-remembered words recalled. Interestingly, this measure did not correlate with actual reported somatic symptoms, indicating that experienced pain is not related to cognitive control deficits, but rather one's reactions to pain. These results suggest that deficits in cognitive control of negative information may underlie pain catastrophizing, which may be an important component of several functional somatic disorders.

A17

PROCESSING OF ERRORS WHILE SWITCHING BETWEEN ADDITION AND MULTIPLICATION: A COMPARISON OF DIFFERENT ERROR TYPES *Kerstin Jost[1], Tim Hahn[2], Frank Rösler[1]; [1]Experimental and Biological Psychology, Philipps-University Marburg, [2]Julius-Maximilians-University Würzburg* – We investigated error-related brain activity in a paradigm, in which participants (n=15) had to switch between single-digit addition and multiplication problems. The task was to decide whether a presented solution was correct or not. Different types of incorrect solutions were compared: Incorrect solutions that were correct for the other operation (between-operation interference, e.g., 4*3=7), incorrect solutions that were correct for another problem of the same operation (within-operation interference, e.g., 4*3=15), and non-interfering incorrect solutions (e.g., 4*3=5 or 17). Both types of interfering incorrect solutions were more often accepted as correct than non-interfering incorrect solutions. However, only the acceptance of a solution that is correct for the competing operation, i.e., "between operation" errors, should be relevant for adaptive control in the switching paradigm and should demand better adaptation to the relevant operation. Consistent with this hypothesis, differences in error processing were indicated by the „error-related negativity" (ERN): the ERN amplitude was larger for between-operation than for within-operation errors.

A18

THE ESSENCE OF SUBJECTIVE CONFLICT DURING SELF-CONTROL: NEURAL CORRELATES OF SUSTAINING INCOMPATIBLE INTENTIONS *Yoo Na Kang[1], Ezequiel Morsella[2], Noah Shamosh[1], John Bargh[1], Jeremy Gray[1]; [1]Yale University, [2]San Francisco State University* – Many theories of self-control or cognitive control are agnostic about subjective awareness. While it is clear that response conflict (incompatible action tendencies) is associated with subjective experience in specific ways, why people consciously experience some conflicts in the nervous system but not others remains a mystery. One hypothesis is that people become conscious only of conflicts involving competition for control of skeletal muscle (Morsella 2005, Psychological Review). To test one aspect of this larger hypothesis, 17 participants were trained to introspect the feeling of conflict (the urge to make an error during a Stroop color-word interference task), and then were asked to introspect in the same way while sustaining simple compatible and incompatible intentions during fMRI scanning (to move a finger left or right). As predicted, merely sustaining incompatible skeletomotor intentions prior to their execution during a novel task produced stronger systematic changes in subjective experience than sustaining compatible intentions, as indicated by self-report ratings obtained in the scanner. Similar ratings held for a modified Stroop-like task (MSIT; Bush & Shin 2006, Nature Protocols) when contrasting incompatible versus compatible trials also during fMRI scanning. We will use the subjective ratings in analyses of fMRI data, focusing a priori on the brain regions involved in cognitive control (e.g., dorsal ACC, lateral PFC).

A19

CORTISOL RESPONSE TO PSYCHOSOCIAL STRESS PREDICTS DECISION-MAKING BEHAVIOR. *Lauren A. Kaplan[1], Tor Wager[1], Richard Gonzalez[2], Lauren Atlas[1], Kevin Ochsner[1], Stephan F. Taylor[2], Israel Liberzon[2], James Abelson[2], Brent Hughes[3], Jason Buhle[1], Kate Hard[1], Edward Smith[1]; [1]Columbia University, [2]University of Michigan, [3]University of Texas at Austin* – Interactions between cognitive and emotional processes have been studied in various domains, yet few studies have directly addressed how stress, as indexed by HPA-axis activity, influences decision-making. We examined the influence of acute social evaluative stress, induced using the Trier Social Stressor Test, and the associated HPA-axis response (measured from salivary cortisol) on basic monetary valuation parameters from Tversky & Kahneman's Cumulative Prospect Theory model (1992). Participants (N = 40) either gave a speech and performed mental arithmetic before a panel of judges or performed a comparable non-stressful control task (N = 20 per group). All subjects then completed a computerized decision task. On each trial, a prospect, or gamble, was presented (e.g. 30% chance of winning $400 and 70% chance of winning $0), and the subjects were asked to indicate the equivalent value of the gamble. Gambles were optimized to minimize error in the estimation of model parameters, which included measures of risk preference, loss aversion, sensitivity to probability variation, and subjective utility of rewards. The Trier Test significantly increased cortisol, though with substantial individual differences in magnitude. Cortisol increases predicted increased loss aversion, and path analysis suggested that the extent of the cortisol response to the stressor was a significant mediator of the relationship between Trier and loss aversion. The results suggest that short-term stressors can affect fundamental processes related to valuation.

A20

MONITORING AND MODULATING YOUR OWN THOUGHTS USING REAL-TIME FMRI FEEDBACK TRAINING *Kamyar Keramatian[1], Graeme McCaig[1], Rachelle Smith[1], Burkhard Maedler[1], Kalina Christoff[1]; [1]University of British Columbia* – Real-time fMRI (rt-fMRI) is a novel neuroimaging technique which allows subjects to observe the effect of their own mental processes on brain activation in real-time. Recent rt-fMRI studies have reported the ability of subjects to modulate localized brain regions such as the sensory-motor cortex, the amygdala, the anterior cingulate, and the insula. It is unknown, however, if higher order regions of the association cortex can be trained for modulation using rt-fMRI feedback. In this study we sought to investigate whether subjects can achieve enhanced modulation of the Rostrolateral Prefrontal Cortex (RLPFC) using rt-fMRI feedback training. This region is known to be at the highest level of association hierarchy and has been associated with mental processing that requires metacognitive awareness, or evaluative introspective thought. Subjects viewed real-time information about the level of activation in their RLPFC, while attempting to up-regulate or down-regulate this activation by engaging in introspective thought (passively observing and labeling any thoughts that occur) or externally-oriented thought (attending to body sensations or visual information), respectively. Three different forms of visual feedback were provided, spanning different time-scales, to assist with modulation. The findings demonstrate improved modulation of RLPFC in the course of successive rt-fMRI feedback sessions, with some individual variability across subjects in terms of both level of success in training and patterns of functional connectivity. These results provide further evidence for the involvement of RLPFC in metacognitive awareness and introspective thought processes, and suggest a novel approach to the study of higher order association regions of the cortex.

A21

STROOP AND STOP-SIGNAL INHIBITION – COMMON OR SEPARABLE MECHANISMS? EVIDENCE FROM BEHAVIORAL AND FMRI STUDIES. *Kiat-Hui Khng[1], Kerry Lee[1]; [1]National Institute of Education, Nanyang Technological University* – A previous study investigating the role of inhibition in the development of algebraic skills found inhibitory measures from the Stroop and Stop-signal tasks loaded on different latent factors. Stroop predicted algebraic performance via susceptibility to intrusions from previously learned heuristics; Stop-signal contributed to performance via intellectual ability. As these findings were based on accuracy measures, the present study was conducted to examine whether the same relationship is found with reaction time (RT) measures, which may be more sensitive and is more commonly used in the literature. 190 adolescents (13– 15 year-olds) completed a Stroop and two versions of the Stop-signal tasks. As with the accuracy measures, Stroop interference and Stop-signal RTs were uncorrelated. We will also report preliminary findings from a second study that examines the same issue from a neuroanatomical perspective. In this study, we perform functional neuroimaging on 30 adolescents (13-15 year-olds) while they perform a Stroop and a Stop-signal task. Based on their susceptibility to intrusions from previously learned heuristics, participants are classified as exhibiting high or low intrusions. Analyses focus on whether inhibitory processes underlying each task are characterized by different networks with overlapping regions, or similar networks with different patterns of activation. Inhibitory-related activations of the two tasks are expected to differ in loci and intensity, and in how they relate to behavioral measures of performance. High and low intrusion groups are expected to exhibit different patterns of activation functionally related to Stroop inhibition. No such difference between intrusion groups is expected for Stop-signal inhibition.

A22

EXOGENOUSLY CUED ATTENTION SWITCHING RECRUITS FRONTAL POLE *Chobok Kim[1], Doerte Spring[1], James Kroger[1]; [1]New Mexico State University* – Frontopolar cortex has been associated with several varieties of complex processing, including Raven's Progressive Matrices, the Tower of London, as well as tasks involving mediation of multiple task sets. Does frontopolar cortex participate in simple cognitive acts? We presented subjects with successive stimuli consisting of two superimposed circles—one large and one small--oscillating sinusoidally, which might be the same (green) or different (green and blue or red) colors, and oscillating in the same or different directions. Subjects indicated whether the circles were the same or different (different color or different oscillation direction). Trials were arranged such that color-different trials and same trials appeared for several presentations, followed by several motion-different and same trials. Appearance of the first motion-different trial (or color-different trial) following a group of the alternate type constituted a cross-dimensional switch trial, which caused subjects to redirect attention from the previously in-play stimulus attribute to the new one. During the switch trials, but not during other difference trials or same trials, frontopolar cortex was activated. Comparing non-switch difference trials to same trials did not reveal significant activations. Comparing within-color (between red and blue) switch trials to within-color nonswitch trials and same trials revealed no significant differences. This study partially replicates a study by Pollmann et al. (2000) but their targets appeared randomly in a spatial grid. Both visual search and appearance of targets inside or outside attentional focus can impact deployment of attention. We demonstrate that with these considerations eliminated, cross-dimensional switch recruits frontopolar cortex.

A23

BENEFITING FROM HIERARCHY: INTERACTIONS BETWEEN LEVELS OF CONTROL IN THE PREFRONTAL CORTEX *Aaron Koralek[1], David Badre[2], Mark D'Esposito[1]; [1]Helen Wills Neuroscience Institute, University of California, Berkeley, [2]Brown University* – Recent studies have provided evidence for a hierarchical organization of cognitive control in the prefrontal cortex, whereby caudal regions resolve competition between concrete action representations, such as among individual responses, while rostral regions process more abstract representations. However, an important property of a hierarchy is that choices at more abstract levels reduce competition at lower levels. This functional magnetic resonance imaging (fMRI) study tests whether this hypothesized property of hierarchy is evident among prefrontal cognitive control mechanisms. Participants were required to select one of a set of keypress responses based on a perceptual feature of a presented object cue, such as its texture or its orientation. A colored box cued the relevant dimension. The number of candidate responses varied between two (low response competition) and four (high response competition), and the relevant dimensions varied between one (low dimension competition) and two (high dimension competition). Importantly, when both response and dimension competition were high, successful selection of a dimension resulted in fewer response alternatives. Consistent with prior work, greater response competition was associated with greater activation in dorsal premotor cortex. Critically, however, there was an interaction such that this effect was reduced under conditions of high dimension competition, consistent with a reduction in lower-level competition due to selection at the more abstract level. These results suggest that activity in dorsal premotor cortex tracks choice demands at low levels of abstraction, and further that selection at higher levels of abstraction facilitates the resolution of competition at lower levels.

A24

VISUAL ATTENTION DRIVES THE CONSTRUCTION AND COMPARISON OF VALUES IN SIMPLE ECONOMIC CHOICE *Ian Krajbich[1], Carrie Armel[2], Antonio Rangel[1]; [1]Caltech, HSS, [2]Stanford University, Economics* – Binary choice between pairs of familiar consumption items is one of the simplest forms of economic choice. Economic and psychological models of decision-making assume that the brain makes these choices by first computing a value for both items and then comparing the values to select the best option. The exact processes used to carry out these operations are unknown. We propose a new model of how the brain makes binary choices. The model is a variant of the race-to-barrier models of perceptual decision-making with an important modification: visual attention guides the path of integration of the value signal. The model makes several novel stark predictions about the relationship between visual attention and choices, and about the performance of the decision-making processes. Among others, it predicts that there is a first-fixation bias (the first seen item is more likely to be chosen), a last fixation bias (the last seem item is more likely to be chosen), an exposure bias (items seem longer are more likely to be chosen), and a left-bias (for Westerners, items placed on the left visual field are more likely to be chosen). We test the critical assumptions of the model, as well as its predictions, using eye-tracking in a real choice task in which hungry subjects choose between snacks. The stimuli are presented in the screen using high-resolution pictures of the food. We find support for the key components of the model as well as for all of the decision-making biases listed above.

A25

THE INFLUENCE OF WORKING MEMORY ON ERROR-LIKELIHOOD PREDICTION IN THE ANTERIOR CINGULATE CORTEX *Adam Krawitz[1], Todd S. Braver[2], Joshua W. Brown[1]; [1]Indiana University, Bloomington, IN, [2]Washington University, St. Louis, MO* – A large body of work has shown that anterior cingulate cortex (ACC) participates in cognitive control by modulating the degree to which other control systems, including working memory, are brought to bear in specific task contexts. Specifically, according to the error-likelihood model (Brown & Braver, 2005), the magnitude of ACC output in a given situation is proportional to the perceived likelihood of making an error. It remains unknown whether ACC may use working memory contents to guide error-likelihood prediction and thus complete a reciprocal loop between working memory and ACC, as predicted by recent work with the error-likelihood model. We addressed this by investigating whether information in working memory is used as context by ACC to inform its evaluation of error likelihood. In a modified version of the change-signal task of Brown & Braver (2005), a cue predicting error-likelihood was incidentally encoded into WM by participants in order to perform a secondary task (delayed match-to-sample). Following the cue, a blank-screen delay period occurred prior to the change-signal trial. Using a rapid event-related fMRI design with partial trial decomposition, we found an area of ACC whose response-related activation predicted error-likelihood as indicated by the initial cue, even for trials without errors or response conflict. This illustrates that information about recent but currently unavailable stimuli, presumably maintained in working memory, is used by ACC in evaluating error likelihood during task performance. Supported by: T32 MH019879 and a NARSAD Young Investigator award to JWB

A26

DOUBLE DISSOCIATIONS BETWEEN LATERAL AND MEDIAL FRONTOPOLAR CORTEX FOR MAINTENANCE AND MANIPULATION OF INTEGRATED INFORMATION *James Kroger[1], Doerte Spring[1], Chobok Kim[1]; [1]New Mexico State University* – Several functions have been ascribed to frontopolar cortex, including maintenance of multiple response plans, coordination of multiple cognitive acts, episodic retrieval, and internal generation of information. Does frontopolar cortex mediate complex information not directly involved with response or action selection? We presented subjects with three kinds of delayed match-to-sample trial with three white letters arranged in a row, three letters in three colors and three spatial locations, or only two colored and spatially distributed letters as samples. In the first two, subjects indicated whether a probe matched the sample. In the third, before the probe appeared, a "manipulation cue" appeared indicating a position change and an identity change to be made to the internally maintained two-latter sample. Significantly greater activation occurred in left frontopolar cortex, dorsolateral prefrontal cortex, and superior parietal cortex for the integrated than for the simple three-letter samples. A similar network was observed during manipulation, but with increased frontopolar activation compared to the three-letter trials. For the integrated three-letter sample, frontal pole was active in the left hemisphere and medial wall, but not right frontal pole. Manipulation recruited right frontal pole the most, and left frontal pole, but was suppressed in medial frontal pole. Thus, 1) simple maintenance of complex integrated information recruits left and medial frontal pole, 2) manipulation of complex information recruits right and left frontal pole more than maintenance of information but is suppressed medially, and 3) right frontal pole is not recruited for maintenance but is the most involved region during manipulation.

A27

FUNCTIONAL CONNECTIVITY IN COORDINATING INCONGRUENT MEMORY PROCESSES OF DUAL N-BACK TASKS *Bo-Cheng Kuo[1], Yei-Yu Yeh[1], Anthony J.-W. Chen[2], Mark D'Esposito[2]; [1]National Taiwan University, Taipei, Taiwan, [2]Helen Wills Neuroscience Institute, University of California, Berkeley* – The prefrontal cortex (PFC) is thought to be a critical mechanism for coordinating concurrent internal operations and enabling the selection of a task-relevant response to accomplish a behavioral goal. Such coordination is necessary in performing dual tasks. Yet, the nature of functional connectivity engaged in dual-task coordination is unclear. By using a dual-task paradigm and fMRI, we examined functional connectivity during dual-task coordination. We designed a dual n-back task involving verbal and spatial working memory (WM) and parametrically manipulated the WM load (n=0, 1, 2) of each task. In the congruent condition, participants performed a verbal n-back and a spatial n-back task with identical WM load (verbal n = 2 and spatial n = 2). The memory load differed in the incongruent condition (verbal n = 1 and spatial n = 2). The demand on executive control should be higher in the incongruent condition. The analysis with cognitive subtraction showed greater activation in the right PFC, anterior cingulate cortex (ACC), and the left parietal region in the incongruent condition than in the congruent condition. The conjunction analysis also showed the common regions of dual-task conditions in the PFC, ACC, and the parietal regions. More important, the PFC showed stronger functional connectivity with the parietal regions in the incongruent condition in contrast to the congruent condition. These results revealed a critical role of PFC in executive control by providing top-down signals that guide neural activity in the posterior parietal regions to meet the behavioral goal in coordinating dual-task processes.

A28

DOPAMINE FUNCTIONING PREDICTS PRESCHOOLERS' THEORY-OF-MIND DEVELOPMENT *Christine Lackner[1], Lindsay Bowman[1], Jennie Ito[1], Mark Sabbagh[1]; [1]Queen's University* – Theory of mind is the ability to understand that others have mental states; more specifically, that others possess knowledge and have goals and intentions that may differ from one's own. Theory of mind shows a stereotypical developmental timetable whereby major developments occur over the preschool years. This timetable has been observed in nearly every culture that has been tested, thereby suggesting a role for neuromaturational constraints. Recent EEG/ERPresults suggest that one such constraint might be frontal lobe development. This hypothesis is strengthened by findings showing that individual differences in marker tasks of frontal lobe functioning (e.g., executive functioning tasks) predict performance in theory-of- mind tasks. The neurotransmitter dopamine (DA) is generally thought to play a crucial role in typical frontal lobe development. Thus, the goal of the present study was to investigate the role that DA might play in theory-of-mind development. Ninety-one children (48- to 62- months-old) were given a battery of theory-of-mind and executive functioning tasks along with EEG measurement as part of a larger study. Because previous research has shown that blink rate is a reliable indicator of DA functioning in adults and children, we combed children's EEG records for blinks and computed their blink rate as average blinks per minute. Regression analyses showed that blink rate predicted unique variance in children's theory-of-mind performance after statistically controlling for the effects of age and performance on executive functioning tasks. These findings provide preliminary evidence that DA functioning is associated with theory-of-mind development in the preschool years.

A29

GOING AGAINST YOUR IMPULSE – A FMRI STUDY OF SELF-CONTROL IN DECISION MAKING UNDER RISK *Grace Lai[1], Jack Grinband[1], Elke Weber[1], Vincent Ferrera[1], Joy Hirsch[1]; [1]Columbia University* – When making decisions that involve risk, people are often influenced by prior gains and losses. Increased risk-seeking is observed following prior gains and decreased risk-seeking after losses. We took advantage of these behavioral tendencies to identify neural mechanisms of self-control recruited when subjects behaved contrary to their impulsive, or prepotent response after gaining or losing money. Subjects were informed that they either gained $1, lost $1, or gained/lost nothing and then prompted to decide whether to gamble or not (bet $1.5 for a 50/50 chance of winning $3.10). As predicted, people gambled more after gains and less after losses. Responses that went against these behavioral tendencies (e.g. gambling after a loss) were associated with longer reaction-times and activated brain regions that mediate top-down control, including right inferior frontal gyrus, medial prefrontal cortex, and right DLPFC. Activity in these regions was correlated with the rarity with which high-control choices were made, which we used as an index of the degree of effort needed to overcome the prepotent response. Impulsive choices, on the other hand, were associated with activity in limbic regions. Impulsive risk-seeking choices activated vmPFC and medial OFC, while impulsive risk-averse choices activated the amygdala. Interestingly, high-control choices also showed increased activation in limbic regions, caudate for high-control risk-averse responses and vmPFC and lateral OFC for high-control risk-seeking responses. These findings identify a network through which automatically initiated responses can be overcome through deliberate control, and suggest mechanisms through which control areas modulate limbic activity in self-control.

A30

CORTICAL AND SUBCORTICAL PROCESSES OF RESPONSE INHIBITION DURING A STOP SIGNAL TASK *C.-S. Ray Li[1], Peisi Yan[1], Rajita Sinha[1], Tien-Wen Lee[1]; [1]Yale University* – Previous studies have delineated the cortical processes of motor response inhibition during a stop signal task. Relatively little is known about the subcortical mechanisms. Here with fMRI of 30 men we showed greater activation in the subthalamic nucleus (STN) during stop (success or error) compared to go trials, as did Aron and Poldrack, 2006. However, since a contrast between stop and go trials involves processes that may be distinguished from response inhibition, the role of the STN remains to be specified. To this end we followed an alternative strategy to isolate the neural correlates of response inhibition. We compared individuals with short and long stop signal reaction time (SSRT) as embodied by the horse race model. The two groups of subjects did not differ in any other aspects of stop signal performance. We showed greater activity in the short than the long SSRT group in the left caudate nucleus, during stop successes, as compared to stop errors. Left caudate activity was positively correlated with that of the anterior pre-supplementary motor area (pre-SMA), previously shown to mediate stop signal inhibition (Li et al., 2006, J Neurosci). Conversely, bilateral thalamic nuclei and other parts of the basal ganglia, including the STN, showed greater activation in subjects with long than short SSRT. Thus, fMRI delineated contrasting roles of the prefrontal-caudate and striato-thalamic activities in mediating motor response inhibition. These new results will be discussed along with the role of the anterior pre-SMA and inferior frontal cortex during stop signal performance.

A31

SPECIFICITY OF ERP ABNORMALITIES DURING RESPONSE INHIBITION IN ADHD CHILDREN *Mario Liotti[1], Margaret Semrud-Clickeman[2], Steven R Pliszka[3]; [1]Simon Fraser Unversity, [2]University of Michigan, Lensing, [3]UTHSC, San Antonio, TX* – Background: Executive function and working memory deficits are present both in ADHD and Reading Disorder (RD). Here, specificity of electrophysiological abnormalities in ADHD-C children during inhibitory control tasks was tested by comparison with a RD group. Methods: High-density ERPs were recorded during the Stop Signal Task in 53 children and adolescents divided in three groups: An ADHD-C group (n=16), a group with RD (n=14), and an healthy group (n=23). Results: The ADHD-C group displayed smaller right frontal N200 relative to controls, while the RD group didn't. Both controls and RD groups showed a success-related right frontal N200 modulation, which was absent in the ADHD group. Finally, the ADHD group showed smaller frontocentral NoGo- P3 amplitudes in response to Failed Stops. In contrast, the RD group showed smaller temporoparietal N200s and a more widespread NoGo-P3 deficit, extending to both Success and Fail Inhibitions. Conclusions: In contrast to ADHD, RD children appear to have intact response inhibition mechanisms. However, they appear to have a deficit in early orienting to task-relevant stimuli, and a generalized deficit in cognitive control and error monitoring mechanisms. Significance: This study suggests that common deficits in executive control and response inhibition in RD and ADHD-C are the consequence of different underlying abnormalities.

A32

COMPONENTS OF COGNITIVE CONTROL PROCESSES IN PRESCHOOLERS FROM POOR- AND NON-POOR HOMES *Sebastian Lipina[1,2], Soledad Segretin[1,2], Julia Hermida[1], Sol Benaros[1]; [1]Unidad de Neurobiologia Aplicada (UNA) CEMIC-CONICET, [2]Escuela de Humanidades, Universidad Nacional de General San Martin (UNSAM)* – Working memory, inhibitory control and planning paradigms, were used to evaluate executive performance of healthy children (N=208, 3-5 years) from poor (P) and non-poor (NP) homes. Significant differences were observed between groups in AnotB (MANOVA, Delay 10", Correct: NP:6.03±1.66, P:5.72±1.95, p=0.02, Consecutive: NP:4.01±1.7, P:3.61±1.8, p=0.01), Three and Four Colors (TFC) (Score1: NP:4.06±1.32, P:1.73±1.06, p<0.01, Score2: NP:4.05±1.69, P:1.95±1.27, p<0.01), and Tower of London (TOL) (Planning Time: NP:6.85"±2.57, P:5.91"±2.56, p>0.01, Score1: NP:6.67±2.85, P:6.39±2.84, p=0.01). To identify key components of executive functions in both groups, data were subjected to two exploratory factor analyses (Method: principal components, Rotation: Varimax). Stable structures consisted in a 5-factors model were found in both groups, explaining 73.93% (KMO=0.66) and 72.49% (KMO=0.65) of the variance, respectively. In the NP group AnotB variables were related to Factor 1 (24.69%) (Correct=0.89; Consecutive=0.92; Perseverative=-0.62; Sets=0.82); TFC and TOL to Factor 2 (15.92%) (TFC Score1=0.76; TFC Score2=0.71; TOL Score1=0.91; TOL Score2=0.85); Color Reversal to Factor 3 (14.84%) (Correct=0.71; Blocks=-0.91; Perseverative=0.89); Spatial Reversal to Factor 4 (11.58%) (Correct=0.78; Blocks=-0.84; Perseverative=0.78); and Day/

Night like stroop to Factor 5 (6.89%) (Score1=0.84). In the P group, TFC and TOL were related to Factor 1 (22.95%) (TFC Score1=0.83; TFC Score2=0.76; TOL Score1=0.85; TOL Score2=0.82); AnotB to Factor 2 (16.14%) (Correct=0.76; Consecutive=0.92; Perseverative=-0.72; Sets=0.87); Color Reversal to Factor 3 (14.14%) (Correct=0.75; Blocks=-0.88; Perseverative=0.90); Spatial Reversal to Factor 4 (12.15%) (Correct=0.71; Blocks=-0.78; Perseverative=0.85); and Day/Night like stroop to Factor 5 (7.11%) (Score1=0.87). Results indicate that factorial structures were similar for both socioeconomic groups, despite their quantitative differences in performance.

A33

CONFLICT VS. ERROR MONITORING AND ADJUSTMENTS IN CONTROL *Yanni Liu[1], William Gehring[1]; [1]University of Michigan* – Theories of performance monitoring have tended to assume that monitoring for response conflict serves the same purpose as monitoring for errors: adjustments in performance will occur when either is detected. Few studies have tested this assumption. In this study, subjects performed a manual version of the Stroop color-naming task. Three conditions were included: congruent (CO), where ink color and meaning of the word were same; stimulus incongruent (SI), where ink color and meaning of the word were different, but were mapped to the same response; response incongruent (RI), where the ink color and the meaning of the color were different and were mapped to two different responses. As in previous studies, RI trials were responded to more slowly than SI and CO trials and SI trials were responded to more slowly than CO trials. Subjects were split into fast and slow groups according to their median reaction times at the CO condition. The results showed that fast subjects' performance monitoring was concerned more with overt errors than with conflict, whereas slow subjects monitored more for conflict than for errors. For example, stimulus- and response-incompatibility effects, the enhancement of the N450 on RI trials, and the enhancement of the CRN on SI and RI trials were all greater in the slow subjects than in the fast subjects. In contrast, post-error slowing and an enhanced CRN following error trials were present only in the fast subjects. In summary, the data are consistent with a double dissociation of conflict and error processing.

A34

FMRI INVESTIGATION OF AGENCY IN ADOLESCENTS *Melissa Long[1], Paul Eslinger[1,2], Jianli Wang[3], Jennifer Realmuto[1], Jorge Moll[4], Fernandez Moll[4], Qing Yang[3]; [1]Penn State College of Medicine, [2]Neural and Behavioral Sciences, Penn State College of Medicine, [3]Radiology, Penn State College of Medicine, [4]Hospital D'or Rio de Janeiro Brazil* – An important component of social behavior concerns intentionality of actions, or agency. Humans are constantly making judgments and acting accordingly, based on their attribution of agency in social situations. As children mature, they develop an understanding of shared and distinctive self-other interactions, their role in social settings, and consequences of their chosen actions. Our objective was to investigate neural activations underlying the effects of agency in a developmental sample of 10 healthy volunteers between 10-17 years of age. The fMRI study was conducted on a 3T MRI scanner with a boxcar fMRI stimulation paradigm consisting of alternating baseline and experimental activation. Experimental blocks consisted of written social-moral situations that involved the participant's intentional action (Agency) or other's actions (Non-agency), in contrast to a non-social-moral baseline condition. Functional images were acquired with an echo planar sequence and data processed with SPM2 software. Significant average activations for the Agency condition were observed in the frontal polar cortex, bilateral superior frontal cortex, bilateral temporo-parietal (TP) junction, and the precuneus. Significant activations for the Non-agency social-moral condition occurred in the bilateral anterior temporal lobes, frontal polar cortex, left TP, precuneus, polar occipital, parahippocampus and cerebellum. In contrast analysis, the Agency condition led to more frontal and paralimbic activations, whereas the Non-agency condition showed comparatively more posterior activations. Results indicate that in addition to activating social-moral knowledge in typically developing adolescents, decisions about personal actions activates a broader network of frontal-paralimbic structures associated with previous personal event knowledge and social emotions.

A35

TEMPORAL DYNAMICS OF FEEDBACK PROCESSING IN THE DORSAL AND VENTRAL STRIATUM ARE MODULATED BY LEARNING AND EXPECTANCY *Dan Lopez-Paniagua[1], Carol A. Seger[1]; [1]Colorado State University* – Previous studies focusing on feedback processing in the striatum have been invaluable for visualizing the different the neural substrates involved in this network. However, conclusions gleaned from these studies are hindered either by a) limited scanning time and/or slow, event-related paradigms, precluding the study of late learning, and b) restricted methods for deconvolving the BOLD response associated with cognitive feedback. The present study used a rapid, event-related functional magnetic resonance imaging paradigm to examine how feedback processing in the striatum is modulated by learning and expectancy using a simple categorization task. On each trial, subjects were presented with one of six abstract visual stimuli, pressed a button indicating whether it predicted "rain" or "sun", then received feedback as to whether the decision was right or wrong. For the six stimuli used, four had a probabilistic relationship (half were associated with rain 80% of trials and sun 20% of trials, or vice versa) and two were on a random reward schedule (50% of trials in each condition). Moreover, both the delay between response and feedback and the inter-trial interval were jittered in order to better visualize the hemodynamic response associated with feedback processing. Preliminary results show that early activation of the head of the caudate and ventral striatum associated with positive feedback early on decreased in later stages of learning, especially for probabilistic stimuli. Conversely, activity associated with negative feedback increased throughout the course of learning and elicited a greater BOLD response in late stages of learning.

A36

PREPARATION FOR A CROSS-MODAL STROOP TASK *Kathy Low[1], Monica Fabiani[1], Gabriele Gratton[1]; [1]Beckman Institute, University of Illinois-Urbana, Champaign* – This study investigated brain activity related to dynamically switching between rules in preparation to attend to the auditory or visual modality in a cross-modal Stroop task. In a previous study using this paradigm, we recorded brain activity with the event-related optical signal (EROS) and found modality-specific preparation effects in sensory association areas as well as task general effects (switch > no switch, independent of modality) in the frontoparietal network. In the present study, we wanted to see whether event-related potentials (ERPs) could also be used to identify signatures of preparation. Precues associated with a switch in modality produced a positive shift at Pz, independent of whether the switch was to the auditory or visual task. In contrast, early sensory components showed modality-specific effects (frontal N1 and P2: auditory > visual; occipital-temporal P1 and N1: visual > auditory), despite the bimodal presentation of the cues. This pattern of both general and modality-specific effects shows good correspondence with our EROS results. A second objective was to see whether this preparatory activity is related to subsequent success or failure on incongruent trials. During the preparatory period, incorrect trials were associated with an enhanced N2 at fronto-central electrodes and a greatly reduced contingent negative variation compared to correct trials. Furthermore, the modality-specific effects on the earliest sensory components were not present on trials that ultimately resulted in an error. Therefore, these data suggest that it may be possible to detect the likelihood of an error well in advance of the commission of an error.

A37

VOXEL-BASED MORPHOMETRY SHOWS TWO NETWORKS ASSOCIATED WITH ATTENTIONAL CONTROL DYSFUNCTION ON A FLANKER TASK IN DEMENTIA *Tracy L. Luks[1], Michael Oliveria[1,3], Katherine Possin[2], Anne Bird[2], Joel Kramer[2]; [1]University of*

California San Francisco, [2]Memory and Aging Center, University of California San Francisco, [3]University of California Merced – Dysfunction of the attentional control system plays an important role in the cognitive deficits experienced by dementia patients, and in their overall quality of life as disease progresses. This study investigated the neurobiological basis of attentional control dysfunction in dementia by determining the effect of regional brain atrophy on the Flanker Test performance of dementia patients. Comparing atrophy associated with incongruent condition performance to that associated with congruent condition performance allowed us to identify regional atrophy specifically associated with increased conflict processing difficulty, which is an indicator of attentional control dysfunction. We hypothesized that atrophy in Dorsolateral Prefrontal Cortex (DLPFC) and Anterior Cingulate Cortex (ACC) would be significantly associated with decreased attentional control. Sixty-five subjects participated in this study, ranging in age from 44 to 81 years of age, including patients with a variety of dementia diagnoses and age-matched healthy controls. A T1-weighted structural MR was obtained on a 1.5-T Seimens scanner (MPRAGE, TR/TE/TI = 10/4/300 ms, 1 x 1mm in-plane and 1.5mm slice resolution). We used Voxel-Based Morphometry (VBM) to measure the relationship between regional grey matter atrophy and attentional control performance on the Flanker Test, measured by accuracy, and response time in the incongruent relative to congruent conditions. Two networks were identified. First, there was an association between DLPFC and ACC atrophy and poorer attentional control accuracy. Second, Temporo-Parietal Junction (TPJ) and Ventrolateral Pre-Frontal Cortex (VLPFC) atrophy were associated with poorer response time measures of attentional control on accurate trials.

A38

DIFFERENCES IN EXECUTIVE FUNCTIONING MODERATED BY TRAUMA HISTORY AND SEX *Kristen Mackiewicz[1], Kirsten Orcutt[1], Marie Banich[1,2]; [1]University of Colorado at Boulder, [2]Institute of Cognitive Science, University of Colorado at Boulder* – Studies have demonstrated alterations in attentional processes in people with Post-Traumatic Stress Disorder (PTSD), but little work has examined other executive functions in people with PTSD or executive functioning in people with trauma histories and no diagnosis of PTSD. The purpose of this study was to examine whether people with diverse trauma histories and no formal diagnosis of PTSD demonstrate differential performance on executive functioning tasks. Undergraduates aged 18-21 completed a computer battery of executive functioning tasks, specifically the classic Stroop task, a delayed discounting task, and a modified Bechara gambling task, as well as measures of working memory, cognitive factors, such as dissociation, and affective factors, such as anxiety. Participants were assigned to one of four conditions based on their response to a trauma survey completed at the end of the session: no trauma history, history of non-interpersonal trauma, men with a history of interpersonal trauma, and women with a history of interpersonal trauma. The main finding was that performance on the Stroop task differed between the groups. Furthermore, men and women with interpersonal trauma histories performed differently on this task, with women demonstrating better performance than men. Dissociation is explored as a factor that might be contributing to group and gender differences. Performance on the other tasks, cognitive and affective factors, and working memory, are explored as well. Relationships between performance on executive functioning tasks and moderators of performance are examined.

A39

FUNCTIONAL NEUROIMAGING OF DLPFC ACTIVATION DURING SET SHIFTING IN CHILDREN *Kathleen Mak-Fan[1,2], Drew Morris[1], Margot J. Taylor[1,2]; [1]Hospital for Sick Children Research Institute, [2]University of Toronto* – The relation between development of frontal cortex and emergence of behavioural abilities is important for understanding the role of the frontal lobes in cognition. Lesion studies in primates and neuroimaging studies in adults using set-shifting tasks have provided evidence for critical involvement of the dorsolateral prefrontal cortex (DLPFC), and it has been hypothesized that this region would be similarly important for this aspect of executive function in children. It is also hypothesized that this would develop as frontal cortex matures during development. The present study examined a set-shifting task in children, in three age ranges (7-8, 9-10, 11-12 years). Using colourful, child-friendly stimuli, the task required a 2-alternative forced choice between visual stimuli of two dimensions, based on a given rule. Periodically, the rule changed; shifts were either intradimensional or extradimensional. Neural activity was measured using functional Magnetic Resonance Imaging (fMRI). Piloting of the task with 8 adults showed activation in DLPFC, and also in parietal lobe. The ability to shift between set/dimension was also measured behaviourally using the Cambridge Intradimensional Extradimensional Shift task, and general executive function using the Test of Everyday Attention for Children (TEAch). It was hypothesized that extradimensional shifts would be associated with activity in the DLPFC, as seen in adults, but that the pattern of this activation would become more focal with age, as frontal cortex matures. It was also hypothesized that the pattern and extent of functional activity would be correlated with performance on behavioural measures of set shifting and executive function.

A40

FEEDBACK PRESENTATION TECHNIQUES FOR REAL-TIME FMRI TRAINING OF HIGHER CORTICAL REGIONS *Graeme McCaig[1], Kalina Christoff[1]; [1]University of British Columbia* – The recent technique of real-time fMRI (rt-fMRI) has been used to train subjects to modulate activation in a number of brain regions, by providing feedback from brain activation data simultaneously with acquisition. Regions examined in the literature include the motor cortex, insula and anterior cingulate. Rt-fMRI investigations in our laboratory have begun to focus on higher-level cortical association regions such as the lateral and medial prefrontal cortex. Rt-fMRI studies typically employ continuously varying feedback, updated every TR. Such feedback presentation may seem desirable, given that feedback is known to be most useful for learning when it follows performance with the least temporal delay. However, targeting higher cortical regions raises challenges for feedback design: accessing feedback information may divert subjects' cognitive and attentional resources away from the task; and attending to the display may encourage brain states that run counter to the task goal. This raises the need to explore alternative feedback presentation techniques. Such techniques include: discretising time-course data via thresholding and hysteresis, adjusting display saliency to remain in the attentional background until significant changes occur, and displaying multiple time scales in parallel to allow quick assessment of current or prior performance. In the current study, subjects were presented with alternate feedback display formats during rt-fMRI sessions. Verbal reports were collected after each session, including ratings of the usage and perceived utility of each feedback method. Results show differences in subjects' reports of usefulness regarding display types, as well as variation of usage and preference over the course of training.

A41

POSTERIOR PARIETAL ACTIVITY AND WORKLOAD CAPACITY AS CORRELATES OF FREQUENCY OF DECEPTIVE RESPONDING: A BOLD IMAGING STUDY *Scott Meek[1], Michelle Phillips[1], Laura Baucom[1], Jennifer Vendemia[1]; [1]University of South Carolina* – In a study with college-aged students (N=30) using directed deceptions during a sentence verification task with two stimuli, BOLD activations in the posterior parietal region were measured. Participants were assigned to one of three deception percentage conditions (10 participants in each condition). Participants responded deceptively 20, 50, or 80% of the time. Previous Event-Related Potential (ERP) research in our lab has shown that increased activity in the posterior attention network (PAN) is related to a decreased preparedness to deceive (Vendemia, Buzan, Green, & Schillaci, 2006). Based on this, we anticipated an increase in PAN activity when the percentage of deception trials was low (i.e. less preparedness to deceive). Specifically, we anticipated BOLD activation in the posterior parietal region to be negatively correlated with presentation rate. We also administered neuropsychological tests of workload capacity (as measured by the CANTAB tests of workload) to every participant. Previous research in our lab suggests a possible correlation between individual differences in workload capacity and patterns of activity in the posterior parietal area during deceptive responding (Vendemia, 2003). The present study sought to further elucidate the existence of this correlation. The findings are discussed as they relate to attentional mechanisms and decision making during deceptive responses.

A42

CONTROLLING EPISODIC-ASSOCIATIVE MEMORY - NEUROFUNCTIONAL BASICS AND AGE-RELATED DIFFERENCES *Franziska Meister[1], Thomas Meindl[2], Christine Born[2], Maximilian Reiser[2], Rolf Engel[1], Kristina Fast[1]; [1]Psychiatric Clinic of the Ludwig-Maximilians-University Munich, Germany, [2]Institute of Clinical Radiology of the Ludwig-Maximilians-University, Munich, Germany* – Within a so-called think/no-think paradigm (subjects have either to remember or to suppress former studied words) a network model of controlling one's own memory by active suppression has been developed: the dorsolateral prefrontal cortex seems to play a crucial role in controlling the hippocampus while retrieving neutral episodic memory contents. On behavioural level has been detected that words remembered during the think/no-think phase as well as words that are only learned initially and retrieved in the end are significantly better stored in memory than words that should be suppressed. This paradigm has been adapted to examine behavioral and neurofunctional (fMRI) data of 15 younger and 15 older healthy adults while completing the think/no-think paradigm. Concerning the behavioural data no suppression effect as predicted by the original study could be replicated in neither of the two groups. However, there was an executive process during the think/no-think procedure, as the imaging data suggest. The results indicate a prefrontal network of cognitive control within the sample of young participants similar to former findings. By dividing the elderly subjects into two groups, the high-performing elderly showed a frontal network comparable to the younger ones with a dedifferentiation concerning the relevant regions activated. The low-performing elderly showed no frontal activation at all at a comparable significance threshold. Therefore, the results of the presented study are in accordance with former studies to frontal compensation and beginning dysfunction during healthy aging and give reason to further aging research related to cognitive control.

A43

TEMPORAL SENSITIVITY OF THE STROOP COLOR-WORD INTERFERENCE EFFECT *Karen Meyerhoff[1], L. Gregory Appelbaum[1], Marty Woldorff[1]; [1]Center for Cognitive Neuroscience, Duke University* – Previous studies of the Stroop color-word interference task have shown that subjects are slower to discriminate the physical color of a word-stimulus when the word meaning is incongruent versus congruent. The incongruency also elicits characteristic frontocentral event-related potentials (ERPs), thought to reflect the processing of conflicting stimulus information. We investigated the temporal dependence of Stroop-related interference by manipulating the relative timing of color and word attributes while recording both behavioral measures and ERPs. Participants discriminated the physical color of a bar that framed the presentation of a color word (e.g. "RED"). The bar and word elements were presented at five relative offsets: No-Delay, Bar-First (100 and 200 ms prior to word), and Word-First (100 and 200 ms prior to color-bar). Stroop-related behavioral interference, measured as longer reaction times for incongruent than congruent trials, decayed with greater temporal offset between the two elements when the color-bar was presented first, and grew with greater offset when the word was presented first. The ERPs in the No-Delay condition showed the characteristic Stroop interference frontocentral negativity peaking at ~450 ms, followed by a positive deflection peaking at ~900 ms. Varying the temporal synchronicity of the Stroop elements resulted in a monotonic shift in the peak latency of the incongruent-minus-congruent difference wave, as well as modulations of the difference amplitudes. These results are consistent with the hypothesis that the introduction of temporal offsets between conflicting stimulus elements results in a nonlinear scaling of neural mechanisms that mediate the detection and resolution of stimulus conflict.

A44

IS MEDIAL PREFRONTAL CORTEX NECESSARY FOR THE SENSATION OF MENTAL EFFORT? *Mandana Modirrousta[1], Lesley K. Fellows[1]; [1]McGill University, Montreal Neurological Institute* – The sensation of mental effort is one aspect of cognitive performance monitoring, and may be important in optimal decision-making and executive control. Several lines of evidence indicate that medial prefrontal cortex (mPFC) participates in 'effortful' tasks, but the precise role of this sector remains a matter of debate. A recent case report suggested that dorsal mPFC damage can disrupt the sensation of mental effort, such as that experienced while performing incongruent trials of the Stroop task (Naccache et al., 2005). We followed up this report in a larger group of subjects with damage to mPFC including anterior cingulate cortex. The patients, and 16 demographically-matched control subjects, completed a modified version of the Stroop task. In the first block, subjects performed a congruent and an incongruent trial (in random order), and were asked to judge which of the two trials felt more "effortful". In a second control block, they were asked to indicate which trial was incongruent. Effort sensation estimation was considered accurate if the trial said to be most effortful in a given pair was the trial with the longer RT. Overall, patients did not differ significantly from controls in Stroop task performance. Both groups performed better than chance in correctly evaluating mental effort (CTL: 74 (10)%; mPFC: 67 (13)%), and performance did not differ significantly between groups. Both groups correctly identified the incongruent stimulus in over 90% of trials. These findings argue against a necessary role for mPFC in the conscious sensation of mental effort.

A45

INTER-STIMULUS JITTER LEADS TO IMPROVEMENTS IN MOTOR RESPONSE INHIBITION *Stewart H. Mostofsky[1,2], Ericka L. Wodka[1,2], Daniel J. Simmonds[1], E. Mark Mahone[1,2]; [1]Kennedy Krieger Institute, Baltimore, MD, [2]Johns Hopkins University School of Medicine, Baltimore, MD* – Inter-stimulus jitter (ISJ) is the randomization of the interval between successive stimulus events. While ISJ is often necessary in event-related fMRI, it is unclear how ISJ affects performance. We examined effects of ISJ on performance (reaction time, variability, errors) on four go/no-go tasks differing in ISJ around a standard interstimulus interval (ISI; 1000 ms). Participants included 31 healthy adults (mean age=27.8, range 18-40). Four go/no-go tasks incorporated an overlearned stimulus-response association (green = go, red = no-go), so that cognitive demands extraneous to response selection/inhibition were minimized. Each task was presented in two 3-minute blocks of 150 trials each (80% "go", 20% "no-go"). The tasks were the same except for ISJ: The 0% jitter had a fixed (1000ms) ISI, the 10% jitter range was 900-1100ms, the 30% jitter range was 700-1300ms, and the 50% jitter range was 500-1500ms. Repeated measures MANOVA revealed a main effect for ISJ on reaction time $F(2,25)=8.3$, $p<.01$ and commission errors $F(2,23)=2.9$, $p<.05$; a linear relationship was observed for reaction time (positive slope) and a quadratic relationship was observed for commission errors (10% jitter best performance). The findings suggest that in healthy adults, motor inhibitory control is optimized by small increases in ISJ (around 10%); this occurs at the expense of RT, which slows with increasing jitter. The more deliberate and controlled responding observed with jitter may reflect increased baseline recruitment of premotor circuits important for response preparation and selection; this may have important treatment implications for disorders, such as ADHD, associated with impaired inhibitory control.

A46

NEURALLY DISSOCIATING OUTCOMES INTO EFFECT AND VALUE COMPONENTS *O'Dhaniel Mullette-Gillman[1,2], Scott Huettel[1,2,3]; [1]Duke University,Center for Cognitive Neuroscience, [2]Duke University/Brain Imaging and Analysis Center, [3]Duke University* – Numerous studies have examined how humans and other animals learn action-reward contingences. Learning these contingencies may have many components – from understanding how an action leads to an outcome to learning what outcomes are rewarding – which may in turn reflect multiple underlying mechanisms. Many behaviors suggest this dissociation, such as satiety, where the valuation of a physical effect changes over time, and observational learning, in which the observer gains information about the effects of an action without full access to its value. To identify brain regions that are involved in the construction and modification of action-outcome and outcome-reward relations, independently, we developed a novel reward-learning task. Subjects performed a two-alternative forced-choice task in which both the mappings of actions (button presses) to outcomes (openings of reward chests on the screen) and the mappings of outcomes to rewards (how much money was in each chest) changed frequently and unexpectedly. While subjects were engaged in this task, we collected functional magnetic resonance imaging (fMRI) data using an inverse spiral pulse sequence in a 4T scanner. We matched action-outcome and outcome-reward changes according to the evoked changes in responses, to control for behavioral confounds. We found that action-outcome changes evoke greater activation in regions associated with executive control, even when the associated behaviors are equivalent. These results suggest that engagement of control during learning may depend not just on the needed behavioral changes, but on the specific type of learning that is required.

A47

DOES EXERCISE IMPROVE EXECUTIVE COGNITIVE FUNCTIONING IN THE ELDERLY? A RANDOMIZED CONTROLLED TRIAL FMRI STUDY *Lindsay Nagamatsu[1], Todd Handy[1], Teresa Liu-Ambrose[1]; [1]The University of British Columbia* – Executive cognitive function has been known to decline with age, but it has been shown that one useful intervention in overcoming this deterioration is aerobic exercise. Because not all seniors are physically able to engage in aerobic exercise, we were interested in investigating whether resistance training would show similar benefits in terms of preventing cognitive decline. The primary aim of this research was to investigate whether regular weight training would improve executive cognitive functioning in seniors. 84 women aged 65 to 75 participated in a six-month randomized controlled trial. Participants were randomly assigned to one of three conditions: resistance training once per week, twice per week, or no resistance training (control). Participants had their brain images recorded in an fMRI scanner while they completed the Erickson flanker task. They were instructed to keep their eyes at central fixation and respond to an arrow in the center of the screen while ignoring distracter arrows in the periphery, which were either congruent or incongruent with the center arrow. Assessments were done at two time periods: baseline and 6 months. Performance on the task for each participant was compared between measurements taken at baseline and at 6 months. Results were then compared for each of the three groups. We found evidence consistent with the hypothesis that weight training can improve executive cognitive functioning in seniors. These findings have implications for improving daily functioning in adults in our aging population.

A48

CONFLICT ADAPTATION PROCESSES IN A COMBINED SIMON-GO/NOGO-PARADIGM *Roland Nigbur[1,2], Birgit Stürmer[1]; [1]Humboldt University Berlin, [2]Berlin School of Mind & Brain* – In an electrophysiological study we investigated whether different types of cognitive conflicts trigger distinct adaptation processes in the upcoming trial. Therefore, a Simon task was combined with NoGo trials. Overall RTs were prolonged in trials following NoGos and errors. Moreover, the preceding trial type affected the Simon effect: The 75-ms Simon effect after a compatible Go was reduced to 29-ms after an incompatible Go. Errors and NoGo predecessors reduced the Simon effect with 46 ms and 50 ms, respectively, to a much lesser extent. NoGo trials elicited a fronto-central negativity peaking between 228 - 240 ms post-stimulus (N2) independent of the predecessor´s trial type. In order to relate the extent of adaptation with N2 measures participants were classified as being strong or weak adaptators depending on their RT benefit for incompatible trials after a preceding incompatible trial. Relating this RT benefit to N2 measures revealed that strong adaptators showed a left frontal N2 for incompatible compared to compatible trials only after a preceding compatible trial. Whereas weak adaptators showed a medio-frontal N2 when comparing incompatible trials for divers predecessors. To conclude, incompatible Simon trials trigger adaptation processes that differ from those after NoGo trials and errors. Moreover, this adaptation processes affect the Simon effect differentially and are correlated with disparate N2 scalp topographies. Adaptation mechanisms of underlying neurocognitive networks will be discussed.

A49

CONFLICTING LEVELS OF AWARENESS: DISTINGUISHING SUBLIMINAL, PRECONSCIOUS AND CONSCIOUS PRIMING EFFECTS IN THE ANTERIOR CINGULATE CORTEX *Redmond O'Connell[1], Robert Hester[1], Jason Mattingley[1], Mark Wakabayashi[1], Mark Bellgrove[1]; [1]School of Psychology, Queensland Brain Institute, University of Queensland, Australia* – The extent to which top-down performance monitoring processes are consciously driven is not well understood. Dehaene et al (2006) have argued for a distinction between subliminal processing, in which a stimulus does not reach consciousness due to weak signal strength, and preconscious processing in which a visible stimulus fails to reach consciousness due to inattention. Adopting this model, our fMRI study investigated the extent to which the anterior cingulate (ACC) conflict response is dependent upon conscious appraisal of the conflicting stimulus. Fifteen neurologically healthy participants were presented with a series of trials containing a masked number (the prime) followed by a readily visible target number. Participants responded according to whether the target number was greater or less than 5 and response conflict was generated by incongruence between the prime and target. In order to compare subliminal and conscious processing the prime stimulus was presented for six different durations (20-120ms) and subjective ratings of visibility were acquired after each trial. In the second experiment we contrasted preconscious and conscious conflict effects. Participants performed the same task but with prime duration fixed at a length that was reliably above detection threshold. To capture attention away from the prime, a pattern of symmetrical distracter stimuli was presented in the periphery at the time of prime onset. Again ratings of visibility were acquired after each trial. In light of previous imaging data we predict that the ACC conflict response will be evident following preconscious and conscious prime detection but not following subliminal prime presentation.

A50

NEURAL CORRELATES OF ACTIVATION AND INHIBITION COMPONENTS OF COGNITIVE CONTROL. *Chrystele Ody[1], Etienne Koechlin[2]; [1]Columbia University, New York, [2]Institut National de la Santé et de la Recherche Médicale, Ecole Normale Supérieure, Université Pierre et Marie Curie, Paris, France* – Flexibility of behavior is given by the ability to switch between several task-sets, each associated with a specific context and attributing a particular response to a given stimulus. Previous studies have shown that task-set selection can occur in preparation of as well as in reaction to stimulus occurrence, and that it relies crucially on the posterior part of the lateral prefrontal cortex (LPFC). However, little is known about how task-set selection is achieved and, more particularly, which are the respective contributions of activating the relevant task-set and of inhibiting irrelevant ones. In the present study, we separate activation and inhibition components of task-set selection by using an experimental protocol mixing three task-sets and varying between trials subjects' foreknowledge about the subsequent task-set. A behavioral experiment including 18 subjects showed that task preparation, as well as task-repetition, improves reaction times. Moreover, we showed that even without foreknowledge of the subsequent task-set, knowledge about what task-set is irrelevant also improves reaction times, suggesting that task inhibition is a significant component of cognitive control. An fMRI study using the same protocol will reveal the neural bases of these subcomponents of task-set selection.

Memory: Other

A51

THE NEURAL RESPONSE WHEN TELLING APART REALITY FROM FICTION *Anna Abraham[1], D.Yves von Cramon[1], Ricarda Schubotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences* – Narratives and storytelling occupy an integral part of our daily lives. Although we can readily assimilate all kinds of information about our real world as well as fictional worlds, we rarely lose sight of what is real and what is fictional. We carried out an fMRI study to explore the neural correlates underlying our implicit knowledge of such distinctions by having participants evaluate reality-based scenarios that involved either real or fictional characters. Processing scenarios involving real people engaged regions associated with episodic memory retrieval and self-referential thinking. In contrast, areas known to be involved in executive processes during semantic memory retrieval were activated when processing scenarios with fictional characters. One of the means by which we tell reality apart from fiction, at least in the explicit context of reality testing, hence lies in the manner in which such information is coded and accessed. Fiction, relative to reality, appears to be represented in factual terms, whereas our representations of reality, relative to fiction, are coded in subjective terms. The findings suggest that the degree of associated self-relevance with a concept plays a role in modulating our understanding of the relative difference between reality and fiction.

A52

HIPPOCAMPAL ACTIVITY DURING THE EPISODIC SIMULATION OF SPECIFIC FUTURE EVENTS: A ROLE FOR RELATIONAL PROCESSING *Donna Rose Addis[1,2], Karen F. Gold[1], Theresa Cheng[1], Daniel L. Schacter[1,2]; [1]Harvard University, [2]Athinoula A. Martinos Center for Biomedical Imaging* – Recent studies have demonstrated hippocampal contributions to imagining future events. We reported that while the left hippocampus was active during the construction of both past and future events, right hippocampus (RHC) was specifically engaged by the construction of future events. This fMRI study sought to (1) replicate RHC activity specific to future event construction; (2) determine whether this effect generalizes across specific and generic future events; and (3) investigate whether RHC activity reflects increased relational processing (recombining details) or the novelty of future events. Participants constructed either a specific (unique) or a generic (routine) past or future event in response to a cue, made a button press, and then generated details. Each event was rated for level of detail and novelty. We replicated our previous finding of increased RHC activity during construction of future relative to past events. An ROI analysis also revealed that specific events engage RHC more than generic events. However, these effects were driven by a significant interaction of temporal direction (past, future) and specificity (specific, generic), such that specific future events engaged RHC significantly more than other conditions, including generic future events. Correlational analyses showed that RHC activity during the construction of specific future events was significantly correlated with the level of detail generated; subjects who generated higher amounts of detail exhibited higher levels of RHC activity. In contrast, novelty did not correlate significantly with RHC activity. These findings further demonstrate the involvement of hippocampus and relational processing in the episodic simulation of specific future events.

A53

EVALUATION OF MEMORY, DISABILITY AND PSYCHOLOGICAL DISTURBANCES IN IRAQI MULTIPLE SCLEROSIS PATIENTS *Eman Al-Khateeb[1]; [1]University of Jordan* – Background: Cognitive impairment is a recognizable aspect of multiple sclerosis (MS), memory is impaired at an early stage of the disease, besides MS is associated with variable degrees of disability, this greatly affects patients mood through the course of the disease. Patients and methods: Sixty relapsing remitting multiple sclerosis patients where recruited from MS clinic, Baghdad teaching Hospital and matched to forty controls for demographic variables. Rey auditory verbal learning test (RAVLT) was used for memory assessment, for disability assessment the pain disability index was used (PDI), and hospital anxiety and depression scale (HADS) was used to assess psychological aspect of the MS patients. Results: RAVLT results indicate statistically significant difference between MS and control group in the 1st recall trial, proactive interference and recognition memory (hits and correct rejections). Impaired recall memory was reported in 18.03% of MS patients and impaired recognition memory in 30% of them. Major disabilities were in recreation, family/home responsibilities social activity and occupation. The mean of PDI for all activities was 3.628 ± 0.318 (mean ± S.E), HADS shows 55 % of MS patients suffers anxiety and 63 % suffers depression. Euphoria was also reported in many patients despite the disability and the pain. Conclusion: It was concluded that Iraqi MS patients suffer impaired immediate memory and some sort of impaired verbal long term memory. Higher disability score were obtained in certain domains while less scores in others (sexual behavior, self care and life support activity) denial may play a role in reducing the score of these items. Besides mood disturbance was reported in higher percentage than it might be for biological, social and psychological factors.

A54

MENSTRUAL PHASE MODULATES THE RELATIONSHIP BETWEEN CORTISOL AND MEMORY CONSOLIDATION *Joseph Andreano[1], Larry Cahill[1]; [1]Center for the Neurobiology Of Learning and Memory, University of California, Irvine* – There is significant evidence to suggest that post-training activation of receptors for glucocorticoids such as cortisol, both centrally and peripherally, can have an enhancing effect on memory (Roozendaal 2002). Recent findings have also indicated sex-related differences in glucocorticoid effects on conditioning (Zorawski et. al, 2005), as well as declarative memory consolidation (Andreano & Cahill, 2006) and retrieval (Wolf et. al, 2001). Specifically, while significant relationships between cortisol levels and memory have been found in men, no such relationship has been identified in women. One possible explanation for these findings would be that ovarian hormones alter the memory modulatory effects of stress, either by affecting the amount of glucocorticoid release, or by altering the receptivity of target tissues. If this were the case, then one would expect stress hormones to differentially relate to memory depending on estradiol and progesterone levels. To test this hypothesis, the relationship between cortisol and episodic recall was examined in three groups of healthy, naturally cycling women, selected by their menstrual position for maximal sex hormone contrast. Results indicated significantly different correlations between cortisol and memory for each menstrual phase, with no relationship in the early follicular phase, a negative relationship in the late follicular phase, and a highly significant positive relationship seen in the mid-luteal phase. These findings suggest that ovarian hormones affect the modulation of memory by stress in women.

A55

PREDICTING ONESELF IN THE FUTURE: CONTRIBUTIONS FROM TWO SEPARATE BUT INTERACTING BRAIN SYSTEMS. *Jessica Andrews-Hanna[1,2], Renee Poulin[1,2], Randy Buckner[1,2,3]; [1]Harvard University, [2]Athinoula A. Martinos Center for Biomedical Imaging, [3]Howard Hughes Medical Institute* – Accumulating evidence suggests that a core network is recruited when envisioning the future (Buckner & Carroll, 2007; Schacter & Addis, 2007; Hassabis & Maguire, 2007). Functional connectivity MRI further reveals that the core network consists of at least two interacting subsystems: the medial temporal system (hippocampal formation, retrosplenial cortex, posterior cingulate, intraparietal lobe, and ventral medial prefrontal cortex) and the medial prefrontal cortex system (dorsal medial prefrontal cortex, posterior cingulate, and the temporoparietal junction) (Buckner, Andrews-Hanna, & Schacter, 2008). The present study systematically explored the component processes that these two subsystems contribute to prediction by manipulating whether a decision required (1) reference to oneself and (2) prediction of the future. During fMRI, 38 participants (15 male, mean age = 22.2) answered questions varying self-relevance (SELF vs. SEMANTIC) and temporal distance (FUTURE vs. PRESENT) in a 2x2 design. Rest data were also acquired for functional connectivity analyses. After scanning, participants indicated the degree to which each decision required mental imagery and self-projection. Self-projection varied markedly between the SELF and SEMANTIC conditions while imagery was held relatively constant. Providing evidence for distinct functional contributions of the two subsystems, the medial temporal system was more active for FUTURE than PRESENT decisions emphasizing its role in predicting novel event scenarios. In contrast, the dorsal medial prefrontal system was more active for SELF than SEMANTIC decisions suggesting a role in self-referential processes. Making predictions about oneself in the future yielded joint recruitment of both systems suggesting the utility for the two systems' close interactions.

A56

ESTABLISHING CONDITIONED PLACE PREFERENCES IN HUMANS USING COCAINE AND NICOTINE *Robert Astur[1,2], Seth Shipman[1], Heather Breslawski[1], Shepard Seigel[3], Skip Rizzo[4], Robert Malison[2]; [1]Olin Neuropsychiatry Research Center, Harford Hospital, CT, [2]Yale School of Medicine / New Haven, CT, [3]McMaster University / Hamilton, ON, [4]Institute for Creative Technologies / University of Southern California* – It is important to examine how to minimize the cravings that occur when people are exposed to environments where they previously abused substances. Within rodent research, this is studied using a conditioned place preference (CPP) paradigm, whereby a specific environment is paired with a positive reinforcer such as cocaine, alcohol, sex, or food, and via classical conditioning, it is evident that a preference exists for this environment in the absence of the reinforcer. To study this phenomenon, we have created a virtual analogue of the CPP to examine whether such a preference can be established in a virtual reality environment. In this study, 10 non-treatment seeking cocaine abusers and 12 nicotine smokers were given repeated pairings of cocaine or nicotine, respectively, in one specific virtual environment, and a placebo in a different virtual environment. Before and after the pairings, the subjects were allowed unrestricted access to both environments without any drug.We also collected data on how much the participants enjoyed their laboratory drug use and also how negative they felt about their overall drug use. On the test day, there was individual variability about whether or not a CPP existed. However, if we integrate the drug use enjoyment data and their overall drug use feelings, there is a 0.72 correlation between our CPP prediction strength and the actual CPP. Hence, we can establish a CPP in humans using cocaine or nicotine, and we are now poised to assess whether interventions can block CPP in humans.

A57

OSCILLATORY BRAIN ACTIVITY ASSOCIATED WITH VOLUNTARY CONTROL OF CONSCIOUS RECOLLECTION *Zara Bergström[1], Jan De Fockert[1], Simon Hanslmayr[2], Karl-Heinz Bäuml[2], Alan Richardson-Klavehn[3,1]; [1]Goldsmiths, University of London, UK, [2]University of Regensburg, Germany, [3]University of Magdeburg, Germany* – We investigated the oscillatory dynamics of brain processes involved in voluntary control of recollection in a series of experiments. Participants were trained on word-pairs, and were subsequently presented with the first word of each pair and asked to either recollect or to completely avoid recollection of the associate. Electroencephalographic (EEG) data recorded at the time of recollection control revealed a number of significant differences between conditions in oscillatory power and synchrony in both low and high frequency bands. Across experiments, the strongest effects were found in the lower beta band (~15-20 Hz) where avoiding recollection was associated with a sustained suppression (or event-related desynchronization, ERD) of beta power. The effect emerged around the same time that recollection related EEG effects typically take place (500-700 ms post-stimulus) and lasted for the duration of the epoch, up to 2.5 seconds post-stimulus. The beta ERD was specifically enhanced when participants were trying to avoid recollection of a demonstrably learned associate memory, compared to when the associated memory had not been learned in the first place. This finding suggests that beta ERD indexed a neurocognitive process that was specifically engaged during efforts to prevent a learned memory from intruding into consciousness. Although beta frequency effects have typically been associated with motor rather than purely cognitive functions, recent studies have related beta ERD to effortful working memory processes. Our results therefore suggest that recollection control engaged executive control mechanisms to keep unwanted memories out of consciousness on an item-by-item basis.

A58

SUPPRESSING NEGATIVE VERSUS NEUTRAL MEMORIES: THE EFFECTS OF EMOTION ON ACTIVATION IN THE HIPPOCAMPUS & AMYGDALA *Andrew Butler[1], Karin James[1]; [1]Indiana University, Bloomington, Indiana* – To further understand the relationship between emotion, memory, and cognitive control an event-related fMRI study comparing the suppression of recall of negative versus neutral words was performed. The hippocampus is crucial for memory retrieval showing greater activation during successful explicit recall (Eldridge et al, 2000). Further, it has been demonstrated that hippocampal activation decreases when subjects intentionally suppress the recall of neutral words (Anderson et al, 2004). Here we test whether the hippocampus is generally less activated during memory suppression or if emotional significance of an event has an influence. Subjects first learned forty word pairs each consisting of a cue and target. Half of the words were neutral (low arousal and intermediate valance), and half were negative (high arousal and negative valence). During scanning subjects were shown the cue words, and were instructed to recall or suppress the targets. We show for the first time that relative bilateral hippocampal deactivation occurs during the suppression of memory for neutral but not negative words. Further, the left amygdala along with visual cortex showed greater activation during the suppression of negative compared to neutral memories. Reactivation in these emotional and sensory related areas may play a role in the sustained or enhanced activation of the hippocampus during attempts at suppressing negative memories. These results may represent the neural correlates of the diminished ability to suppress the recollection of negatively charged memories, a phenomenon that we have all experienced and that can be life threatening in disorders such as Post-Traumatic Stress Disorder (PTSD).

A59

NEURAL CORRELATES OF SPATIAL NAVIGATION UNDER DIRECTIONAL AND POSITIONAL CUE CONDITIONS *Xiaoqian J. Chai[1,2], Lucia F. Jacobs[1], John D.E. Gabrieli[2]; [1]University of California, Berkeley, [2]Massachusetts Institute of Technology* – Previous studies on the neural correlates of spatial navigation have not considered how different aspects of the environment are processed during navigation. In this study we manipulate two distinct classes of cues, directional (global, compass) cues and positional (local landmark) cues. Directional cues include gradient (graded information) and distant objects, whereas positional cues are proximal objects which provide accurate position of the target. Animal studies suggest that different cue types are represented by different parts of the medial temporal lobe (MTL). Here, we use fMRI to examine brain activations during navigation in 3D virtual environments with either directional or positional cues. The directional cue environments are composed of a test arena located on a hill and a river down the hill. In the positional cue environments, the test arena is situated on a flat terrain and positional cues such as rocks and small plants are located within the arena. For each cue condition, 3 trial types are presented in a block design: encoding, retrieval and control. In the encoding trials, subjects are given 30 seconds to explore the arena and remember the location of a visible target. After a delay of 16 seconds, the retrieval trial follows in which the target is invisible and the subject tries to navigation to the location of the target. In the control trial, subjects follow a trail in the same environment. Preliminary data suggest better performance under the positional cue condition, and the two cue conditions activate different areas of the MTL, including the hippocampus.

A60

CONTEXT LEARNING DURING SKILL ACQUISITION *Matthew Crossley[1], John Ennis[1], Greg Ashby[1]; [1]University of California, Santa Barbara* – Single-unit recordings in monkeys show that some neurons in the striatum exhibit category-specific responding following categorization training (e.g., Merchant, Zainos, Hernadez, Salinas, & Romo, 1997, Journal of Neurophysiology). After this same training however, passive exposure to these stimuli (i.e., in which the animal does not respond and receives no reward) elicits no response from these same cells. We propose that this dramatic difference is mediated by the tonically active neurons (TANs) of the striatum. A biologically detailed computational model is described in which the TANs mediate learning of context during skill acquisition tasks that depend on procedural learning. In particular, in non-rewarding environments the TANs tonically inhibit the medium spiny cells of the striatum, but in environments in which rewards are available, the TANs learn to release the medium spiny cells from this tonic inhibition. The model accounts for the results of a number of single-unit recording studies, including those of Merchant et al. (1997). It also accounts for several important behavioral phenomena, including for example, that reacquisition following extinction is faster than original acquisition.

A61

DISSOCIATING THE "RECOLLECTION" AREAS OF THE BRAIN: EFFECTS OF RETRIEVAL DELAY *Sander M. Daselaar[1], Willem Huijbers[1], Cyriel M.A. Pennartz[1]; [1]Swammerdam Institute for Life Sciences, University of Amsterdam, the Netherlands* – A small group of brain regions has been consistently implicated in episodic recollection, the vivid remembering of episodes including contextual details. These regions include posterior hippocampus, retrosplenial cortex, inferior parietal cortex (IPC), and ventrolateral prefrontal cortex (VLPFC). Despite these consistent findings, the functional roles of these regions remain poorly understood. Given that recollection-based memory leads to high-confidence retrieval decisions, it is still unclear whether activity in these regions reflects the episodic, long-term nature of the memory, or is merely associated with retrieval confidence. In order to distinguish between these alternatives, we manipulated study-test delays within the context of a continuous recognition task during fMRI-scanning. The design was based on the assumption that recognition responses after short retrieval delays will be easy (high-confidence) but rely primarily on the short-term memory buffer, whereas responses after long delays will be difficult (low-confidence) but will rely almost exclusively on long-term episodic memory. In line with our behavioral predictions, successful recognition responses were more accurate and faster for the short than for the long delays. Interestingly, the fMRI results indicated opposite levels of activity as a function of retrieval delay in the recollection-related regions: hippocampus and retrosplenial cortex showed increased activity with longer delays, whereas IPC and VLPFC showed the opposite pattern. These findings support the idea that IPC and VLPFC are involved in decision-related retrieval processes rather than remembering based on long-term memory retrieval. To our knowledge, this is the first study to reveal a cross-over dissociation among the "recollection" areas of the brain.

A62

NEURODEVELOPMENTAL CORRELATES OF MEMORY RETRIEVAL: AN FMRI STUDY *Dana DeMaster[1], Simona Ghetti[1]; [1]University of California, Davis* – Recent studies indicate a developmental dissociation between recollection (i.e., the process supporting retrieval of qualitative detail about an event) and familiarity (i.e., the process supporting recognition of the event in the absence of qualitative detail). Behavioral results suggest that when information is processed semantically, familiarity stabilizes during childhood, whereas recollection continues to develop throughout adolescence (Ghetti & Angelini, 2008). Our previous imaging results suggest that at encoding activity in the hippocampus and posterior parahippocampal gyrus is specifically associated with subsequent recollection in adults and that this pattern becomes increasingly evident with age. In younger ages (8 year-olds), hippocampal activity is associated with both subsequent recollection and familiarity. Activation in the anterior parahippocampal cortex appears to be associated with subsequent familiarity across ages. However, whether similar developmental dissociations are observed during retrieval is currently unknown. In this study, children age 8- to 11-years old and adults participate in an fMRI study. At encoding participants view drawings presented in association with a frame of variable color. During fMRI data acquisition, participants complete a self-paced recognition test on studied drawings and new drawings. Participants indicate either the color of the frame associated with the item, or, that the item is new. Behavioral results confirm age-related improvements in our index of recollection but not in that of familiarity. Consistent with our encoding results, we predict that with age the hippocampus will be more specifically activated for recollection judgments. In contrast, across ages the anterior parahippocampal cortex is expected to be involved in familiarity judgments.

A63

BRAIN-DERIVED NEUROTROPHIC FACTOR VAL66MET POLYMORPHISM AND HIPPOCAMPAL ACTIVATION DURING EPISODIC ENCODING AND RETRIEVAL TASKS *Nancy Dennis[1], Roberto Cabeza[1], Anna Need[2], Sheena Waters[1], David Goldstein[2], Kevin LaBar[1]; [1]Center for Cognitive Neuroscience, Duke University, [2]Institute for Genomic Science and Policy, Duke University* – A single nucleotide polymorphism in the targeting region of the brain-derived neurotrophic factor (BDNF) gene (Val66Met) has been associated with a variety of cognitive and affective functions in healthy and clinical populations. Whereas several studies have implicated Met carriers with abnormal hippocampal volume and impaired episodic memory, others have shown protective neurocognitive effects of the Met allele or exacerbated effects in the elderly or clinical populations relative to controls. In the present study, we re-examined the functional role of BDNF allelic variation on medial temporal lobe activation during episodic encoding and retrieval tasks in healthy young adults. The first task was a direct replication of Hariri et al. (2003), which investigated encoding and retrieval of pictures using a blocked fMRI design. The second task was an event-related fMRI study of relational memory encoding and retrieval in which faces were studied in background scene contexts. Across both tasks and genotype subgroups, significant hippocampal and/or parahippocampal activity was found during encoding and retrieval. However, preliminary analysis suggests that the Met carriers exhibited greater activation in these regions than the homozygous Val/Val participants, despite having equivalent memory performance. These group effects were consistent across both tasks and stand in opposition to the results of Hariri et al. (2003). Differences in behavioral performance across studies are discussed as a possible reason to explain the discrepant findings.

A64

NEURONAL CORRELATES OF METAMEMORY: A FUNCTIONAL MAGNETIC RESONANCE IMAGING STUDY *Anne Do Lam[1], Tilo Kircher[1], Siegfried Gauggel[1], Susanne Weis[1]; [1]University Hospital Aachen, Germany* – Metamemory pertains to monitoring and control of own memory performance. Due to existing neuroimaging research, the neuronal correlates of metacognitive processing of memory processes are suggested to be localized in the frontal cortex. The frontal cortex performs monitoring and controlling functions during encoding and retrieval. Encoding and retrieval processes per se, seem to be determined by functions localized in the medial temporal lobe. This study examined the neuronal correlates of metamemory in 16 healthy subjects (Mage=24.8; SD=4.75). The main focus was on monitoring which was measured by judgments of learning (JOLs) during the encoding phase. Subjects studied face-name-associations and provided JOLs immediately after an item has been studied ("immediate JOLs") or after a delay ("delayed JOLs"). Additionally, the names of the to-be-studied associations had to be retrieved during the ongoing experiment. The comparison of the neuronal correlates of subjective and objective memory performance revealed a dissociation of frontal and medial temporal areas. The functions of metamemory were associated with bilateral medial frontal activations, as opposed to the memory retrieval which was associated with activations of medial temporal areas, especially of the hippocampus. Furthermore, delayed JOLs were associated with increased activation of occipital, medial temporal and frontal areas of the left hemisphere. According to the "delayed JOL"-effect, JOLs which are made after a delay show increased accuracy as compared to immediate JOLs. The results of our study support the "monitoring-dual-memories"-hypothesis as explanatory approach of the "delayed JOL"-effect. According to this hypothesis, both short-term and long-term memories are monitored during delayed JOLs.

A65

MEMORY PERFORMANCE AND STEREOTYPE THREAT ACROSS NORMAL AGING *Teal Eich[1], Barbara Knowlton[1], Alan Castel[1]; [1]University of California, Los Angeles* – Stereotype threat (ST) arises from the risk of confirming a negative stereotype about the group to which a person belongs (Steele & Aronson, 1995), and leads to suboptimal performance consistent with the negative stereotype. The current study investigated the ST of memory loss in older adults by testing both implicit and explicit memory in a threat condition and a neutral, no-threat condition. Subjects were healthy older adults divided into a relatively younger group (N=20, mean age 70) and an older subgroup (N=19, mean age 85). ST was induced by telling subjects that previous studies have shown that memory declines with age and that the present study was designed to see if this is true. Subjects then performed several cognitive tests including an incidental word-encoding task followed by a word-stem completion and a cued recall test to assess implicit and explicit memory, respectively. Results showed that memory ST had no effect on implicit memory. However, ST had different effects on explicit memory performance in the younger subgroup and the older subgroup. While the younger subgroup showed significantly impaired explicit memory after the memory ST, the older subgroup was unaffected. These data suggest that memory ST has specific deleterious effects on retrieval processes in older adults and that it may lead to impaired performance in cognitive studies. Furthermore, the fact that ST had minimal influence on performance in very old subjects suggests that people successfully attaining advanced age may be less susceptible to stress effects on cognitive performance.

A66

BEHAVIORAL AND ELECTROPHYSIOLOGICAL INVESTIGATIONS OF HEMISPHERIC ASYMMETRIES IN THE ENCODING OF SURFACE FEATURES *Karen M. Evans[1], Kara D. Federmeier[1]; [1]University of Illinois at Urbana-Champaign* – To examine hemispheric differences in the encoding of visual words and their consequences for verbal memory, we asked participants to remember study words that were lateralized to one visual half-field (thus biasing encoding to a single hemisphere) and then tested centrally at a range of repetition lags. Across study and test presentations, repeated words either appeared in the same letter case (e.g., table-table; TABLE-TABLE) or different letter cases (e.g., table-TABLE; TABLE-table). Previous work has suggested that the left hemisphere (LH) is biased to encode verbal material in an abstract manner that generalizes across such superficial differences, whereas the right hemisphere (RH) is biased to encode more specific information such as surface features. As predicted, electrophysiological measures revealed that different case test words were associated with a weaker memory signal for words initially encoded by the RH, but this was true only at some repetition lags. Furthermore, RH memory advantages observed previously in both behavioral and electrophysiological responses in similar experiments without case switches were not replicated here when surface features were not reliable memory cues, suggesting that the RH's tendency and/or ability to make use of perceptual information for memory judgments is modulated by task demands.

A67

AN EARLY ERP REPETITION EFFECT FOR REMEMBERED COMPARED TO FORGOTTEN FACES *Harlan Fichtenholtz[1], Elise Christopher[1], Marcia Johnson[1], Gregory McCarthy[1]; [1]Yale University* – In two studies we investigated the electrophysiological correlates of face repetition. Participants were instructed make a button press whenever an animal picture was presented in a series that included task-irrelevant pictures of human faces and objects. The faces presented in the first third of the block were repeated in the remainder of the block. These repeated faces were randomly intermixed with objects and novel faces that had not been previously presented. Repetition effects were assessed by comparing the ERPs elicited by the repeated and novel faces. In the first study (N=27) a significantly greater positivity, which peaked approximately 365 msec post stimulus, was observed over frontal scalp electrodes (F3/Fz/F4, FC3/FCz/FC4) for repeated compared to novel faces. The second study (N=21) was similar to the first, but incorporated an unexpected recognition memory test at the end. Participants had better memory for repeated compared to novel faces. A frontal positivity with a similar distribution as in study 1 was observed for repeated faces in study 2. The latency of this repetition effect varied as a function of later recognition. The repetition effect for subsequently remembered faces peaked at approximately 290 msec post stimulus, while the repetition effect for subsequently missed faces peaked at approximately 440 msec post stimulus. These findings suggest that latency of the ERP repetition effect may provide a marker of incidental encoding of information into long-term memory.

A68

MEMORY IMPAIRMENT ASSOCIATED WITH TYPE-1 DIABETES IN CHILDHOOD *Simona Ghetti[1], Joshua Lee[1], Clare Holtpatrick[1], Dana Demaster[1], Nicole Glaser[1]; [1]University of California, Davis* – Research on animal models has demonstrated a causal connection between Type-1 diabetes (T1DM) and neuronal death in the hippocampus possibly due to severe hypoglycemia associated with T1DM. This suggests that individuals with T1DM may suffer from impairment in memory functions that are specifically sub-served by the hippocampus. The present research sought to investigate the relation between T1DM and memory deficits in childhood. Children with T1DM and their non-diabetic siblings (current n = 67; age range =6-16) were tested on item recognition memory (i.e., determining whether they had seen an item before), and memory for qualitative detail about the item (i.e., remembering the color and the spatial position of the item). Preliminary behavioral results showed no significant differences between participant groups in memory performance. However, among patients, those who experienced severe hypoglycemic episodes were more likely to exhibit disproportionately reduced spatial memory, suggesting that hippocampal function may be altered in these patients. It is predicted that the association between severe hypoglycemia and memory deficits is mediated by neuronal death in the hippocampus which is expected to be reflected in reduced hippocampal volume.

A69

MODULATION OF HIPPOCAMPAL ACTIVATION DURING FACE RECOGNITION BY EMOTION *Kevin G. Guise[1], Laura Martin[2], Ashley De Marchena[3], Liang Wang[1], John A. Fossella[1], Cheuk Y. Tang[1], Michael M. Minzenberg[4], Sanjay M. Mathew[1], Xiaosi Gu[1], Jin Fan[1]; [1]The Mount Sinai School of Medicine, [2]Rutgers University, [3]University of Connecticut, [4]University of California, Davis* – Though the neural substrates of face identity recognition and emotional processing have been well delimited by functional imaging studies, the modulatory effect of face emotion on recognition-related substrate is under-explored. In the current study subjects passively encoded a series of faces with fearful and neutral expressions while engaged in an emotional categorization task and were then asked to make “old” and “new” identity judgments on a superset of faces in a separate block of trials while scanned using fMRI. Recognition accuracy was high and subjects were faster to correctly identify old faces than new faces, though there was no main effect of emotional valence and no interaction. Functional imaging data revealed increased activity in the hippocampus, posterior cingulate cortex, and pregenual anterior cingulate cortex to old faces relative to new and increased activity in regions related to emotional processing, such as the amygdala and insula to new faces relative to old faces. A significant recognition (old, new) by emotion (fearful, neutral) interaction was found in the left hippocampus indicating that activity related recognition of faces is positively modulated by fearful face emotion. Results are discussed in terms of interactions on the systems level.

A70

MEMORY PERFORMANCE AND NEUROIMAGING IN MUCOPOLYSACCHARIDOSIS (MPS-I) *Ozgun Evren Guler[1,2], Elsa G. Shapiro[3], Catherine N. Le[3], Kathleen M. Thomas[1]; [1]Institute of Child Development, University of Minnesota, [2]Center for Neurobehavioral Development, University of Minnesota, [3]University of Minnesota* – Mucopolysaccharidosis Type I (MPSI) is a genetic lysosomal storage disease in which deficiency in alpha-L-iduronidase enzyme activity causes accumulation of glycosaminoglycans (heparan and dermatan sulfate), resulting in widespread tissue and organ damage. Level of intellectual functioning and developmental delay vary by subtype. Individuals with the severe form of MPS-I (MPSI_sev, or Hurler syndrome) are treated with hematopoietic stem cell transplant (HSCT) which allows the enzyme to reach the brain and slows cognitive decline. Patients with the attenuated form (MPSI_att; also called Hurler-Scheie or Scheie) are treated with enzyme replacement therapy; however, the enzyme does not pass the blood-brain barrier. Thus, we hypothesized that patients with MPSI_sev would perform better on cognitive measures and show less hippocampal abnormality compared to patients with the attenuated forms of the disease. Fourteen MPSI subjects (7 severe; 7 attenuated) were tested using a battery of neuropsychological assessments and underwent Magnetic Resonance (MRI) and Diffusion Tensor Imaging (DTI). Whole brain and hippocampal volume measures were obtained from T1- weighted high-resolution structural MRI images. From DTI, regional fractional anisotropy (FA), which is an index of directionality of diffusion, and mean diffusivity were calculated. Preliminary analyses suggested that compared to MPSI_sev patients, MPSI_att patients were more impaired on verbal recognition memory, showed smaller volumes for left hippocampus and left caudate; and higher fractional anisotropy in the corpus callosum. In addition, performance on various memory tasks was correlated with hippocampal volume and FA. Comparison with matched controls will allow for further characterization of the disease.

A71

LEFT VENTROLATERAL PFC AND SOURCE REMEMBERING: DELIBERATIVE RECOLLECTION THROUGH SEMANTIC ELABORATION *Sanghoon Han[1], Andrea Eslick[1], Ana Raposo[1], Ian Dobbins[2]; [1]Duke University, [2]Washington University, Saint Louis* – One of more consistent findings in fMRI memory research is increased activation in left ventrolateral prefrontal cortex (VLPFC) when comparing context to item memory. Despite its ubiquity, the functional significance of this activation is debated. One interpretation holds that regional activation indicates the controlled retrieval of, or selection among, semantic representations. However, the prevalence of activation during contextual memory could instead indicate that the region is critical for selecting among competing episodic representations, which tend to share features during context memory. Using event-related fMRI, we compared these accounts by examining context memory judgments for meaningful (scenic pictures) versus meaningless (fractal-like pictures) stimuli. During retrieval, subjects were shown probe triplets containing pictures originating from two prior encoding sources (Pleasant? vs. Complex?) and a novel picture. Compared to novelty judgments, context memory judgments for meaningful stimuli elicited increased activation in left VLPFC along with left dorsal PFC and lateral parietal cortex. In contrast, left VLPFC activation was uniquely absent for the analogous contrast with meaningless stimuli, although context judgments were more demanding for meaningless pictures suggesting greater competition between episodic representations. Finally, multiple regression analysis demonstrated that anterior and posterior VLPFC sub-regions demonstrated different functional properties, with anterior VLPFC uniquely predictive of activation in posterior middle temporal gyrus, a region linked to semantic storage. These findings indicate that left VLPFC is activated as a function of retrieving specific semantic features of retrieval probes during the course of context memory attempts, and not reflective of competition among perceptual or episodic memory representations.

A72

ELECTROPHYSIOLOGICAL ACTIVITY DURING DIRECTED FORGETTING OF UNPLEASANT AND NEUTRAL MATERIAL *Anne Hauswald[1], Johanna Kissler[1]; [1]University of Konstanz* – Directed forgetting refers to the phenomenon that people can intentionally forget material designated as unimportant. When, after learning, a list is marked as ‘to-be-forgotten’ (F-list) its contents are recalled more poorly than the contents of a ‘to-be-remembered’ list (R-list) on a surprise final recall. This effect demonstrates the costs of directed forgetting. However, benefits also occur: When additional lists are learned after an F-list these are better remembered than those learned after an R-list. Using behavioural and electrophysiological measures, we explored directed forgetting of word lists varying in emotional content (neutral and unpleasant). EEG was recorded from 64 channels while subjects learned four lists of words all either neutral or all unpleasant. In the surprise free recall test, costs and benefits of directed forgetting were found for both valences. Additionally, electrophysiology showed increased activity during the presentation of words that followed the F-list compared to those following the R-list. This activity difference occurred between 450 and 650 ms after stimulus onset with a maximum in left-central regions for the neutral words and in left-frontal areas for the unpleasant ones. This enhanced activity indicates that additional resources are recruited during directed forgetting. Furthermore, the results suggest that, at least for verbal material, healthy subjects are able to control their episodic memory and inhibit irrelevant contents regardless of their emotional significance. However, the neural substrates sub-serving this ability may differ as reflected by the different scalp topographies of the effect.

A73

INCREASES IN SERUM BDNF ARE CORRELATED WITH RESPONSE TO NEUROPLASTICITY-BASED COGNITIVE TRAINING IN PATIENTS WITH SCHIZOPHRENIA *Christine Holland[1], Melissa Fisher[1], Michael Merzenich[2], Wendy Closshey[2], Synthia Mellon[2], Owen Wolkowitz[2], Sophia Vinogradov[1]; [1]University of California, San Francisco; San Francisco Veterans Affairs Medical Center, [2]University of California, San Francisco,CA* – BDNF, the most widely distributed neurotrophin in the central nervous system, promotes synaptogenesis and plays a critical function in learning-induced neuroplasticity. In this study, we investigated the relationship between serum BDNF levels and the behavioral response to neuroplasticity-based cognitive training in subjects with schizophrenia. Thirty-two schizophrenia subjects, stratified by IQ and symptom severity, were randomly assigned to either targeted cognitive training (TCT) or a control condition of graphically interesting computer games (CG). Both groups participated in the intervention for 1 hour per day, 5 days per week, for a total of 40-60 hours. We measured serum BDNF levels via enzyme-linked immunoassay (ELISA) at baseline, and after 2, and 12 weeks of the intervention. In addition, serum BDNF was measured in 10 age and education-matched healthy controls. We find that: 1) serum BDNF levels in the schizophrenia subjects are lower than that of healthy controls at baseline, 2) after 12 weeks of cognitive training, serum BDNF levels are increased by 30% in the TCT schizophrenia group but not the CG group (group differences at $p<.05$), 3) preliminary results indicate that the increase in serum BDNF is positively correlated with behavioral gains in measures of learning and memory. These data suggest that increases in serum BDNF levels may serve as a biomarker for improved performance on learning and memory tasks that result from neuroplasicity-based training, consistent with the notion of increased neurogenesis and a trophic/neuroplastic response in hippocampal and cortical neurons.

A74

RESPONSE LEARNING CONTRIBUTIONS TO BEHAVIOURAL PRIMING AND REPETITION SUPPRESSION *Aidan Horner[1], Rik Henson[1]; [1]MRC Cognition and Brain Science Unit* – Prior exposure to a stimulus can facilitate its subsequent identification and classification, a phenomenon called priming. This behavioural facilitation is usually accompanied by a reduction in neural response within specific cortical regions (Repetition Suppression – RS) (Grill-Spector, Henson, & Martin, 2006). Recent research has suggested both behavioural priming and RS are largely driven by previously learnt stimulus-response pairings (Dobbins, Schnyer, Verfaellie, & Schacter, 2004; Schnyer, Dobbins, Nicholls, Schacter, & Verfaellie, 2006). On first presentation, a direct association forms between the stimulus presented and the response given; on a subsequent encounter with the stimulus, this association automatically cues the response, bypassing the processing stages required during its first presentation. Here we present both behavioural and fMRI evidence suggesting that, although response learning mechanisms play a significant role, they cannot explain all priming effects. Furthermore, although response switches between initial and repeated stimulus presentations significantly reduce behavioural priming, RS in perceptual brain regions was found to be relatively robust to changes in both task and response.

A75

WHEN REMEMBERING HINDERS LEARNING *Willem Huijbers[1], Cyriel Pennartz[1], Roberto Cabeza[2], Sander Daselaar[1]; [1]Swammerdam Institute for Life Sciences, Faculty of Science, University of Amsterdam, [2]Center for Cognitive Neuroscience, Duke University* – Recent functional neuroimaging evidence suggests a competition in our memory system between learning new information (memory encoding) and remembering old information (memory retrieval). In particular, successful retrieval has been associated with increased activity in posterior cingulate cortex (PCC) and posterior lateral parietal cortex (PLPC), whereas successful encoding has been associated with decreased activity in these regions. Given that global activity in a particular brain area cannot increase and decrease at the same time, these findings lead to the hypothesis that successful remembering may hinder successful learning when both processes happen concurrently. Using functional magnetic resonance imaging, the present study investigated the behavioral and neural consequences of this potential bottleneck in our memory system. During scanning, participants intentionally remembered old words displayed in the foreground, while incidentally learning new scenes displayed in the background. In addition to confirming and extending previous evidence indicating opposing levels of brain activity during learning and remembering in PCC and PLPC, the study yielded three main findings. First, we found that remembering old information was associated with impaired learning of new information. Second, we found that this behavioral effect was coupled with suppression of learning-related activity in visual and medial temporal areas. Finally, we provide evidence that the mid-ventrolateral part of the left prefrontal cortex (mid-VLPFC) resolves the memory competition by allowing rapid switching between learning and remembering. Overall, the study not only provides novel insight in our capacity to learn and remember, but also increases our general understanding of the neural mechanisms underlying flexible behavior.

A76

CORTICAL ACTIVITIES RELATED TO SOURCE MEMORY RETRIEVAL: CURRENT DENSITY IMAGING WITH INDIVIDUAL MRI *Young Youn Kim[1], Ah Young Roh[2], Jun Soo Kwon[1,2]; [1]Seoul National University College of Medicine, Seoul, Korea, [2]Clinical Cognitive Neuroscience Institute, SNU-MRC, Seoul, Korea* – We investigated the neural correlates of source memory retrieval using low-resolution electromagnetic tomography with 64 channels EEG and individual MRI as a realistic head model. Event-related potentials (ERPs) were recorded while subjects performed recognition tasks for spoken words (items) or for the voice of the speaker in spoken words (sources). At 400-700 ms, the amplitude difference between the correctly judged old and new words was significantly larger in the source memory task than in the item memory task and only the source memory task revealed old/new effects in the right anterior region between 1000 and 1200 ms. We conducted source reconstruction at approximately 311, 604, 793, and 1100 ms and used statistical parametric mapping for the statistical analysis. The results of source analysis suggest that the activation of the right inferior parietal region may reflect retrieval of source information. The source elicited by the difference ERP between the source correct and source incorrect responses exhibited dynamic change of current density activation in the overall cortices with time during source memory retrieval. These results indicate that multiple neural systems may underlie the ability to recollect context.

A77

RETRIEVAL-INDUCED FORGETTING UNDER STRESS - MEMORY PERFORMANCE AND CORTISOL LEVEL *Susanne Kössler[1], Johanna Kissler[1]; [1]University of Konstanz* – Retrieval-induced forgetting refers to the phenomenon that the repeated retrieval of a subset of previously learned material can cause forgetting of the nonretrieved remaining material. However, the degree of retrieval-induced forgetting varies markedly between different subjects and conditions. The aim of the present study was to investigate to what extent retrieval-induced forgetting can be influenced by psychosocial stress. Therefore, intervening between study phase and retrieval practice phase, subjects were exposed to either a standardized psychosocial laboratory stressor (Trier Social Stress Test; stress group) or a cognitively challenging, but nonstressful control task (control group). Personal stress experience was validated by salivary cortisol responses acquired at different time points during the experiment and by use of mood assessment questionnaires. No retrieval-induced forgetting effect occurred in the stress group, whereas a normal degree of retrieval-induced forgetting was found in the control group. Moreover, subjects exposed to stress showed a significant increase in free salivary cortisol and a decrease in mood. The findings show that emotional stress abolishes retrieval-induced forgetting and suggest a causal role of cortisol due to its memory modulating effects.

A78

IN A NEW SEMANTIC LEARNING TASK, SLEEP PROMOTES MEMORY FOR CATEGORY-ATYPICAL BUT NOT CATEGORY-TYPICAL INFORMATION *Emily J. Mayberry[1,2], Timothy T. Rogers[1]; [1]University of Wisconsin, Madison, [2]University of Manchester, UK* – We employed a new semantic learning task to investigate how sleep influences memory for category-typical versus atypical information. Over six training and testing sessions, participants learned the individual names, category labels, and visual appearances of 24 novel objects organized into three categories. Items within each category tended to share similar parts, and varied in their distance to a category prototype. Participants were tested at 12-hour intervals, with half beginning at 8AM and half at 8PM. We then compared improvements over 12-hour spans that involved mostly wake or mostly sleep, contrasting memory for category-typical versus atypical items in a series of visual and verbal tests. Across tests, we found that memory for properties shared by category members improved more over wake than sleep periods; but that memory for properties that individuate category members showed the reverse pattern. These results are consistent with a view of long-term memory in which the hippocampus and cortex play complementary roles (the "Complementary Learning Systems" theory). Specifically, the cortex, because it employs overlapping representations, can extract statistical structure across examples; but to avoid interference, it must learn slowly. The hippocampus, because it employs sparse and non-overlapping representations, can rapidly form representations of individual items without interference; but it will not learn the cross-item statistical structure critical for organizing concepts. Under this theory, the fast-learning hippocampal system "replays" new memories to the slow-learning cortex during sleep, so that new information acquired during the day can be consolidated into the cortical semantic network without disrupting existing knowledge.

A79

STOPPING THOUGHTS: EVENT-RELATED POTENTIAL (ERP) CORRELATES OF INTENTIONAL REMEMBERING AND FORGETTING *Axel Mecklinger[1], Mauricio Parra[1], Gerd Waldhauser[2]; [1]Saarland University, [2]Lund University* – We investigated the neurocognitive processes underlying intentional remembering and forgetting. In a Think/No-Think experiment, adopted for using the ERP technique, participants learned word pairs. Subsequently, they were presented with the cue words and were instructed to either suppress (suppression condition) or to recall and think about the target word (respond condition) for 16 times. During final cued recall tests for all initially learned targets, memories of the to-be-suppressed or to be-recalled items were tested either with the same probe (initial cue word) or with an independent probe (category cue word). We found remembering effects in the same probe test and forgetting effects in the independent probe recall test. The results further revealed several ERP effects related to retrieval attempts or attempts to avoid unwanted memories. Retrieval attempts were characterized by an enhanced P2 component and a late parietal positivity, i.e. the ERP correlate of recollection. As revealed by subsequent remembering/forgetting analyses the parietal positivity was predictive for enhanced memory performance in the respond condition. Attempts to avoid unwanted memories were characterized by a negativity at 400 ms that bears similarities with negativities found in motor stopping paradigms and in this task presumably reflects the inhibition of the prepotent recollection response. The amplitude of the negativity was predictive for subsequent forgetting in the suppression condition. The results suggest that the avoidance of unwanted memories results from the inhibition of prepotent responses that depletes recollection-based remembering.

A80

SKILL LEARNING AND REPETITION PRIMING IN ALZHEIMER'S DISEASE *Sarah Merbah[1], Thierry Meulemans[1]; [1]University of Liege* – Several studies have shown with the mirror reading paradigm that procedural learning and repetition priming might be preserved in the early stages of Alzheimer's disease (Deweer et al., 1994). Repetition priming is demonstrated by the reading times improvement for repeated words, while procedural learning is demonstrated when this improvement is also observed for new words. Our hypothesis was that this improvement could be due to a repetition priming effect for the letters rather than to the learning of a mirror reading skill. Indeed, because the same letters are presented throughout the task, a repetition priming effect could be sufficient to explain the improvement of performance. In order to test this hypothesis, we have administered to 20 young and elderly subjects and to 20 Alzheimer's patients a new mirror reading task including two phases: an acquisition phase comprising pseudo-words constructed with one part of the alphabet, and a test phase in which both pseudo-words constructed with the same part of the alphabet and pseudo-words constructed with another part of the alphabet were presented. Reading faster the new pseudo-words composed with the repeated letters would reflect a repetition priming effect, while reading faster pseudo-words composed with "new" letters would reflect a procedural learning effect. Results show comparable repetition priming effects in Alzheimer's patients and in young and elderly subjects, whereas only young and elderly subjects showed a procedural learning effect. These results suggest, contrary to previous studies, that the learning of a new perceptual skill could be not preserved in Alzheimer's disease.

A81

DOSE EFFECTS OF TRIAZOLAM AND SCOPOLAMINE ON METAMEMORY *Miriam Mintzer[1], Bethea Kleykamp[1], Roland Griffiths[1]; [1]Johns Hopkins University School of Medicine* – Benzodiazepine and anticholinergic drugs both induce temporary amnesia when administered acutely to healthy volunteers. This double-blind, double-dummy, placebo-controlled study tested the dose effects of the benzodiazepine triazolam (0.125, 0.25 mg/70 kg, orally administered) and the anticholinergic scopolamine (0.25, 0.50 mg/70 kg, subcutaneously administered) in an independent groups design in healthy volunteers (N = 16/group). Drug effects on memory accuracy, memory quantity, and separate components of metamnemonic monitoring and control were tested within semantic memory (Koriat et al., 1996) and episodic memory (Kelley et al., 2003) paradigms. There were no significant differences between corresponding doses of triazolam and scopolamine. Neither drug significantly affected memory or metamemory in the semantic memory paradigm. While both drugs dose-dependently impaired accuracy and quantity in the episodic memory paradigm, the usual pattern of higher accuracy and lower quantity under free report conditions (participants choose whether or not to use each response towards performance-based bonus pay) relative to forced report conditions (participants are required to respond to each item) was observed under both placebo and active drug conditions. Both drugs appeared to impair the absolute accuracy measure of monitoring (calibration) and control sensitivity (correlation between confidence and decision to use response), but not to impair the relative accuracy measure of monitoring (correlation between confidence and accuracy). Both drugs also appeared to affect response criterion setting under certain conditions. Results support the selectivity of drug effects on different components of metamemory, but do not provide evidence for differences between benzodiazepines and anticholinergics.

A83

NEURAL CORRELATES OF RETRIEVAL FROM EXPLICIT MEMORY AS A FUNCTION OF AGE AND DEPTH OF PROCESSING *Alexandra Osorio[1,2], Séverine Fay[3], Soledad Ballesteros[2], Viviane Pouthas[1]; [1]Unité de Neurosciences Cognitives et Imagerie Cérébrale, LENA CNRS UPR 640, Paris, [2]Universidad Nacional de Educacion a Distancia, Madrid, Spain, [3]Langage, mémoire et Développement Cognitif, Université François Rabelais, UMR CNRS Tours, France* – The purpose of the present study was to find out whether episodic memory performances and neural correlates of explicit retrieval would change with aging. Completion rates and event-related potentials (ERPs) were recorded while participants from two age groups with high educational level (20-30 and 60-70 years) performed a word-stem cued-recall task. Depth of processing at encoding (lexical vs. semantic) was manipulated. Levels of recall (percentage of correct completions belonging to studied items) were higher for deeply (semantically) studied words than shallowly (lexically) studied words, but did not differ between the two age groups. ERP old/new effects were observed in each encoding condition. Several differences were observed between young and old adults. In the lexical condition, the old/new effect was obtained at frontal and parietal sites as soon as 400ms and lasted up to 600ms post stimulus in the elderly, whereas it became significant only at 600ms and lasted up to 1000 ms post-stimulus in the young adults. In the semantic condition, a robust old/new effect lasting between 400 and 1000ms was observed over frontal and parietal sites in the young group. In the older group, the O/N effect was significant between 600 and1000ms over the parietal sites whereas over the frontal electrodes the effect was only significant over the right hemisphere between 600 and 800ms and, over both hemispheres between 800 and 1000ms. Since memory performances did not differ between the two age groups, the ERPs results might reflect cognitive compensation in elderly.

A84

SLEEP PREFERENTIALLY ENHANCES MEMORY FOR EMOTIONAL COMPONENTS OF SCENES *Jessica Payne[1], Robert Stickgold[2], Kelley Swanberg[1], Elizabeth Kensinger[3]; [1]Harvard University, [2]Harvard Medical School, Beth Israel Medical Center, [3]Boston College* – Central aspects of emotional experiences are often well remembered at the expense of background details. Previous studies have focused on memory after brief delays, but little is known about how these components of emotional memories change over time. Here we investigated the evolution of negative scene memories across 30 minutes, 12 daytime hours spent awake, or 12 nighttime hours including sleep. Negative objects were well remembered at the expense of their backgrounds after 30min. Time spent awake led to forgetting of the entire negative scene, with both objects and their backgrounds decaying at similar rates. Sleep, on the other hand, led to a preservation of negative objects, but not their backgrounds, suggesting that the two components undergo differential processing during sleep. Negative scene memories develop differentially across time delays containing sleep and wake, with the unique brain-state of sleep selectively consolidating those aspects of a memory that are of greatest value to the organism.

A85

EMOTIONAL MODULATION OF THE HIPPOCAMPUS: FUNCTIONAL CONNECTIVITY ANALYSIS REVEALS EARLY AND LATE SPATIOTEMPORAL NETWORK DYNAMICS *Jordan Poppenk[1,2], Debbie Talmi[1,2], Morris Moscovitch[1,2], Adam Anderson[1,2], Anthony McIntosh[1,2]; [1]University of Toronto, [2]Rotman Research Institute* – Researchers have determined that the emotional content in pictures enhances memory encoding. We used the hippocampus as a starting point to explore spatiotemporal network interactions during encoding of materials with high emotional valence. A right posterior hippocampal region that predicted successful memory encoding was identified in an fMRI experiment measuring brain responses to neutral and negatively-valenced pictures (Talmi et al., 2006, Dissertation Abstracts International). Brain volumes from the dataset were transformed to represent the covariance of brain voxels with this hippocampal region. The covariance images were the focus of a novel volume-wise "coupling analysis" of functional network connectivity involving a non-rotated partial least squares contrast of emotional and neutral items using permutation and bootstrap testing (McIntosh & Lobaugh, 2004, Neuroimage). The BOLD response of a network containing occipitotemporal and subcortical regions – which included the amygdala but no frontoparietal cortices – was found to preferentially couple with the hippocampal BOLD response 2-4s after stimulus onset in response to emotional pictures. A second network, dominated by frontoparietal cortices and containing no subcortical regions, preferentially coupled with the hippocampal BOLD response 4-6s after stimulus onset in response to emotional pictures. These findings indicate that initial encoding of emotional information involved interplay amongst the hippocampus, sensory cortices and amygdala, perhaps serving to merge perceptual and emotional information. Later processes engaged the hippocampus and frontoparietal networks, which may reflect higher-order attentional processes needed to integrate memory into cortical networks.

A86

PROSPECTIVE MEMORY AND AGING *Sarah Raskin[1], Hanna Ghaleb[1]; [1]Trinity College* – Prospective memory (ProM) entails retaining intentions and retrieving them at the appropriate time. Proper functioning of ProM is essential to everyday life and the effects of age are of great importance to developmental research. To further investigate the elements of ProM and how it changes with age, this study examined how 30 young adults (mean = 19.7 years) and 30 older adults (mean= 64.1 years) performed on the Memory for Intentions Screening Test (MIST). The test takes into account 7 different possible error types, as well as testing performance in relation to 3 variables: response type (action or verbal), time delay (2 or 15 minute retention intervals) and cue type (event- or time-based). There is also a task to call 24 hours after the end of testing. It was hypothesized that older adults would make more errors than the younger adults overall and that participants would perform better on the shorter delay tasks than longer delay, and better on event-cued tasks than time-cued tasks, and that there would be significant age effects for cue type. Results indicate a clear effect of age on ProM performance. For the most part, both groups showed the same pattern of performance, with older subject showing more impairment in all domains. However, older adults show ProM errors not shown by younger subjects.

A87

ELECTROPHYSIOLOGICAL MEASURES FOR REMEMBERED, IGNORED AND NOVEL WORDS IN A STRATEGIC LEARNING TASK *Mary Kathryn Reagor[1], Mandy Maguire[1]; [1]University of Texas at Dallas* – The goal of this study is to investigate the mechanisms underlying recognition memory for memorized, novel, and actively ignored words. Previous studies have used the Old/New paradigm to demonstrate electrophysiological differences between words that have been seen before and those that have not. What the Old/New task does not test is how we process information that we are supposed to ignore. For this reason, we used the "Strategic Learning" (SL) task. The SL task requires that participants either attend to or ignore words from a list based on a perceptual property (e.g. CAT, mouse). Then, during the testing portion of the task, the participant sees and responds to a list of words that they memorized, words they ignored, and novel words (e.g. Cat, Dog, Mouse). ERPs were used to investigate the differences between attended, ignored and novel words in the recognition portion of the experiment. The attended words elicited a larger early frontal activation than the ignored words or the novel words, $t(84)=5.87$, $p<.001$, and $t(84)=7.01$, $p<.001$, likely due to the depth of encoding. Left parietal showed activation due to remembered and novel words was larger than that of ignored words, $t(322)=3.35$, $p<.001$ and $t(322)=-2.12$, $p=0.035$, possibly due to suppression the ignored words. There was also a right frontal increase in power for attended and ignored words as compared to the novel words, $t(247)=4.89$, $p<.001$ and $t(247)=3.50$, $p<.001$. The increase for the ignored words could be due to the active control of suppression.

A88

DOPAMINE ENHANCES LONG-TERM RECOGNITION MEMORY IN THE AGED *Julia Reinholz[1], Hubertus Lohmann[1], Rasmus Thieme[1], Bianca Dräger[1], Sabine Bruchmann[1], Heike Wersching[1], Caterina Breitenstein[1], Stefan Knecht[1]; [1]University of Muenster, Germany* – The dopaminergic system is crucially involved in learning and memory. In normal aging, a positive relationship was demonstrated between the amount of endogenous dopamine and cognitive functioning (Volkow et al. 1998; Bäckman et al. 2000; Erixon-Lindroth et al. 2005). Accordingly, exogenous administration of dopamine increased motor training (Floel et al. 2005; 2006). Here, we wanted to investigate whether levodopa administration can improve spatial learning and memory in healthy elderly. Twenty subjects (mean age 68 years) completed a randomized double-blind placebo-controlled crossover study. Subjects received three dosages of 100mg levodopa/ 25mg benserazide or placebo within two days, the third dosage 90 minutes prior to testing. Spatial learning was assessed by an associative procedure. Test sessions included a learning phase, a free recall, and a recognition test (immediately and one-hour delayed). For learning, drug effects interacted with randomization order. In the levodopa-first group, there was a trend for practice effects, but no significant difference between conditions. In the placebo-first group, subjects learned significantly better under levodopa. There were no effects on free recall. For the recognition task, a positive effect of levodopa on performance was found in both groups. Overall, performance across the 60-min interval improved under levodopa and worsened under placebo. Our results further underscore dopaminergic neuromodulation of learning and memory. Since the second session was characterized by task familiarity, dopaminergic effects might be greater for non-strategic associative learning. More importantly, levodopa robustly enhanced long-term recognition memory. Our results demonstrate the potential of dopaminergic interventions to improve cognitive functions in healthy aging.

A89

CULTURE INFLUENCES THE EFFECT OF GENERATION ON SOURCE MEMORY *Zachary Rosner[1,2], Qien Yang[3], Kaiping Peng[1,2], Arthur Shimamura[1]; [1]The University of California, Berkeley, [2]Tsinghua University, [3]Beijing University* – Previous research has demonstrated a generation effect; generating responses such as rhymes, antonyms, or semantic associates to stimuli during encoding can facilitate memory for items when compared to simply reading the same stimuli (Slamecka & Graf, 1978). On the other hand, generation can impair memory for source information such as color or font (Mulligan, Lozito & Rosner, 2006). In contrast to these negative generation effects, Marsh (2006) found a positive generation effect for memory for stimulus location. While these effects have been well-studied in the U.S., no one has explored the consistency of these effects across cultures. This study compared item and location memory between American and Chinese participants using an idiom generation task. Participants completed idioms in which one target word was missing. Later, their memories were tested for both the target word (item memory) and the location on the computer screen (source memory). We hypothesized that both populations would show a positive generation effect for item memory. However, differences in the educational systems between the two countries (rote memorization in China vs. active generation in the U.S.) would lead to generation being a more cognitively demanding task for Chinese participants, impairing location memory. As expected, generation benefited item recognition in both populations, demonstrating the superiority of active generation on item recognition regardless of the learning method with which one is familiar. Interestingly, generation facilitated location memory in American participants but impaired it in Chinese participants, suggesting that the effect of generation on source memory varies across cultures.

A90

A REEVALUATION OF LEARNING AND AWARENESS IN THE HEBB DIGITS TASK *Lorenda Rush[1], Samantha Avenengo[1], AnnMarie Hilfiker[1], Geoffrey O'Shea[1]; [1]SUNY-Oneonta* – The Hebb Digits (HD) task has been a useful paradigm for investigating the transfer of serial information from short-term to long-term memory. In the procedure for the HD task, participants are exposed to a total of twenty-four nine digit sequences with one digit sequence repeated every third presentation. In the HD paradigm, enhanced recall of the repeated digit sequence compared to the non-repeated sequences is considered evidence of learning. Previous results have indicated that equivalent learning of the repeated digit sequence occurs irrespective of awareness of sequence repetition (McKelvie, 1987). However, McKelvie (1987) assessed awareness using only a self-report measure. In the present experiment, two forms of awareness of sequence repetition were assessed: Recognition Awareness (e.g., identifying sequences as familiar/unfamiliar) and Recall Awareness (e.g., examining knowledge of item positional information) using the process-dissociation procedure (Jacoby, 1991). Results found learning of the repeated sequence was greater for aware than unaware participants suggesting that information learned via implicit mechanisms may not be as strongly represented in memory compared to information learned via explicit mechanisms. Additionally, unaware participants were found to overestimate certain temporal aspects of the task such as the elapsed time for each trial and the total time engaged in the task. These results are discussed in terms of the role of awareness in directing serial learning as well as how awareness can influence one's subjective perception of time. Finally, the present experiment is important in that it introduces alternative methods for assessing awareness in the HD paradigm.

A91

EXAMINING NEURAL REPETITION EFFECTS ACROSS DIFFERENT VISUAL EXEMPLARS IN FMRI *Mithra Sathishkumar[1], David Schnyer[1]; [1]University of Texas at Austin* – Previous research has revealed that prefrontal (PFC) neural activity reductions associated with repetition priming can be linked to a mechanism of response learning (RL), where an object becomes associated with previous classification decisions. Utilizing different visual exemplars of common objects, it was found that RL did not transfer when one specific exemplar was repeated during learning and then a different exemplar of the same object was presented at test (Schnyer, et. al, 2007). One possibility is that RL is specific to lower level visual representations, while another is that attention can be shifted to higher lexical levels at study and contribute to RL across visual exemplars. In the current work, participants made size judgments while viewing visually presented common objects while fMRI was recorded. In a study phase participants classified (bigger than shoebox) 3 different exemplars of the same object. In a subsequent test phase, objects not seen previously and a 4th exemplar of the objects repeated in the study phase were presented. During this phase, participants either continued with the same decision cue seen during study or inverted their decision orientation (smaller than shoebox). Both behavioral response times and function imaging data reveal repetition related reductions, with neural reductions most evident in portions of left PFC. In contrast to previous work where repetitions were of the same visual exemplar, there were only sparse reductions in ventral temporal cortex and when the decision cue was altered to render previous decisions invalid, neural reductions were significantly reduced across the entire brain.

A92

INVESTIGATING THE ROLE OF EPISODIC MEMORY IN PROBLEM SOLVING FOR YOUNGER AND OLDER ADULTS. *Signy Sheldon[1], Aida Ramos[1], Morris Moscovitch[1,2]; [1]University of Toronto, [2]Rotman Research Institute* – In this study, we tested the hypothesis that episodic memory is essential to solve ill-defined problems by comparing the results of younger and older adults on a measure of social problem solving (MEPS; Platt and Spivak, 1975). The older group, having deficient episodic memory retrieval likely associated with hippocampal deterioration (Driscoll et al., 2003), was expected to perform worse than the younger group on the MEPS. Participants were given the beginnings and endings of ten vignettes that each involved an ill-defined social problem. The task was to describe, in detail, the steps one must take to reach a solution. Much like past memories, older adults provided fewer episodically driven details than younger adults when describing scenarios that led to a solution; however, both groups provided a similar number of semantically-driven details. Although both age groups provided the same number of steps to solve the problems, older adults provided fewer steps that were relevant to the given solution (story end) than younger adults. Importantly, for older adults, the number of relevant steps provided in the stories was significantly correlated with the number of episodic details provided in each story, but not the number of semantic details. Additionally, older adults were also asked to describe five past memories. The number of episodic details in these past memories was significantly correlated with the number of episodic details provided in the means-end problem solving stories. Altogether, this study suggests that solving ill-defined problems depends crucially on recollective processes associated with episodic memory.

A93

INTERNALIZATION OF NEGATIVE AGE PERCEPTIONS IS ASSOCIATED WITH HIGH CORTISOL LEVELS AND DEPRESSIVE SYMPTOMS IN OLDER ADULTS *Shireen Sindi[1,2], N.P.Vasavan Nair[1,2], Ying Kin Ng[1,2], George Scwartz[1,2], Nathalie Wan[1], Sonia Lupien[1,2]; [1]McGill University, [2]Douglas - University Institute in Mental Health* – Recent studies have shown that internalized negative aging stereotypes are associated with declines in physical and cognitive functioning. Few studies however have looked at the impact of internalized age perceptions (AP) on biological markers such as cortisol. The present study investigated the associations between AP and measures of morning and afternoon cortisol levels, scores on the Geriatric Depression Scale (GDS), and scores on subjective memory assessments in older adults aged between 51-85. Bivariate correlations were conducted. The results showed that AP were associated with GDS scores and cortisol levels only when assessing self (internalized) AP related to being useful to society and memory decline. For the item related to being less useful to society, the scores on self perceptions revealed a significant positive correlation with GDS score ($r=0.57$; $p<0.056$) and salivary cortisol levels in the afternoon and evening ($r=0.435$; $p<0.05$). For the item on memory declines, the scores on self-perception revealed a significant positive correlation with subjective complaints of memory as assessed by the Mac-Q ($r=0.604$; $p<0.04$) and Baddeley ($r=0.57$; $p<0.07$) questionnaires, and PM salivary cortisol ($r=0.438$; $p<.05$). There were no significant correlations with cortisol, GDS or subjective memory complaints for the items related to life becoming less enjoyable, and becoming more dependent on others with aging. Thus, older adults that have internalized negative aging perceptions deem their memory worse and show greater depressive symptomatology and elevated pm cortisol levels. Future studies could assess the predictive value of internalization tendencies in older adults on changes in cortisol and mood profiles.

A94

AS TIME GOES BY –HIPPOCAMPAL CONNECTIVITY CHANGES WITH REMOTENESS OF AUTOBIOGRAPHICAL MEMORY RETRIEVAL *Hedvig Soderlund[1], Morris Moscovitch[1,2], Namita Kumar[1], Marina Mandic[1], Brian Levine[1,2]; [1]The Rotman Research Institute, Baycrest Centre, [2]University of Toronto* – Recent and remote autobiographical memories may differentially engage brain structures critical for memory, such as the hippocampus. In studies where recent and remote memories have been matched on vividness and personal importance, the hippocampus has been equally involved in their retrieval. However, recent memories were usually chosen from the last year(s), and possibly already consolidated in a similar fashion as the more remote memories. To determine how age of memory affects the neural correlates of autobiographical retrieval at a finer time scale than previously investigated, we had participants (n=12) recall memories from 1 week, 1 month, 1 year and 10 years back while being scanned with fMRI in an event-related design. Initial pairwise comparisons contrasting retrieval from the different time periods to a control condition (odd/even number judgment) showed significant hippocampal activity only during the three most recent time periods. We investigated time period effects in detail through multivariate spatiotemporal connectivity analyses (seed PLS), which revealed that hippocampal-neocortical interconnectivity during the retrieval time course differed in the most remote time period as compared to the others. These differences in connectivity patterns may underlie the differences in hippocampal activation across time periods. In summary, it appears that recent (up to 1 year) and remote (10 years) memories differ in the way hippocampal-neocortical interactions unfold over time. This may relate to differences in the accessibility or other characteristics of memories across time periods.

A95

EVENT-RELATED FMRI STUDIES OF EPISODIC ENCODING AND RETRIEVAL: A META-ANALYSIS USING ACTIVATION LIKELIHOOD ESTIMATION *Julia Spaniol[1], Patrick S. R. Davidson[2], Alice S. N. Kim[3,4], Cheryl L. Grady[3,4], Morris Moscovitch[3,4]; [1]Ryerson University, [2]University of Alberta, [3]Rotman Research Institute at Baycrest, [4]University of Toronto* – The recent surge in event-related fMRI studies of episodic memory encoding and retrieval has generated a wealth of information about the neural correlates of these processes. However, interpretation of individual studies is limited to particular experimental and fMRI imaging methodologies, and sample sizes are typically small. We submitted activation results from studies on episodic memory in healthy young adults, published between 1998 and 2007, to a voxel-wise quantitative meta-analysis using Activation Likelihood Estimation (Laird et al., 2005). We conducted separate meta-analyses for 3 contrasts of interest: episodic retrieval success (Hit vs. Correct Rejection), episodic encoding success as measured in the subsequent-memory paradigm (subsequent Hit vs. Miss), and subjective recollection (e.g., Remember vs. Know). Concordance maps revealed significant cross-study overlap in spatial activitation patterns for each contrast. Retrieval success was associated with activation in a bilateral fronto-parietal network as well as bilateral caudate and left parahippocampal gyrus. Encoding success was associated with activation in regions including left middle frontal gyrus, right inferior frontal gyrus, right fusiform gyrus, and left superior parietal lobule. Subjective recollection was associated with activation in multiple frontal and parietal regions, as well as left hippocampus and bilateral parahippocampal gyrus. These results identify consistent activation patterns associated with episodic encoding and retrieval, regardless of experimental paradigm, imaging parameters, and testing materials. The concordance maps also provide a standard of comparison for activation patterns observed in future individual studies.

A96

START HARD, LEARN FASTER: A BETTER METHOD FOR LEARNING INFORMATION-INTEGRATION CATEGORIES *Brian Spiering[1], F. Greg Ashby[1]; [1]University of California, Santa Barbara* – In the current study, we assessed three different training methods for learning categories: (1) train the most difficult exemplars first followed by successively easier exemplars, (2) train the easiest exemplars first followed by successively more difficult exemplars, and (3) train all exemplars. Participants first trained on the most difficult exemplars performed better when tested on all exemplars compared to participants who were first trained on the easiest exemplars or trained on all exemplars. The structure of the categories required information from both stimulus dimensions to be integrated at some pre-decisional stage to maximize accuracy, i.e. information-integration. This result suggests that training difficult exemplars first is a better method for learning information-integration categories.

A97

IMPACT OF PRELIMINARY SEMANTIC KNOWLEDGE ON SERIAL REACTION TIME PERFORMANCE *Nicolas Stefaniak[1], Thierry Meulemans[1]; [1]University of Liège* – Many of our abilities reflect some kind of adaptation to the environmental regularities which are learned outside of awareness of what we know. This knowledge learned implicitly includes the acquisition of semantic – e.g., categorical (see, for example, Ashby et al., 1998) – information. The aim of the present study was to further explore the relationship between semantic memory and implicit learning. More specifically, our purpose was to test the hypothesis that a preliminary sequential semantic knowledge might influence performance in an SRT task involving the learning of the same sequential structure. To explore this issue, we administered an SRT task in which the repeating sequence was created on the basis of a phone number well known by the participant. To limit the surface similarity between the to-be-learned sequence and the phone number, the number 1 was added to each figure of the phone number. Reaction times for the phone-number-like sequence were compared to a similar non significant sequence. The results show that reaction times are faster for the significant sequence than for the non significant one; moreover, this effect is implicit, as attested by the incapacity of the participants to notice de relation between this sequence and their phone number. These results confirm (1) that implicit learning and semantic memory are closely related, and (2) that a structured semantic knowledge might influence implicitly the learning of structurally similar semantic information.

A98

SLOW-WAVE SLEEP PREDICTS SPATIAL MEMORY CONSOLIDATION IN HUMANS *Dana Szeles[1], Seth Shipman[1], Heather Breslawski[1], Peter Morgan[2], Robert Astur[1,2]; [1]Olin Neuropsychiatry Research Center, Institute of Living, Hartford, CT, [2]Yale University School of Medicine, New Haven, CT* – Objective: The purpose of this study was to examine the effects of sleep and sleep architecture on performance of a hippocampal-dependent spatial memory navigation task. Subjects: Subjects were ages 18-30, physically healthy, with no DSM diagnoses. Participants were assigned to either the "Sleep" group (N= 17) or the "Wake" group (N=15). "Sleep" participants were trained at night (7-9pm), then 12 hours later following a night of sleep, while "Wake" participants were trained in the morning, then 12 hours later without sleep. For the "Sleep" group, participants wore a NightCap that quantified amount of sleep and relative periods of slow wave sleep (SWS) and REM sleep. Methods: Training consisted of performing a hippocampal-dependent virtual Morris water task whereby participants were in a virtual reality room and were to navigate to a hidden platform in a round pool of water. A "probe" trial was conducted whereby the platform was removed from the pool, and participants were required to mark where the platform should be located. This probe was again administered in session 2. Results: Session 2 probe trial data indicate the Sleep group has a savings in memory of the platform location, whereas the Wake group does not. Moreover, there is a significant positive correlation with the amount of SWS and spatial memory indicating that more SWS results in better consolidation of spatial memory whereas increased REM sleep results in worse spatial memory. These data reveal that SWS is important for consolidation of spatial memory in humans.

A99

CONTEXTUAL PROCESSING IN EPISODIC FUTURE THOUGHT *Karl Szpunar[1], Jason Chan[1], Kathleen McDermott[1]; [1]Washington University in St. Louis* – The present study was designed with the goal of elucidating the relation between remembering (from one's past) and envisioning specific future events (i.e., episodic future thought). Specifically, we tested the hypothesis that regions within posterior cingulate cortex (PCC), parahippocampal cortex (PHC), and superior occipital gyrus (SOG), shown previously to be equivalently active in remembering and episodic future thought, serve to reinstate previously-experienced contexts within which personal future events are envisioned. In two tasks, participants underwent functional MRI while imagining personal past and future events occurring in the context of familiar settings (e.g., apartment). In a third task, participants generated personal future events occurring in the context of unfamiliar settings (e.g., safari). Our data showed that PCC, PHC, and SOG were similarly engaged as participants thought about personal events in familiar contexts, irrespective of temporal direction (past and future). Conversely, PCC, PHC, and SOG exhibited relatively little neural activity as participants generated personal future events in unfamiliar contexts, suggesting that these regions support the contextual architecture associated with personal future events.

A100

ELECTROPHYSIOLOGICAL CORRELATES OF THE INTERACTION BETWEEN EMOTION AND MEMORY CONTROL *Anne-Cécile Treese[1], Mikael Johansson[1], Magnus Lindgren[1]; [1]Lund University, Sweden* – This event-related potentials (ERP) study examined memory control processes for emotional and neutral faces. We used repeated runs of a continuous recognition task to measure healthy participants' ability to distinguish relevant from irrelevant emotional and neutral memories. Participants showed difficulties in the subsequent runs to distinguish relevant from irrelevant memories. Although performance data showed that control mechanisms worked equally efficient for neutral and negative faces, the ERP data suggested that different retrieval monitoring processes contributed to the successful control of neutral and negative memories. Neutral faces in the third run were associated with an early target effect, indicating that targets and distracters had been differentiated. This effect was absent for emotional faces. In a later time window, negative distracters were associated with a sustained posterior positive-going modulation, suggesting that participants relied upon a recall-to-reject strategy to successfully reject irrelevant distracter faces. Strategic retrieval processes were also engaged for positive faces, however not enough diagnostic information was available in order to reject irrelevant memory traces.

A101

DISSOCIATING REGIONAL CHANGES IN PREFRONTAL CORTEX STRUCTURE THAT IMPACT TEMPORAL AND SPATIAL SOURCE MEMORY PERFORMANCE DURING NORMAL AGING. *Luc Valiquette[1], Sidney Pinto[1], Rafael Langay[1], Jens Pruessner[1], Maria Natasha Rajah[1]; [1]McGill University* – With age, there is reduction of the ability to recollect spatial and temporal contextual details pertaining to past events. Recent fMRI studies indicate that the prefrontal cortex (PFC) is important for context memory (CM) retrieval. Moreover, patients with PFC damage exhibit deficits in recollecting contextual details. This suggests that age-related reductions in CM may be due to changes in PFC function. This is supported by studies showing age-related volume reductions in PFC. However, it remains unclear if CM retrieval decrements in the elderly are correlated to similar or different region-specific changes in PFC volumes. To test this, we conducted an fMRI study in which 15 young and 15 elderly adults performed face recognition, temporal source and spatial source retrieval tasks, within the same session. Furthermore, semi-automatic mapping of the PFC was done via an automated template based package allowing non-linear mapping across the whole brain (ANIMAL), and manual correction. Grey matter volumes were calculated in both hemispheres for the anterior PFC, dorsolateral PFC and ventrolateral PFC regions of interests (ROIs), using previously published landmarks. Group (2) X Task (3) ANOVA of the behavioral accuracy and reaction time (RT) data indicated that elderly performed consistently worse then young subjects on the CM tasks for accuracy and RT. Moreover, there was a difference in RT between groups for recognition, but not for accuracy. Volumetric analysis showed that elderly exhibited smaller PFC grey matter volumes; results from Group (2) X ROIs (6) ANOVA will be presented, as will results from ROI volume-behavior correlations

A102

NEURAL CORRELATES OF AGE-RELATED CHANGES IN ASSOCIATIVE LEARNING *Jorien van Paasschen[1], Linda Clare[1], Robert Woods[1], David Linden[1]; [1]School of Psychology, Bangor University* – Although both young and older adults perform worse on associative compared to item memory tasks, this discrepancy in performance is disproportionately larger in older people. Some studies proposed that alterations in medial temporal lobe areas play a key role in associative memory decline in aging, while others suggested that changes in the fronto-striatal system are the main cause for this deterioration. We investigated age-related functional differences in intentional encoding of associations compared to single items with functional magnetic resonance imaging (fMRI).

Using an event-related design, 12 young and 12 healthy older adults were scanned while they learned face-name associations (AL condition) and single faces and names (SI condition). Task performance for items and associations was matched within groups. Both groups showed higher activation in hippocampal and prefrontal regions for the AL condition compared to the SI condition. When activation for encoding of associations was contrasted between the two age groups, young adults showed higher activation in both prefrontal and medial temporal lobe regions. This suggests that during associative learning, either one of these areas is under-recruited in the older group and that this affects its input to connected regions, or that both of these areas are under-recruited by the older group. However, when only activation during successful trials for associations were compared between older and young adults, we found no significant differences between the groups, which implies that during successful formation of an association, both groups use a very similar network of areas more or less to the same extent.

A103

NEUROPLASTICITY-BASED COGNITIVE TRAINING IMPROVES SELF-REFERENTIAL SOURCE MEMORY IN SCHIZOPHRENIA PATIENTS: BEHAVIORAL AND FMRI ASSESSMENTS *Sophia Vinogradov[1], Karuna Subramaniam[1,2], Stephanie Aldebot[1], Arul Thangavel[1], Adelaide Hearst[1], Melissa Fisher[1], Tracy Luks[1], Gregory V. Simpson[1]; [1]UCSF, [2]Northwestern University* – Previous research has shown that schizophrenia patients, compared to healthy controls (HCs), are impaired at identifying themselves as the source of self-generated items, and show relatively decreased activation within dMPFC compared to when HCs engage in this process (Vinogradov et al., 1997; 2006). In the present study, we investigated whether this deficit is amenable to a behavioral intervention. Sixteen patients and 8 HCs underwent an fMRI source-memory task at baseline. Eight patients were then randomly assigned to 80 hours of computerized targeted cognitive training (TCT) exercises that focused on auditory and visual processing, facial affect recognition, and mentalizing tasks (PositScience). The other eight patients were assigned to a control condition of 80 hours of graphic-based computer games (CGs). All subjects repeated the task after the 16-week intervention period. Before scanning, subjects were presented with sentences, where the final word was either supplied by the experimenter, or was left blank for subjects to fill in themselves. During scanning, subjects were presented with words, and decided whether they were experimenter-presented or self-generated. BOLD fMRI activity was measured on a 3T GE scanner (EPI; TR=1sec, 14 slices) before and after intervention. Images were analyzed using SPM2. At baseline, patients were significantly more impaired on each category within the source-memory task, relative to controls. Preliminary results regarding the changes in performance relative to baseline indicate that after training, TCTs correctly identified 65% more externally-generated items; 55% more self-generated items; and made 69% fewer errors at incorrectly attributing external items as self-generated, compared to CGs.

A104

THE INFLUENCE OF AGING AND SCHIZOPHRENIA ON REWARD-BASED STIMULUS-ASSOCIATION LEARNING *Julia A. Weiler[1,2,3], Christian Bellebaum[1], Martin Brüne[4], Georg Juckel[4], Irene Daum[1]; [1]Institute of Cognitive Neuroscience, Ruhr-University Bochum, Germany, [2]International Graduate School of Neuroscience, Ruhr-University Bochum, Germany, [3]Ruhr-University Research School, Bochum, Germany, [4]LWL Clinic Bochum, Germany* – Reward-based associative learning is mediated by a distributed network of dopamine dependent brain regions. Healthy aging and schizophrenia lead to changes in key regions of this system, the striatum and the prefrontal cortex, which may adversely affect the ability to use reward information for the guidance of behavior. In the present study, different components of reward learning, such as acquisition, reversal, effects of reward magnitude, and transfer of learning, were investigated in healthy young, healthy old, and schizophrenic subjects. All participants completed two probabilistic reward-based stimulus association learning tasks. Compared to young subjects, older participants showed poorer overall acquisition, impaired reversal learning, as well as deficits in transfer learning. When only those subjects who showed evidence of significant learning were considered, younger subjects showed significant learning irrespective of reward magnitude, while learning in older subjects only reached significance for high reward magnitudes. Schizophrenic subjects in comparison to healthy matched controls exhibited poorer overall performance during all experimental phases leading to a profound impairment also during transfer learning phases. Additionally, significantly less schizophrenic subjects could be classified as learners. However, if only those patients who showed evidence of significant learning were considered, performance differences between groups reduced to impairments in reversal learning.

A105

THE USE OF PERCEPTUAL FLUENCY IN PATIENTS WITH ALZHEIMER DISEASE: THE ROLE OF EXPECTATIONS *Sylvie Willems[1], Martial Van der Linden[1,2]; [1]University of Liège, [2]University of Geneva* – We investigated whether the use of perceptual fluency as recognition cue by patients with Alzheimer disease (AD) depends on whether fluency is perceived as relevant to the recognition decision. In normal subjects, enhanced perceptual fluency increased positive recognition responses when study and test stimuli were presented in the same sensory modality but not when stimuli were presented in different modalities (Westerman et al., J. of Mem. & Lang., 47, 2002). These results suggest that the use of perceptual fluency as a heuristic in recognition memory depends on the correspondence between study and test modalities and thus on the perceived usefulness of fluency. We investigated this change of sensory modality between study and test phases in 16 AD patients and 16 matched normal controls by using a verbal recognition task. The perceptual fluency of recognition test items was enhanced by briefly presenting a prime that matched the subsequent test item. We observed that changes in modality attenuated the contribution of fluency to the recognition decision in both subjects groups. In addition, we noted a positive correlation between fluency use and metamemory self-evaluation. These results suggest that the fluency heuristic is subject to metacognitive control in AD patients, exactly in the same way as normal subject, since patients' attributions of perceptual fluency depend on expectations about the relevance of fluency as memory cue.

A106

DEVELOPMENTAL DIFFERENCES IN EPISODIC AND SEMANTIC AUTOBIOGRAPHICAL MEMORY *Karen A. Willoughby[1,2], Erin D. Sheard[1], Sarah M. Wheeler[1,2], Mary Desrocher[3], Joanne Rovet[1,2]; [1]Hospital for Sick Children, [2]University of Toronto, [3]York University* – Autobiographical memory (AM), the recollection of past life events, includes episodic and semantic components with distinct neuroanatomical underpinnings. Evidence suggests that episodic AM predominantly engages the left hippocampus and medial prefrontal cortex, while semantic AM involves a more distributed frontal and temporal neural network. Given that the prefrontal cortex and hippocampus mature later than surrounding cortex and continue to develop into adolescence, episodic and semantic AM may have different developmental trajectories. Despite a growing literature on the emergence of AM in children, no study has examined AM development in adolescence. The aim of the present study was to specifically examine AM development in 180 8-16 year-olds using the Children's Autobiographical Memory Interview (CAMI; developed from the Autobiographical Interview for Adults). All participants were asked to recall two autobiographical events, each of which occurred on a single day more than one month earlier. After the initial description of each event, participants answered a series of structured questions eliciting additional event-related details. Interviews were scored according to a standardized system for categorizing episodic and semantic AM details. Regression analyses revealed that age was a significant predictor of episodic AM: older participants reported more episodic details than younger participants. In contrast, no age-related differences in semantic AM were found.

These results indicate that only episodic AM develops into adolescence, possibly due to late maturation of requisite brain regions. This study provides critical insight into current understanding of AM development and the distinctions between episodic and semantic memory in children and adolescents.

A107

LOOKING FOR MEANING: USING EYE-MOVEMENTS TO CHARACTERIZE THE ORGANIZATION OF SEMANTIC MEMORY *Eiling Yee[1], Stacy Huffstetler[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania* – Many theories of semantic memory describe the representation of object concepts as patterns distributed across semantic features, such that objects sharing features have overlapping representations. We used eye movements to explore whether activating one object's concept leads to the activation of objects that are similar in function, shape or color. Participants were presented with a multi-picture display and instructed to click on the picture that corresponded to a heard word. In critical trials the conceptual representation of one of the displayed objects (the "related" object) was similar to that of the target object in function, shape or color (according to participants' ratings). Importantly, similarity between related objects was not apparent in the visual depictions (e.g., for the target "frisbee", the shape-related object was a triangular slice of pizza; for the target "frog", the color-related object was a grayscale image of peas). By eliminating the possibility of visual confusion, preferential fixations on the related object can be attributed to the overlap in conceptual representations on the features of interest. We observed relatedness effects for function and shape (with shape information becoming available earlier than function information). For color, we found no overall relatedness effect when all pictures within a display were presented in grayscale. However, when each display contained color as well as grayscale pictures, there was a positive correlation between degree of color similarity and fixations on the (grayscale) color-related object. These findings indicate that semantic memory is organized with respect to function, shape and to a small degree, color.

Perceptual processes: Low-level vision

A108

A DIFFERENTIAL ENCODING ACCOUNT OF HEMISPHERIC ASYMMETRY IN VISUAL PERCEPTION *Janet Hui-wen Hsiao[1], Reza Shahbazi[1], Garrison Cottrell[1]; [1]University of California, San Diego* – Hemispheric asymmetries in the perception of local and global features have been consistently reported (e.g., Sergent, 1982): there is an advantage for responses to global features in the left visual field/right hemisphere (RH) and an advantage for responses to local features in the right visual field/left hemisphere (LH). It has been proposed that this asymmetry originates from differential frequency bias in the two hemispheres (Double Filtering by Frequency theory, Ivry & Robertson, 1998). Nevertheless, there is little evidence supporting hemispheric specialization for particular frequency ranges (e.g., Peterzell, Harvey, & Hardyck, 1989), or differential frequency tuning in the neurons in the two hemispheres. Here we test the hypothesis that this hemispheric asymmetry takes place at the encoding stage beyond the sensory level. We use two autoencoder networks with differential connectivity configurations as the way to develop differential encoding in the two hemispheres, to reflect the anatomical evidence that there is more interconnectivity among neighboring cortical columns of the RH than the LH (Hutsler & Galuske, 2003): the RH network has a narrower connectivity distribution to allow more connectivity among neighboring nodes compared with the LH network. We then use a perceptron network to examine how good the two encoding systems are in terms of detecting local and global features. We show that this differential encoding mechanism has a better contact with human data than the model based on differential frequency bias, and thus is a more anatomically realistic and cognitively plausible model in accounting for the hemispheric asymmetry in visual perception.

A109

DEVELOPING ENDOPHENOTYPIC MARKERS FOR SCHIZOPHRENIA: TESTING A BRIEF MONOCULAR DEPRIVATION PARADIGM *Victoria Leavitt[1,2], Sherlyn Yeap[3], Jogin Thakore[3], Sophie Molholm[1,2], John Foxe[1,2,3]; [1]Nathan Kline Institute, [2]The Graduate Center of The City University of New York, [3]St. Vincent's Psychiatric Hospital, Dublin, Ireland* – Visual sensory processing deficits in patients with schizophrenia have been well established in the literature. A recent electroencephalographic (EEG) study from our group found the visual P1 to be an endophenotypic marker for schizophrenia, with first-degree relatives showing significant attenuation of the component. However, in this study there was inter-individual variance resulting in substantial overlap in P1 amplitudes between controls and patients. We sought to increase the sensitivity of our measure by tapping into a second order effect that would "tax" the system further, enabling us to separate the distributions of patients from controls. We created a paradigm that would challenge the visual system such that patients would show greater relative decrements in their visual evoked potentials (VEPs) than controls. We recorded VEPs from twenty patients and ten controls as they viewed visual stimuli with both eyes for 9 minutes, then we administered an eye patch and recorded VEPs from each single eye as participants viewed visual stimuli monocularly for 9 minutes with each eye. Brief monocular deprivation in controls resulted in robust VEPs from the non-occluded eye. For the visual P1 in controls, an ANOVA found a significant interaction for group (patient vs. controls) x condition (both eyes vs. sum of eyes), $p=0.029$. The compensatory mechanism that allows healthy individuals to generate robust VEPs monocularly does not appear to be effectively activated in patients with schizophrenia. This VEP challenge test may provide us with an endophenotypic marker for the disease.

A110

PRESTIMULUS EEG ALPHA ACTIVITY REFLECTS TEMPORAL EXPECTANCY *Byoung-Kyong Min[1,2], Jae-Jin Kim[1,2], Hae-Jeong Park[1,2]; [1]College of Medicine, Yonsei University, Seoul, Korea, [2]Institute of Radiological Science, College of Medicine, Yonsei University, Seoul, Korea* – As prestimulus EEG alpha activity has recently been considered as conveying prestimulus top-down information, in the present study we further investigated whether prestimulus alpha activity reflects temporal expectancy of upcoming stimulation. EEG was recorded from 12 subjects performing a color and a shape discrimination task. We compared prestimulus EEG alpha activity and contingent negative variation (CNV) under two inter-stimulus interval (ISI) conditions: a constant ISI (1500 ms) vs. variable ISIs ranging from 1500 to 2500 ms. For investigating the amplitude and time-course of oscillatory activity, the EEG signals were convolved with Morlet wavelets. Although we did not observe significant differences in the CNV between the two ISI conditions, we found significantly higher prestimulus alpha activity in the constant ISI condition than the variable ISI condition, particularly in the color task (Wilcoxon test: $p<0.01$). We proposed that prestimulus alpha activity could reflect temporal expectancy more elaborately than CNV. Since the constant ISI condition yielded higher prestimulus alpha activity than the variable ISI condition, higher prestimulus alpha activity may reflect higher expectancy of upcoming stimuli. We supposed that the considerable inhibition of more salient color feature in the shape task might interfere in efficacy of expectation, probably resulting in no significant differences in the shape task. All the observations corroborate that prestimulus ongoing alpha activity reflects a prestimulus top-down mental state.

A111

LIGHT DETECTION TRAINING IMPROVES TEMPORAL-INFORMATION PROCESSING IN CEREBRAL VISUAL FIELD DEFECTS *Dorothe A. Poggel[1,2], Bernhard Treutwein[3], Bernhard A. Sabel[4], Hans Strasburger[1,5]; [1]Generation Research Program (GRP), Ludwig-*

Maximilian University Munich, Germany, [2]Center for Innovative Visual Rehabilitation, Boston VA Medical Center, [3]IuK, Ludwig-Maximilian University Munich, Germany, [4]Institute of Medical Psychology, Otto-von-Guericke University Magdeburg, Germany, [5]University of Göttingen, Germany – Cerebral visual system lesions lead to visual field loss in perimetry, i.e. partial blindness towards light detection. Many patients additionally show impaired temporal-information processing, even in perimetrically intact regions (Poggel et al., CNS 2006). We investigated whether a computer-based training designed to restore light detection would also have an effect on dynamic visual field properties. Before and after a three months period of Vision Restoration Therapy (VRT, Boca Raton, FL), nine patients with cerebral visual field loss underwent visual field assessment with three techniques: standard perimetry, double-pulse resolution (DPR, minimum perceivable duration of temporal gap between two light pulses), and simple reaction times (RT). Patient performance was compared to normative values (Poggel & Strasburger, 2004). Intact visual field size increased over the training period. DPR and RT remained unchanged in the intact visual field, but improved significantly in areas of residual vision where light detection improvement was also most pronounced. Effect size was graded with the level of intactness of the visual field region. Temporal information processing improved relative to pre-training baseline, but only in some patients reached normal levels after training. We thus observed a generalization of training effects from light detection to dynamic visual functions. Study supported by a grant of the Deutsche Forschungsgemeinschaft (Str 354/3-1) to HS.

A112

RICA: A COMPUTATIONAL MODEL THAT EXPLORES THE FUNCTIONAL ROLES OF HIGHER VISUAL LAYERS *Honghao Shan[1], Garrison Cottrell[1]; [1]University of California, San Diego* – The efficient coding hypothesis (Barlow, 1961) has been used to explain the functional role of low-level vision. When ICA (Independent Component Analysis), a linear implementation of the efficient coding hypothesis, is applied to natural image patches, the resulting basis functions resemble V1 simple cells' receptive fields (Olshausen and Field, 1996; Bell and Sejnowski, 1997). Then what are the functional roles of higher layers in the human visual pathway? Since the anatomical structures of higher visual layers are similar to that of the primary visual cortex, it is likely that the higher layers are also working under similar computational principles as V1. We take the assumption that higher layers are also working under the efficient coding principle, and derive a hierarchical statistical model, the recursive ICA (RICA), to capture nonlinear statistical structure of natural images (Shan, Zhang, and Cottrell, 2006). In this model, the linear efficient coding model is at work on each layer and coordinate-wise nonlinear activation functions transform the outputs of a lower layer to the inputs of the higher layer. When RICA is applied to natural images, the learned first layer basis functions resemble V1 simple cells' receptive fields. Higher layers of RICA capture more complex visual structures. Specifically, some of the second layer basis functions encode the combinations of bar/edge orientations. This result qualitatively matches the neurophysiological observations of monkey's V2 neurons (Anzai, Peng, and Van Essen, 2007). Also, the learned RICA features outperform most state-of-art computer vision techniques when applied for pattern recognition tasks.

A113

EVENT RELATED POTENTIALS AND VISUAL SENSORY GATING IN A FLASH TRAIN PARADIGM *Lucy J. Troup[1], Carly A. Yadon[1], Michael A. Pitts[2], Jessa S. Hafer-Zdral[3]; [1]Colorado State University, Fort Collins, Colorado, [2]University of California San Diego, California, [3]Reed College, Portland, Oregon* – Auditory sensory gating is a well documented phenomenon in which pairs of brief identical stimuli are presented, and the neural response to the second stimulus is reduced relative to the first. Analogous processes in the visual domain have not yet been identified. Further, the distinction between sensory gating, habituation, and sensory refractory periods remains unclear. In the current study, participants viewed visual stimulus trains (1200 msec inter-stimulus intervals) consisting of 5 identical flashes (grey; 12 msec duration), followed by a sixth deviant flash (green; 80 msec duration). All stimuli including the deviant were isoluminant. ERPs were recorded using a high-density electrode configuration to allow for potential source analyses. ERPs for flashes 2-5 showed no differences anywhere on the scalp. Early amplitude differences (less than 150 msec) were found at occipital-parietal scalp locations between flash 1 and all other flashes including the sixth deviant stimulus. Differences between the sixth deviant stimulus and the first 5 stimuli did not occur until after 200 msec. A possible interpretation of these results is that visual sensory gating may exist, albeit later in processing than its auditory counterpart. Habituation could not fully account for the pattern of results. Alternatively, sensory refractory periods may explain the amplitude differences observed in this study as well as in previous auditory gating experiments.

A114

ABNORMAL SPATIAL FREQUENCY PROCESSING IN 3- AND 4-YEAR-OLDS WITH AUTISM SPECTRUM DISORDER (ASD) *Petra Vlamings[1], Chantal Kemner[1,2]; [1]University of Maastricht, [2]University of Utrecht* – Besides problems in social interaction, people with ASD have an atypical visual processing style which is more detail oriented than in typical subjects (Happe and Frith, 2006). Any input to the visual system consists of luminance variations at various frequencies across space. Low spatial frequencies (LSF) capture large-scale variations (coarse information) whereas high spatial frequencies (HSF) represent small-scale variations (fine information). Several studies indicated abnormal spatial frequency (SF) processing in ASD (Boeschoten et al., 2007). In the present study we investigate whether abnormal SF processing is already present in ASD in early childhood and how this is reflected in the brain. Nineteen ASD children (3/4 years) and 21 age matched controls were presented with 90 HSF and 90 LSF gratings (duration: 500 ms; ISI: 500-900 ms), during which EEG was recorded. We predicted faster or elevated processing of HSF in ASD. No latency differences between ASD and controls were found for the P1 (positivity at 100 ms) and N2 (negativity at 200 ms) at OZ (electrode above visual cortex). Children with ASD showed higher P1 amplitudes for HSF than for LSF, whereas this was not significant in controls. Amplitude differences at the P1 are typically linked to the involvement of different brain areas for HSF and LSF in adults (Ossenblok & Spekreijse, 1990).The present data suggest that the visual system might be more differentiated and mature at an early age in ASD, as the pattern of larger P1 amplitudes to HSF than LSF gratings is also seen in healthy adults.

Perceptual processes: Other

A115

THERMAL STIMULATION AS A PROBE TO INTEROCEPTIVE CORTEX FUNCTION *Craig Bennett[1], Daniel Ansari[2], Abigail Baird[3]; [1]Dartmouth College, [2]University of Western Ontario, [3]Vassar College* – It has been hypothesized that there are distinct neural systems for the processing of internal, interoceptive stimuli (originating within the body) and exteroceptive stimuli (originating from outside the body). The anterior insula, especially on the right side, has been highlighted as a region where interoceptive information is integrated with higher cognitive processes. The goal of this experiment was to determine the feasibility of using thermal stimulation to investigate the function of interoceptive cortex. Twenty adult subjects completed the functional MRI experiment. During the task participants were asked to make magnitude judgments between their left and right hands. During the thermal condition participants made decisions based on varying levels of temperature per hand. During the tactile condition participants made decisions based on a varying number of pegs in contact with the hands. Participants responded with the hand that had the warmer temperature or that had the greatest number of pegs in contact. Areas of intraparietal sulcus (IPS) and lateral premotor cortex were commonly activated between the two modalities. The tactile condition differentially activated areas of the somatosensory system, including the primary (S1) and secondary (S2) areas of somatosensory cortex. The thermal condition differentially activated areas of interoceptive cortex, including areas of left mid insula and right anterior insula. The results of this study add empirical support to the hypothesis that thermal stimuli tap into the resources of the interoceptive system. It also demonstrates the feasibility of using this methodology in future studies examining the representation and perception of internal state.

A116

LEARNING TO BECOME AN EXPERT: REINFORCEMENT LEARNING AND THE ACQUISITION OF PERCEPTUAL EXPERTISE *Olav Krigolson[1], Lara Pierce[2], Clay Holroyd[2], Jim Tanaka[2]; [1]University of British Columbia, [2]University of Victoria* – Although we know that birdwatchers, dog judges and other types of perceptual experts acquire their skills through systematic training and years of practice, the neural learning mechanisms that underlie the acquisition of perceptual expertise are poorly understood. More specifically, while a growing body of research has demonstrated enhanced neural responses when experts view objects from their domain of expertise, how these neural changes occur is not well understood. To help resolve this question, we recorded event-related brain potentials while participants performed a category verification task in which they learned to indentify randomly generated blob stimuli. Our results demonstrate increases in ERP components associated with object recognition (the N250) and internal error evaluation (the response error-related negativity) for participants who demonstrated performance improvements at the experimental task. Changes in the amplitudes of the N250 and response error-related negativity were not observed for participants who did not improve their performance of the task. Importantly, our results suggest that a reinforcement learning system involving anterior cingulate cortex and the basal ganglia underlies the acquisition of perceptual expertise.

A117

UNFORCED ERROR: SYSTEMATIC MISLOCALIZATION OF TENNIS BALLS BY PROFESSIONAL REFEREES. *Elizabeth Louie[1], Nicole Wurnitsch[1], Byron Hontiveros[1], David Whitney[1]; [1]University of California, Davis* – It is well known that moving objects appear shifted in the direction of their motion. Here, we investigated whether referees misperceive bouncing tennis balls as being shifted in the direction of the ball's motion. We examined sixteen recorded matches (videos as well as replays using the "PointTracker" online tool) from the 2007 Wimbledon series and recorded balls that bounced near any line boundary. Incorrect referee judgments were divided into two categories: the landing position of the ball was either misperceived as being shifted "consistent" with the direction of motion or "opposite" the direction of motion. Thus, a leftward moving ball that is perceived to land on the left side of a line is a "consistent" judgment; a leftward moving ball that is perceived to land on the right side of a line is an "opposite" judgment. If an object's direction of motion influences its perceived landing position, then we should expect to find more "consistent" calls rather than "opposite" calls. Indeed, we found a "consistent" to "opposite" ratio of 22 to 3. In a follow-up psychophysical experiment, we confirmed that a moving object's bounce is mislocalized as being shifted in the direction of motion. This perceptual error depended on the bounce angle and speed of the moving object and the fixation of the subject. The results suggest that motion-induced perceptual errors occur in professional sports, and the asymmetries in these errors can be exploited by players who are given opportunities to challenge referee calls.

A118

HEMISPHERIC DIFFERENCES IN FACE PROCESSING: EVIDENCE FROM DIVIDED VISUAL-FIELD PRIMING *Elias Mouchlianitis[1], Rik Henson[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK* – Our previous studies on repetition priming of faces (Mouchlianitis & Henson, in prep) found larger priming effects when a central prime was followed by a probe lateralised to the right visual-field (left-hemisphere, LH) than a probe lateralised to the left visual-field (RH). Bourne & Hole (2006), however, found greater priming for the RH than LH when using lateralised primes followed by a central probe. We proposed that both these findings can be explained by the RH advantage in face-processing, which causes the RH advantage at encoding found by Bourne & Hall, but a LH advantage following (central) face encoding, owing to the LH benefiting from priming to a greater extent than the RH, in which face processing may already be close to optimal. This proposal was supported by priming effects in a number of behavioural experiments that explicitly crossed the lateralisation of the prime and the lateralisation of the probe. These experiments were extended using fMRI, with the addition of non-face control stimuli. Despite main effects of visual-field and of stimulus-type (face vs house), there was no evidence for an interaction, in either left or right FFA (and despite overall greater activity in the right than left FFA). In other words, the face-house difference in FFA did not appear greater for left than right visual field presentations. Moreover, no priming effects reached significance. This lack of reliable modulation of face-processing by visual hemifield may reflect the limited temporal resolution of fMRI, which has prompted subsequent MEG versions of the experiments.

A119

IMAGING UNSUPERVISED PERCEPTUAL LEARNING *Matthew Mundy[1], Robert Honey[1], Richard Wise[2], Dominic Dwyer[1]; [1]School of Psychology, Cardiff University, [2]Cardiff University Brain Research Imaging Centre* – Unsupervised exposure to a pair of highly similar stimuli can improve subsequent discrimination between them. This is true with faces (e.g. Mundy et al., 2007), random chequerboards and scenes as the test stimuli. Of particular importance, the schedule of exposure modulates this effect. Alternating two stimuli (e.g. AX, BX, AX, BX) during exposure produces larger improvements in discrimination than an equivalent amount of blocked presentation of the two stimuli (e.g. AX, AX… BX, BX…). This schedule effect is the same regardless of the nature of the stimuli used, which implies that the cognitive mechanism for perceptual learning is similar in all cases. However, it could be suggested that different neural mechanisms may be recruited in tasks using different categories of stimuli. For instance, a recent paper (Graham et al., 2006) reported that medial temporal lobe structures may be selectively involved in perceptual learning with non-face stimuli. In this event-related fMRI study participants were given intermixed and blocked exposure to confusable face-pair and chequerboard-pair stimuli and subsequently were asked to perform same/different judgements as an index of perceptual learning. Areas of cortex recruited during perceptual learning were identified by contrasting activation associated with discrimination following intermixed presentation with that following blocked presentation. We present evidence for both stimulus-invariant (e.g. primary visual cortex) and stimulus specific (e.g. fusiform face area) regions of activation following perceptual learning. There is also evidence to indicate that the stimulus invariant activation is modulated by the quality of perceptual learning (see also Mukai et al., 2007).

A120

MEG RESPONSE TO VISUAL IMPRESSION OF SOCIAL INTERACTION THROUGH MOTION *Marina Pavlova[1], Michele Guerreschi[1,2], Werner Lutzenberger[3], Alexander Sokolov[4], Ingeborg Krägeloh-Mann[1]; [1]Children's Hospital of University of Tübingen Medical School, Tübingen, Germany, [2]University of Padova, Italy, [3]MEG-Center, University of Tübingen Medical School, Germany, [4]CNL, University of Ulm Medical School, Ulm, Germany* – Perception of intentions and dispositions of others is an essential ingredient of adaptive daily-life social behavior and non-verbal communication. Visual information revealed through motion of living beings allows for veridical estimation of social properties of agents involved in these events. Recent brain imaging and lesional data point to several brain regions involved in visual perception of social interaction through motion. However, temporal interrelations between regions are still unknown. Successful visual perception of social interaction through motion depends on intact communication between different brain regions. Here we assess induced gamma oscillatory MEG response to visual social interaction of two abstract geometric shapes revealed through their motion in Heider-and-Simmel-like animations. In healthy adults, enhanced peak of gamma activity (62 Hz) was observed at 1 s from the stimulus onset over the right temporo-parietal junctions. Two further enhancements in gamma oscillatory response of lower frequency of 44 HZ occurred at 1.4 s over the prefrontal and posterior temporal cortex in the right hemisphere. Consequent peaks of 44 Hz were found over the left temporo-parietal and right temporal cortices. The findings uncover the cortical network involved in visual processing of social interaction through motion. For the first time, the data show that gamma oscillatory cortical activity underlies visual processing of social interaction.

A121

SUBJECTIVE SHORTENING IN DURATION AND LENGTH DISCRIMINATION *Frances Rauscher[1], Sean Hinton[2], Karin Reinke[1]; [1]University of Wisconsin-Oshkosh, [2]Abbott Laboratories* – This study examined how perception of the duration of an event is systematically distorted as a function of how long the event duration is stored in working memory, a phenomenon known as subjective shortening [see Wearden, Parry, and Stamp (2002)]. The current experiment tested discrimination of 1000 ms (duration) and 100 mm (length) standard stimuli against six logarithmically arrayed comparison stimuli at three different delay intervals (1, 3, and 9 seconds). Based on the findings of Wearden et al., one would expect to observe in the present study that increasing delay interval improves performance on longer comparison intervals while impairing performance on shorter ones and that there are no delay-related changes in line-discrimination performance. Our preliminary data (N = 19) that are most comparable to Wearden et al.'s show some evidence of the first pattern. However, further evidence of subjective shortening in our design would also be manifested by the stimulus just slightly shorter than the standard being the least accurate. Instead, our data show the slightly longer stimulus being least accurate. In addition, over the range of stimuli used by Wearden et al., we find a consistent pattern of monotonically decreasing accuracy with increasing delay interval for the length-discrimination task, a finding that also runs contrary to a subjective-shortening account. A variety of differences exist between the two studies that might account for these discrepant results. More research will be required to identify the specific features of our respective designs that can explain these apparently contradictory findings.

A122

EFFICACY OF BILATERAL RTMS OVER TEMPORO-PARIETAL CORTEX IN REDUCING AUDITORY HALLUCINATIONS IN SCHIZOPHRENIA *A. Vercammen[1], H. Knegtering[2], J. A. Jenner[2], C. Slooff[3], H. Westenbroek[2], R. Bruggeman[2], A. Aleman[1]; [1]BCN NeuroImaging Center, University Medical Center Groningen, The Netherlands, [2]University Medical Center Groningen, The Netherlands, [3]Mental Health Center Drenthe, Assen, The Netherlands* – Background: Low frequency transcranial magnetic stimulation (rTMS) of the left temporo-parietal area has been proposed as a treatment for auditory hallucinations in schizophrenia. Recent neuroimaging studies have indicated bilateral temporal cortex involvement. We hypothesized that bilateral stimulation could improve effectiveness of rTMS treatment. We present preliminary data on a small sample from a sham-controlled randomized trial. Methods: rTMS stimulation was conducted on left (n=6) or bilateral (n=6) temporo-parietal sites in 12 sessions of 20 minutes at 90% of the motor threshold. Placebo treatment (n=5) was achieved using a sham-coil. Outcome measures were recorded at four timepoints: baseline, mid-treatment, post-treatment and one week follow-up. Measurements consisted of a clinical interview (Positive and Negative Syndrome Scale; PANSS) and self-report questionnaires, including the Auditory Hallucination Rating Scale (AHRS), and the Positive and Negative Affect Scale (PANAS). Results: We performed separate repeated measure analyses, comparing bilateral and left groups with the placebo group. We observed a time by group interaction on the frequency item of the AHRS, indicating a decrease in the bilateral [$F(3,15)=4.18$; $p<.05$], but not the left group [$p>.10$], compared to the placebo group. The bilateral, but not the left group showed a decrease on the negative PANAS subscale, compared to the placebo group. This effect was observed mid-treatment and post-treatment [$F(1,9)=5.67$; $p<.05$; $F(1,9)=5.74$; $p<.05$], but failed to reach significance at follow-up. PANSS subscales revealed no significant effects. Conclusions: Preliminary results point to increased effectiveness of bilateral rTMS, in terms of a reduction of hallucination frequency and negative emotional responsiveness.

A123

FAST FORWARD: REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION OF PARIETAL CORTEX DISRUPTS TEMPORAL PERCEPTION *Martin Wiener[1], Roy Hamilton[1], Matthew Matell[2], H.B. Coslett[1]; [1]University of Pennsylvania, [2]Villanova University* – Although the perception of time is a fundamental element of human cognition, much debate exists regarding its neural instantiation. Recent work (Lewis & Miall, 2006) suggests that a right fronto-parietal network is involved in temporal perception. In order to further elucidate the properties of this network, we administered brief trains of repetitive transcranial magnetic stimulation (rTMS) at a frequency of 10hz to the supramarginal gyrus of the left and right parietal cortex during a temporal discrimination task. Subjects were required to judge whether a comparison visual stimulus was displayed for a longer or shorter duration than a standard visual stimulus (600ms). Subjects received rTMS at the onset of presentation of the standard visual stimulus on half of the trials in a session. When compared to non-rTMS trials, subjects demonstrated a significant change in accuracy on rTMS trials, more so for the right supramarginal gyrus than for the left. The direction of the effects across comparison conditions suggests that rTMS increased the perceived duration of the standard. These results support the notion of a network for temporal perception that preferentially employs the right-hemisphere and demonstrate that the supramarginal gyrus modulates temporal discrimination.

A124

DAMPENING THE PAIN SIGNAL: COGNITIVE MANIPULATIONS ON EXPERIMENTAL PAIN *Fadel Zeidan[1], Nakia Gordon[1], Junaid Merchant[1], Catherine Zanbaka[1], Paula Goolkasian[1], Larry Hodges[1]; [1]University of North Carolina at Charlotte* – It is well established that pain has sensory as well as cognitive and affective components (Melzack, 1999). Manipulating the cognitive component has been effective in pain attenuation; perhaps through reallocation of attentional resources (Seminowicz & Davis, 2007). The current study examined the effectiveness of 3 cognitive manipulations, which potentially allocate resources in different ways, on subjective pain ratings (NR; 0-6). “Painful” and “unpleasant” electrical stimuli were delivered while subjects (N=55) engaged in a virtual reality game (VR), a three-day mindfulness meditation intervention, or an arithmetic distraction task (math). Meditation, VR, and math all significantly reduced pain intensity ratings when compared to a baseline condition. However, meditation was significantly more effective at reducing pain than VR or math, and, was effective at both the “painful” and “unpleasant” levels of stimulation. In previous neuroimaging studies, expert meditators show decreased activity in the pain neuromatrix and pre-frontal cortices (Orme-Johnson et al., 2006). Virtual reality and arithmetic distraction, also show reductions in the pain neuromatrix, but not in the pre-frontal cortex (Hoffman et al., 2004; Del Percio et al., 2006). Prefrontal activation may account for the more global effect meditation had at reducing both painful and unpleasant pain responses compared to the distraction tasks that were only effective at the higher intensity of pain. As a cognitive technique, meditation may be more effective in reallocating attentional resources. These data highlight the necessity of comparing different cognitive techniques to explore how attentional resources are allocated to influence pain perception.

Perceptual processes: Somatosensory processing

A125

TRACING PAIN PATHWAYS FROM STIMULUS TO REPORT *Lauren Atlas[1], Matthew Davidson[1], Kate Dahl[1], Martin Lindquist[1], Tor Wager[1]; [1]Columbia University* – The relationship between stimulus intensity and reported pain is robust and lawful, but endogenous brain processes play a large role in determining how painful a given stimulus will actually be. Identifying the brain pathways and components that determine pain intensity is a critical step towards understanding the circuits that generate and regulate pain and related affective processes. We used a single-trial fMRI approach combined with multi-level mediation analyses to localize pathways that link stimulus intensity to reported experience. We quantified the amplitude, onset, and shape of responses to individual thermal stimuli of four intensities in each brain voxel. This single-trial estimation allowed us to perform effective connectivity analyses on variations in trial response amplitude, avoiding issues with hemodynamic variation across the brain. Multi-level mediation analyses identified a network of regions that explained a significant amount of the covariation between temperature and pain reports. A 'stimulus-related' network tracked the stimulus intensity more closely than reported pain, including thalamus, posterior SII, periaqueductal gray, rostral dorsal anterior cingulate and rostral anterior insula. Anterior SII, right mid-anterior insula, dorsal anterior cingulate, and deep cerebellar nuclei were mediators of the relationship between applied stimulation and reported pain. Finally, a 'response-related' network tracked reported pain, but not stimulus intensity, including putamen and posterior cingulate cortex. Results identify many known 'pain' regions—including putative 'sensory' and 'affective' regions—as key mediators, and identify novel frontal activity related specifically to stimulus processing.

A126

'MIRROR-TOUCH' SYNAESTHESIA IS ASSOCIATED WITH ENHANCED TACTILE DISCRIMINATION *Michael Banissy[1], Vincent Walsh[1], Jamie Ward[2]; [1]Institute of Cognitive Neuroscience, UCL, UK, [2]University of Sussex, UK* – People with synaesthesia have unusual perceptual experiences (e.g. graphemes may evoke color, or watching someone touched may elicit tactile sensations). However, it is unclear whether their perception of veridical stimuli is normal. Yaro and Ward (2007) provided evidence that grapheme-color synaesthetes have enhanced color discrimination for luminance matched stimuli (and better memory for color). Is this a general property of synaesthesia? Is the enhanced performance due to back-translation from colors to verbal labels? In order to answer these questions, we assessed tactile discrimination (two alternative forced-choice discrimination of spatial gratings applied to the fingertips) in a group of 'mirror touch' synaesthetes in whom observed touch to another human elicits tactile sensations on their own body. These synaesthetes had enhanced tactile perceptual discrimination relative to age matched controls. We conclude that enhanced perceptual discrimination is a core property of synaesthesia that is not limited to color, but occurs in each affected sensory modality. It remains to be determined whether an over-sensitive (and/or over-active) concurrent perceptual system is a cause or consequence of synaesthesia.

A127

AGING EFFECTS ON TEMPORO-SPATIAL PERCEPTION: BEHAVIOURAL AND EVENT-RELATED POTENTIALS (ERPS) EVIDENCE *Gerard Nisal Bischof[1,2], Kirsten Hoetting[1], Brigitte Roeder[1]; [1]University of Hamburg, Germany, [2]Beckman Institute for Advanced Science and Technology, Urbana-Champaign, IL* – Crossing the hands has been shown to interfere with temporo-spatial tactile perception. It has been suggested that this effect reflects a conflict between an anatomical and an external spatial reference frame. Developmental studies have provided evidence that a default remapping of tactile input into external coordinates is acquired rather than innate but it is not known yet if tactile temporo-spatial encoding is subject to age-related changes. Thirteen healthy elderly adults (mean age 71 years) and 12 young adults (mean age 25 years) performed a tactile temporal order judgment task (TOJ) adopting either an uncrossed or crossed hands posture. The just noticeable difference (JND) for the two tactile stimuli, one presented to either hand were larger in old participants. Furthermore the crossed hands deficit was larger for old adults as compared to young adults. To investigate the role of spatial coordinate systems involved in the control of tactile-spatial attention and in subsequent attentional modulations of somatosensory processing, event-related potentials were recorded. Thirteen elderly adults (mean age 68 years) and 17 young adults (mean age 24 years) performed a tactile attention task during uncrossed and crossed hands positions. Qualitative and quantitative differences of age were observed during shifts of tactile spatial attention. In addition, attentional modulations of somatosensory ERPs were attenuated with crossed as compared to uncrossed hands in both groups. Moreover old adults showed quantitative differences in the onset of attention-related processing of somatosensory stimuli. Thus, temporo-spatial encoding seems to be susceptible to aging effects.

A128

VISION OF THE BODY IS ANALGESIC FOR PAIN *Matthew Longo[1], Viviana Betti[2,3], Salvatore Aglioti[2,4], Patrick Haggard[1]; [1]University College London, United Kingdom, [2]Università di Roma ("La Sapienza"), Italy, [3]AFaR, Fatebenefratelli Hospital, Isola Tiberina, Rome, Italy, [4]Centro Ricerche Neuropsicologia, IRCCS Fondazione Santa Lucia, Rome, Italy* – Several recent studies have demonstrated that non-informative vision of the hand increases the acuity of touch on that hand. In this experiment, we investigated how such non-informative vision of the hand affects the processing of painful stimuli using a Nd:Yap laser, using both subjective ratings of pain obtained with a visual analogue scale (VAS) and laser-evoked potentials (LEPs) obtained from the EEG. Participants looked into a mirror aligned with their body midline at either the reflection of their own left hand (creating the illusion that they were looking directly at their own right hand), or at the reflection of a non-hand object (a small brown book). Though the actual laser stimulation was constant throughout the experiment, VAS ratings indicated that pain was significantly less intense and unpleasant when participants looked at their hand than at the object. Similarly, vision of the hand led to a selective reduction of the amplitude of the P2 component of the LEP that is thought to originate from the ACC and to index cognitive/affective responses to pain. Reduction of subjective pain and LEPs was correlated across participants. These results demonstrate that non-informative vision of the hand is analgesic for pain on that hand. Whereas vision of the hand selectively increases sensory processing of tactile stimuli, it selectively decreases cognitive processing of painful stimuli. This dissociation suggests that vision of the body does not indiscriminately increase somatosensory processing generally, but differentially influences different sensory channels.

A129

CHILDREN WITH AUTISM SHOW ATYPICAL EARLY RESPONSE TO NOVEL TACTILE STIMULI USING MAGNETOENCEPHALOGRAPHY (MEG) *Elysa Marco[1], Kasra Khatibi[1], Anne Findlay[1], Zhao Zhu[1], Sophia Vinogradov[1], Heidi Kirsch[1,2], Srikantan Nagarajan[1]; [1]University of California, [2]University of California, Epilepsy Center* – Children with autism experience sensory processing difficulties which may be at the core of their learning and behavioral deficits. The nature of these deficits, especially in the tactile domain, remain unclear. M50 sensory evoked fields (SEF) collected in response to familiar and novel finger taps reflect the early processing of somatosensory information. This study aims to compare early unimodal cortical processing in children with high functioning autism (AS) and matched healthy controls (HC). Responses were recorded for the AS group (N=7, mean age=9.6) and the HC group (N=6, mean age=8.9) using a 275-sensor MEG. The stimuli were pneumatic finger taps (140 ms, ~17 PSI, and ISI 330 ms).

Taps to the right index finger (deviant) occurred every 3 -7 taps to the middle finger (standard). The amplitude and latency averages of the M50 were compared between AS and HC for deviant taps, pre-deviant standard taps and post-deviant standard taps. Reliable parietal M50 was elicited to all tactile stimuli and exhibited a characteristic latency and waveform in the HC group. The HC group demonstrated the expected latency delay and amplitude increase to the deviant stimuli. By contrast, the AS group showed considerable variability in their waveforms, with M50 peak amplitude to deviant stimuli being significantly lower than HC. Our results suggest an atypical processing of novel tactile information in autism that can be detected as early as the M50 waveform. While this may represent primary sensory cortical dysfunction, we cannot exclude the contribution of disrupted top-down modulation to novel stimuli.

A131

NEURAL PROCESSING OF SUBJECTIVE PAIN EXPERIENCE: THE RELATIONSHIP BETWEEN STATE AND TRAIT *Michal Ziv[1], Rachel Tomer[1], Ruth Defrin[2], Talma Hendler[3]; [1]University of Haifa, [2]Sackler Faculty of Medicine, Tel Aviv University, [3]Tel Aviv Sourasky Medical Center and Tel Aviv University* – Both state (attention, arousal, affect) and trait (personality) factors are part of the psychological component of pain experience. Using pain anticipation, we tried to characterize the relationship between these two factors and to examine their effect on the subjective experience of pain. Twelve subjects underwent fMRI while receiving a sequence of twelve intense pain stimuli to their wrist. Six of the painful stimuli were preceded by a warning signal and six were not. Following each stimulus participants rated the pain intensity on a ten point scale. In addition, each subject completed Cloninger's Tridimensional Personality Questionnaire (TPQ). The results showed that, on average, subjects gave a higher rating to the intensity of the painful stimuli which were preceded by a warning cue. However, there was inter-subject variability – only half of the subjects reported expected pain as more painful than unexpected pain. This rating variability, representing individual sensitivity to anticipation, was found to be correlated with activity of the frontal and cingulate cortex, the midbrain and the hippocampus. Correlating whole brain activity with harm-avoidance trait scores revealed a different neural network, including the medial frontal & temporal cortex, the cingulate cortex and the amygdala. The results of this study suggest two possible neural mechanisms that mediate the subjective experience of pain; one includes the hippocampus and is involved in the processing of preceding cues (state) while the other, which includes the amygdala, relates to differences in harm avoidance (trait).

Poster Session B

Attentional processes: Visual

B1

DISTINCT NETWORKS OF CONNECTIVITY FOR PARIETAL (AIPS/PIPS) BUT NOT FRONTAL (VLPFC/DLPFC) REGIONS IDENTIFIED WITH A NOVEL ALTERNATIVE TO THE "RESTING STATE" METHOD *Rhodri Cusack[1], Adrian Owen[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge* – Scanning volunteers without specifying a task for them to do ("resting state") has previously been used to find functionally connected networks. In the current study, rather than choosing this approach, connectivity was measured across a broad range of different tasks in 1200+ imaging runs acquired from 300+ volunteers for FMRI studies performed at our institution. Even across this task variety, clear consistent networks were identified, with high correlation values for some distant regions. Seeds in the VLPFC and DLPFC both revealed strong connectivity with the multiple demands (MD) fronto-parietal network. No dissociation was found, consistent with a lack of modular distinction between these regions as concluded following meta-analysis. In contrast, although both also showed co-activation with the MD network, the pIPS and aIPS dissociated, with the former showing greater connectivity to the hippocampus, parahippocampal regions and medial frontal cortex. This dissociation is consistent with findings from other methods, including human DTI, macaque axon tracing, a recent resting state study, and FMRI of perceptual organisation and selective attention. This method avoids a problem inherent in resting state studies which is that a significant proportion of the observed results may arise from the fact that volunteers are performing a similar task, albeit not one specified by the experimenter. It has the added advantage that it does not require the collection of new FMRI data, and as a result can have great power at low cost. We discuss the challenges faced in the implementation of the method, and future extension to multivariate connectivity.

B2

INATTENTIVE SYMPTOMS PREDICT ATTENTIONAL SET DYSFUNCTION IN ADULT ADHD INDIVIDUALS *Brendan Depue[1], Marie Banich[1,2,3], Gregory Burgess[1], Erik Willcutt[1]; [1]University of Colorado-Boulder, [2]Institute of Cognitive Science, University of Colorado–Boulder, [3]University of Colorado-Denver* – The relationship between brain activation in adults with ADHD and behavioral symptomatology is largely unknown. Whereas, hyperactive symptoms decrease as ADHD individuals transition into adulthood inattention symptoms remain relatively stable. We investigated the degree to which inattentive and hyperactive symptoms were associated with patterns of brain activity in an attentional task in 23 young adults (14 male, 9 female) carefully screened to have ADHD symptoms both currently and during childhood but who are not co-morbid for other psychiatric disorders. Our participants performed a hybrid blocked/event related manual Stroop task with blocks of incongruent, neutral, and congruent trials. Comparisons of all these blocks to fixation baseline indicated that individuals with lower inattentive symptoms showed increased activity in a multitude of brain areas and not necessarily those associated with attentional control in the Stroop task. In contrast, higher hyperactivity and inattention symptoms ratings were associated with increased brain activation in overlapping regions of the bilateral superior frontal gyrus (SFG) and the left middle frontal gyrus (MFG). This latter result suggests that individuals with higher overall levels of ADHD symptoms appear to recruit areas involved in attentional control to a greater degree across all conditions (neutral, incongruent, congruent) in which attention must be directed away from the more automatic process of word reading to the less automatic process of ink color identification. Our results provide a first step in being able to realize the promise that brain imaging holds for the diagnosis and treatment of psychiatric disorders.

B3

SENSORY GAIN CONTROL AT FIXATION *Jordan DeVylder[1], Paul Corballis[1], Nathan Parks[1]; [1]Georgia Institute of Technology* – Spatial attention appears to operate by a sensory gain control mechanism, enhancing visual perception in attended regions of space. Sensory gain effects can be measured electrophysiologically through changes in the amplitude of the P1 component of the event related potential (ERP). P1 amplitude can be modulated by low-level sensory features as well as by attention allocation, and changes in P1 amplitude can be attributed to attention effects if all physical stimulus properties are held constant. Sensory gain effects are well documented with attention to the periphery of the visual field, but have rarely been studied at fixation. The few studies that have been conducted that look at sensory gain for foveal stimuli have yielded conflicting results (Handy & Khoe 2005; Miniussi, Rau, & Nobre, 2002), and sensory gain for extrafoveal stimuli at fixation has only been found in emotion studies (Smith, Cacioppo, Larsen, & Chartrand, 2003). We manipulated attention towards centrally-presented foveal and centrally-presented extrafoveal stimuli at fixation, using three levels of attentional load for each stimulus size. ERPs were recorded in response to stimulus onset, and tested for differences in P1 amplitude across attentional load conditions. Sensory gain was interpreted as an increase in P1 amplitude as attentional load increased, and was tested independently for the foveal and extrafoveal stimulus sizes. P1 amplitudes were greater for high attentional load than for low attentional load, suggesting that attention exerts an effect on the perception of centrally-presented stimuli in a manner consistent with sensory gain control.

B4

CONTEXTUAL CUEING IN SCHOOL-AGED CHILDREN USING TARGET-DIRECTED ACTION *Matthew Dixon[1], Daniel H Lee[1], Philip David Zelazo[3], Eve De Rosa[1,2]; [1]University of Toronto St. George, [2]Rotman Research Institute, Baycrest Centre for Geriatric Care, [3]University of Minnesota, Institute of Child Development* – Prior experience with the spatial layout of stimuli ultimately enhances attentional deployment to relevant locations (Chun & Jiang, 1998). This phenomenon, termed "contextual cueing", is mediated by a medial temporal lobe (MTL)-posterior parietal network that support mnemonic and attentional processes respectively. It remains unknown whether children have mature neural substrates to support such memory-guided attention. Thus, we examined the development of spatial contextual cueing in school-aged children between the ages of 5 to 9 ($M = 6.93$, $SD = 1.03$) with target-directed action. Children searched for a target among distractors in both novel displays and in "old" displays on a touchscreen. Old displays, which were repeated five times across the experiment, provided an opportunity for prior experience with the spatial layout of the stimuli to guide attentional deployment. Consistent with the adult literature, we hypothesized there would be progressively faster response times (RT) with the repetition of the old displays. Using a touchscreen, children were able to directly act on the target stimulus allowing us to have a reliable RT measure and removed the need for children to maintain a response mapping to keys. As expected, children displayed no difference in RT at block five relative to block one for novel displays, but were significantly faster at block five when searching old displays. To our knowledge, this is the first evidence for intact contextual cueing in children and may reveal a maturity of a MTL-posterior parietal network that supports memory-guided attentional deployment.

B5

EXPLORING THE SPATIOTEMPORAL DYNAMICS OF SUSTAINED ATTENTION USING SSVEPS *Paul Dockree[1], Redmond O'Connell[1,2], Simon Kelly[4], Shani Shalgi[3], Ian Robertson[1]; [1]Trinity College Institute of Neuroscience, Dublin, [2]Queensland Brain Institute, University of Queensland, [3]The Hebrew University of Jerusalem, [4]The Cognitive Neurophysiology Laboratory, Nathan Kline Institute for Psychiatric Reserach* – The aim of the present investigation was to examine within-subject changes in Steady State Visual Evoked Potential (SSVEP) amplitude and oscillatory alpha activity in relation to behavioral indices of momentary lapses of attention. Short-term changes in these signals may help elucidate the temporal dynamics of sustained attention performance in neurologically healthy subjects and sustained attention failures in clinical populations. High-density EEG recordings were acquired from 128-scalp electrodes during performance on a visual sustained attention task. Neurologically healthy volunteers were presented with flickering (25Hz) pattern-reversal stimuli and were required to monitor standard stimuli presented for 800ms and respond with a key press to target stimuli presented for the longer duration of 1120ms. Each participant completed 10 blocks each with 180 standard stimuli and 20 targets. The pattern-reversal sustained attention task proved sensitive to transient lapses of attention over time as demonstrated by both the number and distribution of errors over task blocks in each subject. Furthermore, the transient ERPs, the steady state oscillatory response and phasic changes in the alpha (~10Hz) band were extracted for analysis and examined in relation to target detections and misses (or lapses of attention). Results are discussed in terms of increased sensory transmission in parieto-occipital regions necessary for increased visual attention to task stimuli. In a second experiment, a modified visual attention task was used in which response time (RT) to warned and unwarned targets was manipulated. Similarly, transient ERPs, SSVEP power and alpha power were analysed and the clinical utility of this measure is discussed.

B6

ONLINE MEASUREMENT OF DYNAMIC CHANGES IN TRACKING LOAD. *Trafton Drew[1], Todd Horowitz[2,3], Edward Vogel[1]; [1]University of Oregon, [2]Brigham and Women's Hospital, [3]Harvard Medical School* – In the multiple-object tracking paradigm, subjects are asked to covertly track several target objects simultaneously as they move randomly amongst identical distractors. Recently, Wolfe and colleagues have demonstrated that observers can dynamically change which items are being tracked during the course of the trial. In the current study, we attempted to examine the neural mechanisms underlying this ability by measuring ERPs as the subjects tracked moving objects. In particular, we examined the contralateral delay activity (CDA) which provides an online neural measure of the number of active representations being held in memory. On some trials, a cue informed subjects to switch from tracking one item to three items, while on others the tracking load switched from three items to one item. Here we found that shortly following the switch cue, the amplitude of the CDA increased when subjects added new items and decreased when they were instructed to drop target items. Moreover, our electrophysiological results suggest that the time-course of dropping tracked items is much slower than that of adding new items into the tracked set. Together, these results demonstrate that this activity can measure rapid and dynamic changes to the current attentional tracking load.

B7

ASSESSMENT OF HEMISPATIAL NEGLECT WITHIN A VIRTUAL ENVIRONMENT *Assaf Dvorkin[1], William Rymer[1,2], Krista Settle[1], Richard Harvey[1], Ross Bogey[1], James Patton[1,2]; [1]Rehabilitation Institute of Chicago, Chicago, IL, [2]Northwestern University, Chicago, IL* – Hemispatial neglect is commonly assessed using batteries of paper-and-pencil tests. However, these tests have several drawbacks due to their fixed and repetitive nature. Although neglect has been most commonly assessed and studied in the horizontal spatial dimension, recent studies have shown neglect along the radial and vertical dimensions as well. We have developed and tested a virtual reality based assessment tool for spatial neglect in multiple spatial dimensions. The performance during a target-detection task of five stroke patients with neglect was compared to that of eight stroke patients without neglect and eight age-matched healthy controls. Subjects were exposed to a three-dimensional virtual scene and were instructed to press a response button when they detected a target appearing within the scene. To quantify perceptual performance both the percent of correct detection and reaction time to initiate a button press were calculated. Our results show significant differences between the neglect patients and control groups. All neglect patients exhibited asymmetries of performance, where their mean reaction time and detection accuracy systematically varied in one or more spatial dimensions – an obvious left as well as near neglect were evident. This asymmetry was not a harsh transition but instead showed a gradual reduction of attention across the space. By contrast, the neglect patients' performance on the Behavioral Inattention Test was less conclusive. These findings demonstrate the feasibility of virtual reality tools for detailed assessments of multidimensional attentional deficits, supporting the hypothesis that neglect patients might exhibit spatial bias in one or more spatial dimensions simultaneously.

B8

THE CO-INVOLVEMENT OF FRONTAL EYE FIELDS AND POSTERIOR PARIETAL CORTEX IN VISUAL ATTENTIONAL TASKS *Amanda Ellison[1], S. Jayne Swindells[1], Daniel Smith[1], Thomas Schenk[1]; [1]Durham University* – The decrease in reaction time when target location is repeated in successive trials in visual search is an established effect. Using transcranial magnetic stimulation (TMS) we have previously shown that repetition of target location in a colour/orientation conjunction visual search task is also commensurate with a decrease in involvement of right posterior parietal cortex (rPPC), an area known to be involved in the processing of this task. The decrease in reaction time therefore seems to be mediated by a concomitant lack of engagement of rPPC. So there must be another area of the brain which can keep track of target location and render rPPC redundant in the processing of the task. This role could be fulfilled by slowly decaying saliency maps, which are thought to reside in the frontal eye fields (FEF), involved in the recall of location and orientation of attention. Much has recently been discovered about the role of FEF in visual search tasks and also how FEF influences activity in posterior regions. This leads to an interesting prediction; by TMS stimulation of FEF, it should be possible to restore the action of rPPC even after several repetitions i.e. if the area involved in location priming is disrupted, rPPC would be required for processing of every trial. Results show that FEF and rPPC TMS has a constant and additive effect over location repeated trials and so can be taken as evidence of important functional pathway involved in the control of spatial attention.

B9

WHAT YOU ATTEND IS WHAT YOU GET: ATTENTION DOES NOT AUTOMATICALLY SPREAD TO ALL FEATURES OF AN OBJECT *Edward Ester[1], Edward Awh[1], Edward Vogel[1], John Serences[2]; [1]University of Oregon, [2]University of California, Irvine* – What are the units of visual attention? O'Craven, Downing, and Kanwisher (1999) have demonstrated that attending to one feature of an object (e.g., motion) enhances the cortical response to this feature as well as other features (e.g., form) of the same object. This result suggests that attention operates at the level of whole objects. However, the behavioral task used in these studies did not explicitly discourage observers from attending multiple features of the same object. In the present experiments, observers performed a change detection task in which they were required to discriminate differences in either the orientation or color of a single object. To encourage a narrow focus of attention on the relevant feature, task difficulty was continuously titrated for each observer. Using fMRI and a multivoxel pattern analysis (MVPA), we show that when the observer was attending orientation, the pattern of activation in V1 discriminated the currently viewed orientation, but not the currently viewed color. In contrast, when the observer attended color, the pattern of activation in V1 discriminated the currently viewed color, but not the currently viewed orientation. These results are inconsistent with the notion that attention automatically spreads to all features of an attended object. Instead, they suggest that attention may be voluntarily restricted to a single behaviorally relevant feature.

B10

THE EFFECTS OF IRRELEVANT PRE-TARGET STIMULI ON FEATURE-SPECIFIC BASELINE SHIFTS IN SELECTIVE ATTENTION *Sean P. Fannon[1,2], George R. Mangun[2]; [1]Folsom Lake College, [2]Center for Mind & Brain, UC Davis* – Functional MRI studies have shown that visual selective attention to a spatial location increases baseline neural activity in visual areas that represent that location even before the onset of an attended visual target. However, analogous "baseline shifts" are not observed consistently for attention to non-spatial visual features. Some previous studies that reported baseline shifts during feature-based attention presented an irrelevant visual stimulus in the interval preceding attended targets (e.g. Chawla et al., 1999; Shulman et al., 1998). However, similar studies in which the screen was left blank during the pre-target period failed to observe feature-specific baseline shifts (e.g. Shulman et al., 2002; Fannon and Mangun, 2005). We tested the hypothesis that selective attention modulates the visual system's response to irrelevant pre-target stimuli, producing what appear to be feature-specific baseline shifts. We examined BOLD responses to randomly intermixed cues for specific colors and directions of motion in individually localized color- and motion-sensitive visual areas. During half of the runs only a small fixation cross was present during the cue-target interval, but during the other half of the runs a static random dot stimulus was present during these periods. Feature-specific baseline shifts were not observed in either run type, failing to confirm our suspicion that the presence of irrelevant stimuli in the pre-target interval permits attentional modulation that might be interpreted as a baseline shift. Other possible explanations for the discrepant results of previous studies are offered.

B11

ATTENTION NARROWS POSITION TUNING IN EARLY VISUAL AREAS *Jason Fischer[1], David Whitney[1]; [1]University of California, Davis* –

Voluntary visual attention allows us to perceive a selected region with a great deal of precision. Psychophysical studies have shown that attention improves performance on tasks that depend on spatial resolution; however, the mechanisms underlying such resolution improvements remain unclear. Several studies have found boosted neuronal responses to attended stimuli, and such signal gains could produce resolution improvements. However, recordings in extrastriate areas have also found that attention can effectively shrink the receptive fields of individual neurons. This has given rise to the hypothesis that in addition to producing signal gain, attention might also narrow the selectivity of population-level responses for object position. However, no evidence has yet been found for this narrowing of position tuning. Here, we tested the hypothesis that attention narrows position tuning in early visual areas, including V1. Subjects either passively viewed or attended to the positions of target objects. We measured the pattern of fMRI BOLD response across visual areas V1 through V4 and found that in each area, the precision of retinotopic encoding improved significantly with attention. Further, when subjects attended to object position, regions of BOLD activity produced by adjacent stimuli overlapped less than they did under passive viewing, as revealed by a decreased correlation between the patterns of activity in the attended conditions. A multiplicative gain mechanism alone cannot explain these results; the resolution improvements result from the simultaneous influence of signal gain and an improvement in selectivity for object position at the population level.

B12

ATTENTIONAL MODULATION OF PERCEIVED ECCENTRICITY *Francesca Fortenbaugh[1], Lynn Robertson[1]; [1]University of California, Berkeley* – Can attention change the perceived extent of the visual field? The present study investigated this question by asking 12 participants to estimate the eccentricity of target dots briefly flashed on a computer screen under three levels of attentional distribution along horizontal and vertical axes: 1) attend to one radius, 2) attend to one axis, and 3) attend to both axes. Participants gave magnitude estimates between 0 (central fixation) and 100 (edge of aperture at 30deg). Attention was modulated by informing participants along what axes the targets would appear before each block. Seven eccentricities were randomly tested along each of the four radii from fixation. Participants increasingly underestimated the eccentricity of the targets as the true eccentricity increased, and this underestimation was mediated by both axis and attentional distribution. Specifically, the degree of underestimation increased with the area of visual space the participants monitored and greater underestimations were observed along the horizontal axis than the vertical axis. The magnitude estimates were well fit by power functions and show a complex relationship between the best fitting constants and exponents. Analysis of the standard deviations of the magnitude estimates showed a significant quadratic trend with eccentricity, suggesting that participants showed the greatest uncertainty when the target was farthest from the two anchoring positions (i.e. fixation and the aperture's edge). This suggests that attention did not simply increase the uncertainty of target locations in unattended regions but actually modulated the perceived extent of the visual field.

B13

DEVELOPMENTAL CHANGES IN FUNCTIONAL NETWORKS FOR VISUAL SELECTIVE ATTENTION *Stacia Friedman-Hill[1,2], Meryl Wagman[1], Andrew Speer[1], Daniel Pine[1], Ellen Leibenluft[1], Leslie Ungerleider[1]; [1]National Institute of Mental Health, [2]National Science Foundation* – While a great deal is known about the fronto-parietal selective attention network in adults, much less is known about the functional organization of attention in children. Given that frontal and parietal cortex have different developmental trajectories, what are the relative contributions of these areas across development? We employed event-related fMRI to study 18 healthy adults and 19 typically developing children (age 8-13) as they performed a visual discrimination task which varied in difficulty and distractor salience. During a practice block, we determined subjects' perceptual threshold, in order to equate task difficulty. In subsequent fMRI blocks, we found no differences in error rates between children and adults. Children's response times were equivalent to adults for difficult discriminations, but were slower for easy discriminations. Although there were few behavioral differences between adults and children, fMRI activations revealed many significant differences between the groups. For easy discriminations, adults had significantly more activation than children of inferior parietal lobule and fusiform gyrus, whereas children had greater activation than adults of superior and middle temporal gyri, putamen, thalamus, caudate, insula, medial frontal gyrus, and anterior cingulate. For difficult discriminations, adults showed greater recruitment than children of intraparietal sulcus, inferior and superior parietal lobules, and inferior and middle frontal gyri. In contrast, children continued to show greater activations than adults of the same regions as noted for easy discriminations, and additionally superior frontal gyrus (BA 10) and paracentral lobule. These results suggest that the fronto-parietal attention network has not yet reached functional maturity in school-age children.

B14

DISSOCIATION OF VISUAL C1 AND P1 COMPONENTS AS A FUNCTION OF ATTENTION: EVENT-RELATED POTENTIAL STUDIES *Shimin Fu[1], John Fedota[1], Raja Parasuraman[1]; [1]George Mason University, Fairfax, VA* – The earliest cortical location at which attention influences visual information processing in the brain remains controversial. Previous event-related potential (ERP) studies comparing the cortical response to the same stimulus when attended and unattended have shown modulation of the P1 component but not the earlier C1 component. Here we used an alternative method to evaluate the effects of attention on C1 and P1. A virtual square consisting of four brackets was presented in the left, right, or both visual fields. ERPs were recorded while participants performed a passive viewing task (exp. 1) and an active viewing task (exp. 2). ERPs to the unilateral left and right stimuli were summed and compared to the ERPs to the bilateral stimuli. The C1 component (~80 ms) was comparable in amplitude and latency between the bilateral and the summed ERPs, regardless of the experimental condition. In contrast, while the amplitude of the P1 component (~130 ms) between the summed ERPs and the bilateral ERPs was comparable under passive viewing, a larger P1 for summed ERPs was observed in the active condition. These results using a novel methodology suggest a dissociation between the C1 and P1 components as a function of attention—C1 is an exogenous component that is sensitive primarily to stimulus properties and insensitive to attention, whereas P1 is modulated by attention.

B15

INDUCED ALPHA-BAND EEG OSCILLATIONS INDEX ANTICIPATORY BIASING OF VISUAL CORTEX DURING VOLUNTARY SPATIAL ATTENTION *Jessica Green[1], John McDonald[1]; [1]Simon Fraser University* — During voluntary shifts of spatial attention, two electrophysiological effects have been linked to anticipatory biasing in visual cortex: the late-directing-attention-positivity (LDAP) in the event-related potentials (ERPs) and increases in alpha-band (8-14 Hz) activity in the electroencephalographic (EEG) oscillations. However, in a handful of studies that used variable intervals between attention-directing cues and response-relevant targets the LDAP was not observed in the ERPs despite other evidence that attention had been allocated to the cued location. Here we sought to determine if alpha-band oscillations would still occur when the target onset was unpredictable and anticipatory biasing was not observed in the ERPs. We performed two variants of an attention cueing task with multiple intervals between the cues and targets (300, 900, or 1500 ms), one in which the target onsets were unpredictable and only the to-be attended location was cued (Exp. 1) and one in which both the temporal interval and to-be-attended location were cued (Exp. 2). As expected, when the target onset was unpredictable no LDAP was evident, whereas when the target onset was predictable the LDAP was observed. Increases in alpha-band activity, however, occurred in visual cortical regions contralateral to the to-be-ignored location in both experiments, suggesting they play an integral role in anticipatory biasing of sensory cortex. When the target onset occurs at a predictable interval the alpha oscillations become phase-locked to the stimuli, enabling their visualization in the ERP waveforms.

B16

THE AUTOMATIC NATURE OF SOCIAL STIMULI ON SPATIAL ORIENTING OF ATTENTION: CAN SOCIAL CUES GENERATE INHIBITION OF RETURN? *Deanna J. Greene[1], Eran Zaidel[1,2]; [1]University of California Los Angeles, [2]University of California Los Angeles, Brain Research Institute* — Evidence suggests that directed social cues, such as eye gaze, cause automatic shifts in attention following gaze direction. The effect of central gaze cues on attention has been investigated using a variant of Posner's spatial cueing paradigm, where participants respond to a peripheral target that is preceded by a valid or invalid cue. Participants typically respond faster to validly cued than invalidly cued targets, even when gaze direction does not have predictive value. Typical automatic cues, such as peripheral luminance changes, exhibit a selective inhibitory effect (inhibition of return; IOR), in which participants respond faster to invalidly cued targets at long (>300ms) cue-to-target intervals. However, there have been no reports of IOR with gaze cues. A similar behavioral pattern has been found for non-predictive central arrow cues, which are commonly used as a nonsocial control for gaze cues. Yet, peripheral cues are usually presented briefly, while the aforementioned central cues are not. Thus, we ran a variation of the spatial cueing task with three non-predictive cue types (central gaze, central arrow, peripheral squares), all flashed briefly for 125msec. While previous studies blocked different cue types, we presented both blocked and randomly intermixed versions of the task. We found IOR for both peripheral and gaze cues, but not for arrow cues in the blocked experiment. In the mixed experiment, gaze cues no longer showed IOR, similar to arrow cues. This demonstrates that social cues are flexible and behave like peripheral cues in isolation, but like central cues in mixed context.

B17

INVESTIGATING NEURAL NETWORKS IN HUMAN SPATIAL ATTENTION USING FREQUENCY TAGGING *Nienke Hoogenboom[1], Markus Butz[2], Alfons Schnitzler[2,3], Klaus Kessler[1]; [1]Centre for Cognitive Neuroimaging, University of Glasgow, UK, [2]MEG Laboratory, Neurology, Heinrich-Heine-University, Duesseldorf, Germany, [3]Wolfson Centre for Clinical and Cognitive Neuroscience, University of Bangor, UK* — Spatial attention studies have demonstrated that the neural activity elicited by a visual stimulus is enhanced when the observers direct their attention to the region of space containing that stimulus. Increasing evidence has suggested a number of cortical regions to be involved in attentional networks, however, in these classical paradigms it is difficult to disentangle the various brain processes going on in parallel. Another well known phenomenon is that flickering visual stimuli entrain the visual cortex into oscillations in the same frequency (Steady State Visually Evoked Potentials, SSVEP). We set out to test whether such oscillations are modulated by attention and whether we would observe cortico-cortical synchronization in this frequency. This would allow us to trace the network and disentangle parallel processing by means of a "frequency tag".Accordingly, we employed flickering stimuli in a spatial attention paradigm while recoding magnetoencephalography (MEG). We presented figures in left and right hemi-field with a flicker frequency of 6Hz or 7.5Hz, while subjects had to maintain fixation. At the beginning of each trial two directional cues (endogenous and exogenous) were presented and subject had to direct their attention to the cued side. Preliminary data of 16 subjects shows a clear driving effect of tagging frequencies and its harmonics in visual cortex, while attention modulates the power in these frequency bands. Furthermore, preliminary analysis revealed clusters of activity in the tagging frequencies that extended beyond visual cortex. We therefore suggest that frequency tagging is a sensitive tool to study networks of spatial attention.

B18

HUMAN PARIETAL CORTEX MEDIATES BOTH STIMULUS-DRIVEN AND GOAL-DRIVEN VISUAL ORIENTING *Masud Husain[1,2], Victoria Singh-Curry[1,2], Paul Bays[1,2]; [1]Institute of Cognitive Neuroscience, University College London, UK, [2]Institute of Neurology, University College London, UK* — To extract useful information from the visual world we must direct our eyes serially to different regions of space. How do we decide where and in what order these fixations should be directed? Studies in primates suggest that attentional priority may be represented in the brain by neuronal activity in posterior parietal cortex (PPC), in the form of a topographically-organised map of visual space. Consistent with this, PPC lesions in humans may result in failure to direct attention to stimuli in space – contralesionally in unilateral neglect and bilaterally in Bálint's syndrome – perhaps reflecting damage to such a priority map. Activity in primate PPC appears to combine a stimulus-driven component, relating to the visual salience of the retinal image, and a goal-driven component, reflecting the relevance of items in the scene to our current aims and intentions. Here we attempt to dissociate the effects of PPC lesions in humans on stimulus- and goal-driven visual orienting. Subjects are given the task of scanning a rapidly-changing array of distractors for target letters. We provoke reflexive saccades to non-target items by increasing their salience, through changes in onset, luminance, or orientation. Patients with parietal lesions show deficits in both stimulus-driven orienting, as determined by saccades to salient non-targets, and goal-driven orienting, evaluated by saccades to targets and by exploratory eye movements. The spatial distribution of impairment is identical in each case, supporting the conclusion that human PPC represents both stimulus-driven and goal-driven components of attentional priority.

B19

FUNCTIONAL ORGANIZATION OF HUMAN FRONTAL CORTEX ACCORDING TO PERCEPTUAL AND RESPONSE SELECTION DEMANDS *Akiko Ikkai[1], Trenton Jerde[1], Clayton Curtis[1,2]; [1]New York Univeristy, [2]Center for Neural Science, New York University* – Compared to posterior cortex, the functional organization of the frontal cortex remains largely unknown. Here, we test the hypothesis that segregated projections from posterior cortex carry visual information about actions and perceptions to dorsal and ventral frontal cortex, respectively. We used rapid event-related functional magnetic resonance imaging (fMRI) to measure cortical activity that parametrically scaled with perceptual or response selection demands of a visual search task. We manipulated perceptual demands by increasing the number of distractors in a search array (i.e., 4, 8, 12 items). We manipulated response demands by requiring more difficult transformations between a search target location and the instructed saccadic goal (i.e., prosaccade, antisaccade, 90-degree rotated saccade). Longer saccadic response times were associated with larger set sizes and more difficult saccade transformations, but these two factors did not statistically interact. In posterior cortex, fMRI signal in the ventral visual stream (i.e., occipito-temporal cortex) was associated with increasing set size. Signal in the dorsal visual stream (i.e., parietal cortex) was associated with more difficult saccade transformations. In frontal cortex, we observed strong saccade transformation effects, regardless of set size, along the extent of the precentral sulcus. However, the set size manipulation had relatively small effects in the frontal cortex. Thus far, the data do not support a dorsal-ventral distinction in frontal cortex according to perceptual and response selection demands. These preliminary results may indicate that although visual processing is segregated in posterior cortex, it may be integrated in frontal cortex.

B20

EFFECTS OF VOLUNTARY MODULATIONS IN ATTENTIONAL FOCUS ON DISTRACTOR INTERFERENCE *Tonya Jacobs[1], Ewa Wojciulik[1]; [1]University of California, Davis* – Behaviorally irrelevant distractors often interfere with task performance, especially when the task is easy. However, distractor interference can be reduced when spatial cues define an attentional window that excludes irrelevant information. Here we determined whether the size of an attentional window can be reduced in the absence of spatial cues in a voluntary manner such that irrelevant stimuli are filtered out. Subjects performed a 2-choice letter identification task while ignoring task irrelevant distractor letters. One of two possible target letters was presented within a row of non-target letters. Distractor letters flanked this central row and were either compatible or incompatible with the target. The task was either easy or was made more difficult by presenting letters at reduced size and contrast. Prior to each display, a central 'readiness' cue indicated the onset of a trial and subjects were instructed to ignore the flanking distractors to the best of their ability. Less frequently, a central 'focus' cue indicated that the subject should make an extra effort to restrict their attentional focus in order to filter out flanking distractors. Results show that distractor interference was significantly diminished when a 'focus' cue preceded a trial, with significant reductions in reaction time differences between compatible and incompatible trials for both easy and hard task conditions. These data suggest that the size of an attentional window can be modulated as part of an endogenous control process that may be initiated prior to a task without the use of concurrent spatial cues.

B21

CULTURAL DIFFERENCES IN THE PROCESSING OF INCONGRUOUS SCENES REVEALED USING FMR ADAPTATION. *Lucas Jenkins[1], Yung-Jui Yang[1], Joshua Goh[1], Ying-Yi Hong[1], Denise Park[1]; [1]University of Illinois at Urbana-Champaign* – Converging behavioral and neuroimaging evidence indicates that culture influences the processing of complex visual scenes. Whereas Westerners focus on central objects and tend to ignore context, East Asians process scenes more holistically, attending to the context in which objects are embedded. We investigated cultural differences in contextual processing by manipulating the congruity of visual scenes presented in an fMR adaptation paradigm. We hypothesized that East Asians would show greater adaptation to incongruous scenes, consistent with their tendency to process contextual relationships more extensively than Westerners. Sixteen Americans and 16 native Chinese were scanned while viewing sets of pictures consisting of a focal object superimposed upon a background scene. In half of the pictures objects were paired with congruous backgrounds (e.g. a cow in a field), and in the other half objects were paired with backgrounds that were incongruous but not impossible (e.g. a blender on a bus). We found that within both the right and left lateral occipital complexes (visual processing regions selective to objects), Chinese subjects showed significantly greater adaptation to incongruous scenes than to congruous scenes relative to American subjects. These results indicate that Chinese subjects were more sensitive to contextual incongruity than were Americans and that they reacted to incompatible object/background pairings by focusing greater attention on the focal object.

B22

MINDWANDERING SHIFTS THE LEVEL OF SENSORY ANALYSIS IN VISUAL CORTEX *Julia Kam[1], Jonathan W. Schooler[1], Todd C. Handy[1]; [1]University of British Columbia* – Mindwandering is associated with reduced cognitive analysis of external visual events, yet it remains uncertain as to exactly how the processing of visual events are dampened during periods of mindwandering. Here we used event-related potentials (ERPs) to examine whether mindwandering may be associated with reduced sensory responses in visual cortex. Participants performed a target detection task at fixation while ERPs were recorded. Interspersed with each target was a task-irrelevant probe in the visual periphery. At the end of each trial block participants self-reported on whether or not they had been mindwandering at the conclusion of the trial block. The ERPs to peripheral probes were then examined as a function of whether or not they immediately preceded a report of mindwandering. We found that the amplitude of the lateral occipital P1 ERP component elicited by the probes decreased during periods of mindwandering relative to reports of being "on-task", which suggests that mindwandering reduced sensory-level responses in the extrastriate visual cortex. At the same time, however, we also found that mindwandering increased sensory responses in primary visual cortex, as measured via the C1 ERP component. Taken together, our data thus suggest that mindwandering doesn't simply reduce the intensity of sensory responses in the visual cortex in a manner akin to turning off the attentional spotlight. Rather, mindwandering appears to shift the focus of sensory analysis to a more primitive or cursory cortical level.

B23

DIFFERENTIATED VISUAL AND MOTOR COMPONENTS OF CUEING EFFECTS ON ANTI-SACCADES *Aarlenne Z Khan[1], Stephen J Heinen[1], Robert M McPeek[1]; [1]Smith-Kettlewell Eye Research Institute, San Francisco, California* – Previous studies have shown that congruent spatial cues can influence saccade latencies (attentional capture vs. inhibition of return (IOR)). However, it is unclear whether the cue affects the time it takes to detect the visual target or to form the motor response to the same spatial location. To address this issue, we used a mirror-antisaccade task to dissociate visual detection from saccade generation and then tested the effect of a cue on these two components separately. Visual targets were presented at one of 4 oblique positions at a 7 degree distance from central fixation. Subjects made saccades to the mirror position of the visual target (90 degrees away), e.g. if the visual target was presented up and to the left, they were to make a saccade up and to the right. A cue was flashed randomly at one of the 4 positions at different times before the visual target was presented. Therefore, the cue could appear at a location that was the same as or opposite to that of either the saccade goal or the visual target. We found that the spatial cue affected the visual detection of the target but not the motor planning stage, suggesting that attention may influence only early sensory processing. In addition we found that the cue only affected visual detection at very short cue-target delays (attentional capture but no IOR). This suggests that different attentional components, i.e. early attentional facilitation vs. later inhibitory mechanisms, are subserved by distinct neural substrates.

B24

EFFECTS OF HEALTHY AGING ON THE DISTRIBUTION OF ATTENTION IN A WORKING MEMORY TASK *Reshma Kumar[1], Pamela Greenwood[1], Raja Parasuraman[1]; [1]George Mason University* – Attention and working memory are mutually dependent processes that interact. Specifically, selective attention can restrict the contents of working memory to task-relevant events. Consequently, age-related decline in working memory performance may reflect reduced efficiency of selective attention. We tested this hypothesis by using verbal and spatial versions of the 2-back task to assess the effect of attention on working memory. The task presented a continuous string of discrete letters to which a match/non-match response was required which compared the identity (verbal 2-back) or spatial location (spatial 2-back) of the current letter to one presented 2 trials previously. To manipulate the focus of attention, letters could occur at two possible locations -- 2° or 4.8° from central fixation -- along two imaginary circles. Target letters (1°) appeared equiprobably at all 12 locations for 200ms, followed by a response interval of 2750ms. For the spatial task, older adults showed increased accuracy when targets appeared at the farther location while younger adults benefited from targets appearing closer to central fixation ($p < 0.01$). No age effects were seen for the verbal task. For both tasks, older adults were more accurate on match trials while younger adults performed better on non-match trials. Results show (a) the attentional distribution influences the efficiency of spatial encoding; (b) in healthy aging, attention is broadly distributed facilitating peripheral at the expense of central spatial encoding in working memory. Therefore, one explanation for age deficits in spatial working memory is the different distribution of visuospatial attention.

B25

THE NEURAL FATE OF ATTENDED VS. IGNORED WORDS: LESSONS FROM NEUROLOGICALLY HEALTHY PARTICIPANTS AND A PATIENT WITH UNILATERAL NEGLECT *Ayelet Landau[1], Lara Pierce[2], Lynn Robertson[1,3]; [1]University of California, Berkeley, CA, [2]University of Victoria, British Columbia, Canada, [3]Veterans Administration, Martinez, CA* – The present study was designed to examine perceptual responses to words under different attentional conditions in normal participants and in patients with unilateral neglect. EEG was recorded from scalp electrodes while participants were either attending or ignoring words presented lateralized to fixation. The focus was on the N170 ERP to words and was measured for both attention conditions (attend/ignore). Each display contained a symbol at the center of fixation and a lateralized presentation of a word. Words either appeared to the left or to the right of fixation (in separate blocks). In the attend-word condition, participants were monitoring the peripheral words covertly for an inverted word. In the ignore-word condition participants were instructed to monitor the symbols for an 'x'. ERPs to attended and ignored words were compared in a group of 16 neurologically healthy participants and a patient with neglect. In the neurologically healthy group the N170 was modulated by spatial attention. Namely the N170 was larger to attended words compared to identical displays in which the words were ignored. This finding was consistent across visual fields and was present in both hemispheres. In the patient with unilateral neglect attention modulation of the N170 depended on the visual field of the lateralized-stimulus. When a word appeared in the LVF (the bad field) this modulation was present in both hemispheres. When a word appeared in the RVF (the good field) the modulation was restricted to the intact hemisphere suggesting a functional asymmetry in hemispheric relay subsequent to unilateral damage.

B26

FUNCTIONAL NETWORKS UNDERLYING HUMAN TOP-DOWN VISUAL SPATIAL ATTENTION *Thomas Lauritzen[1,2,3], Mark D'Esposito[2,3], David Heeger[5], Michael Silver[2,3,4]; [1]Redwood Center for Theoretical Neuroscience, UC Berkeley, [2]Helen Wills Neuroscience Institute, UC Berkeley, [3]Wheeler Brain Imaging Center, UC Berkeley, [4]School of Optometry, UC Berkeley, [5]Center for Neural Science, New York University* – Visual spatial attention enhances perception at attended locations. Functional magnetic resonance imaging (fMRI) studies have shown that allocation of attention increases fMRI signals in portions of early visual cortex that retinotopically represent the attended location, even in the absence of a visual stimulus (Kastner et al. 1999). When attention is maintained during a delay period, these visual cortical signals are sustained for the duration of the delay period (Silver et al., 2007). IPS1 and IPS2 are topographically organized areas in human posterior parietal cortex that may transmit top-down spatial attention signals to early visual cortex (Silver et al., 2005). We employed fMRI and computed coherency among visual cortical areas and IPS1 and IPS2 during periods of sustained visual spatial attention in the absence of visual stimulation. Subjects performed a visual detection task in which a variable-duration delay period preceded target presentation. During the delay period, subjects continuously maintained attention at the visual field locations corresponding to the annulus. We calculated coherency magnitudes (strength of coupling) and phase delays (temporal differences in activity) between pairs of cortical areas during periods of sustained visual spatial attention and for periods of visual fixation. The magnitudes and phase delays during fixation were subtracted from the corresponding measures during sustained attention to determine the functional connectivity specific to top-down spatial attention. Both the coherency magnitude and phase delay results are consistent with transmission of top-down spatial attention signals from IPS1 and IPS2 to early visual cortex.

B27

NEURAL BASIS OF ATTENTIONAL TOP-DOWN MODULATION OF CAUSAL JUDGMENT *Roberto Limongi-Tirado[1,2], Reza Habib[1], Michael Young[1], Karen Reinke[1,3]; [1]Southern Illinois University Carbondale, [2]Venezuelan Institute for Scientific Research, [3]University of Illinois at Springfield* – The behavioral literature has reported a differentiation between bottom-up (perceived) and top-down (inferred) causality. While the bottom-up approach presupposes that the brain automatically detects direct causal events, we propose that linguistic representations of causation increase the system's sensitivity to detect a wide range of indirect causal events via top-down modulation of the sensory input. Psycholinguistic research has shown that whereas lexical sentences such as "the orange ball moves the purple ball" describe direct causal events, periphrastic structures of the form "the orange ball causes the purple ball to move" could represent either direct or indirect events. Consequently, we hypothesized that a periphrastic verbal instruction would modulate the perception of the visual causal events. We used functional magnetic resonance imaging to identify the neural basis of this linguistic top-down modulation. In a decision task, participants observed lexical and periphrastic verbal instructions followed by animations of causal (direct and indirect) and non-causal events. During the reading of the periphrastic verbal instruction, activations were noted in the frontal cortex, the caudate nucleus and the visual cortex. Moreover, during the observation of the animations under the periphrastic condition, we found differential activity in frontal, temporal, and parietal regions previously reported as participating in goal-directed attentional tasks. We summarize these results as the periphrastic effect, and hypothesize a two-stage top-down modulation of causal judgment. Fronto-striatum connections might elicit anticipatory activity in the visual area which, in turn, would be followed by activity in areas associated with top-down attentional control.

B28

THE ROLE OF THE HUMAN PULVINAR IN VISUAL ATTENTION AND ACTION: EVIDENCE FROM TEMPORAL ORDER JUDGMENTS, SACCADE DECISION AND ANTI-SACCADE TASKS *Liana Machado[1], Isabel Arend[2], Michelle McGrath[2], Tony Ro[3], Robert Ward[2], Robert Rafal[2]; [1]University of Otago, [2]Bangor University, [3]Rice University* – Recent research indicates that the pulvinar nucleus of the thalamus may play a key role in visual attention functions. We investigated the contribution of the human pulvinar to visual attention and oculomotor behavior by testing a small pool of patients with unilateral lesions involving the pulvinar nucleus. Here we present new evidence for the role of this structure in both visual attention and eye movements through perceptual and oculomotor versions of a temporal order judgment task and an anti-saccade task. Pulvinar damage induces a bias against contralesional stimuli for both perceptual temporal order judgments and saccadic decision, and also increases the latency of anti-saccades for contralesional targets. The demonstration that pulvinar damage affects both visual perception and eye movement behavior highlights the role of this structure as a part of the complex network engaged in integrating visual and oculomotor signals that are central for both visual attention and action.

B29

IMPROVEMENTS IN PERCEPTUAL THRESHOLD WITH INTENSIVE ATTENTION TRAINING THROUGH CONCENTRATION MEDITATION *Katherine MacLean[1,2], Clifford Saron[2], Stephen Aichele[2], David Bridwell[2], Tonya Jacobs[2], Anthony Zanesco[2], George Mangun[1,2]; [1]University of California, Davis, [2]University of California Davis/Center for Mind and Brain* – The practice of concentration meditation aims to cultivate trait improvements in selective attention, perceptual resolution and attentional control. Selective attention has consistently been shown to promote perceptual learning such that discrimination of attended features improves with exposure and training. In this vein, meditation training may enhance perceptual learning as task relevant features are better attended during exposure. We investigated changes in perceptual discrimination threshold in a group of participants (n = 30) who practiced concentration meditation (shamatha taught by Alan Wallace) for 8-10 hours/day during the course of a 3-month retreat. We compared their performance on computer-based tasks to that of a group of wait-list controls (n=30) who were matched on demographic, psychological and performance-based factors. Continuous EEG from 88 channels was collected during task performance. Visual discrimination thresholds – the visual angle difference between a long non-target line and a short target line - were determined using Parameter Estimation through Sequential Testing (PEST). At each of three testing points, participants completed the threshold task immediately before a related visual sustained attention task. Results from t-tests show that the groups had similar thresholds at pre-test (p = .73), with retreat participants exhibiting a trend toward lower thresholds at mid-test (p = .07) and significantly lower thresholds at post-test (p = .01). These findings demonstrate that intensive training in concentration meditation can lead to generalizable improvements in perception that are likely driven by enhanced selective attention. Changes in early and late ERPs describe the neural processing that underlies the observed improvements.

B30

TOP-DOWN MODULATION OF VISUAL CORTEX BY HIGH-LEVEL ATTENTIONAL CONTROL REGIONS OBSERVED BY MEG-BASED GRANGER CAUSALITY ANALYSIS *Muhilan Mahalingam[1], Steven L Bressler[1], Rajamini Sreenivasan[2], Dimitrios Pantazis[3], Darren L Weber[4], Corby L Dale[5], Richard M Leahy[3], Gregory V Simpson[5]; [1]Florida Atlantic University, [2]National Institute of Mental Health, [3]University of Southern California, [4]Smith Kettlewell Institute, [5]University of California, San Francisco* – Although prefrontal and posterior parietal cortical areas have been implicated as high-level control regions in the top-down biasing of visual spatial attention, the nature of their influence on low-level visual cortical regions has not been resolved. We hypothesized that following spatial cueing top-down attentional modulation of representations of the cued location is facilitatory and that of the non-cued location is suppressive. We therefore predicted that top-down influences from prefrontal and posterior parietal regions to visual cortical regions observed after spatial cueing would differentially modulate visual cortical representations of cued and non-cued locations. We tested this prediction with Granger Causality analysis of magnetoencephalographic (MEG) data collected from 8 human subjects as they performed a cued covert visual spatial attention task. A cortically-constrained minimum norm imaging method was used to localize 40,000 cortical sources from which ROIs were selected for analysis. MultiVariate AutoRegressive (MVAR) modeling was used to derive spectral power, coherence and Granger causality. Analyzing these spectral measures in multiple frequency bands and in multiple post-cue time windows, we characterized the nature of cortico-cortical interactions of high-level control regions with low-level visual cortical regions in relation to visual spatial attention.

B31

FMRI INVESTIGATIONS OF THE EFFECT OF MACULAR DEGENERATION ON SPATIAL ATTENTION *Keith L. Main[1], Kevin P. Moloney[1], Erin N. Kinzel[1], Jimmy Ginn[1], Temilade A. Adelore[1], Susan A. Primo[2], Julie A. Jacko[1,2], Eric H. Schumacher[1]; [1]Georgia Institute of Technology, [2]Emory University* – Research indicates that human visual cortex is able to reorganize in response to retinal deafferentation. Studies conducted on patients with ocular or retinal diseases, such as macular degeneration (MD), show that lesion projection zones (LPZ) begin to respond to ectopic stimulation in the peripheral retina (Baker et al, 2005). This reorganization may depend on whether patients adopt a preferred retinal location (PRL) (Main et al, 2007). These findings indicate that visual cortex may be able to adapt either structurally, functionally, or both, to changes in sensory input. In addition to changes in striate cortex, reorganization may extend to extrastriate and executive control areas of the brain. Connections between striate cortex and these areas have been demonstrated in the normal human brain (Desimone & Duncan, 1995). Such connections may allow changes in the organization of striate cortex to subsequently affect extrastriate and frontal brain areas that mediate attention. To investigate this hypothesis, we examined the spatial attention of patients with MD using both behavioral and fMRI procedures. We found marked departures in the way MD patients allocate their attention between their PRLs and other, non-PRL, retinal areas. These behavioral findings were corroborated by fMRI data, showing differential activation in neural correlates of attention in response to stimulation of the PRL and Non-PRL areas.

B32

ACTIVITY WITHIN THE HUMAN MIRROR SYSTEM DURING IMITATION OF UNSEEN HAND ACTIONS: AN FMRI STUDY USING CONTINUOUS FLASH SUPPRESSION *Jason B. Mattingley[1], Chris Brander[1], Darren Tan[1], Trevor Chong[1], Ross Cunnington[1]; [1]Queensland Brain Institute & School of Psychology, University of Queensland* – The primate 'mirror neuron' system is thought to provide a neural mechanism through which perceived actions are understood by engaging representations within an observer's own motor repertoire. Evidence from monkeys suggests that some mirror neurons are sensitive to the degree of correspondence between observed and executed actions. In humans, this is manifested as a congruency effect for actions that are performed while participants observe task-irrelevant matching versus non-matching actions. Here we investigated whether such congruency effects are evident within the human mirror system during imitation of actions that are rendered invisible using continuous flash suppression. In the first phase of the study, we used fMRI to localize areas of the brain that responded under all four of the following conditions: (1) passive observation of actions; (2) self-selection of actions; (3) cued actions; and (4) imitated actions. Neural responses within these operationally defined mirror areas were then examined in a second phase in which participants performed a familiar hand action (e.g., hammering a nail) while viewing dynamic displays of congruent or incongruent actions. The visual displays were either visible or rendered invisible using continuous flash suppression. Activity within the mirror regions did not vary significantly with congruency for visible actions; by contrast, a small region of the left premotor cortex was sensitive to the congruency manipulation when the observed hand actions were not consciously perceived. The findings suggest that in the absence of strategic control processes the mirror system encodes potential conflict between observed and executed actions.

B33

A NEW ELECTROPHYSIOLOGICAL MARKER OF ATTENTIONAL SUPPRESSION IN HUMANS *John McDonald[1], Clayton Hickey[2], Vincent Di Lollo[1]; [1]Simon Fraser University, [2]Vrije Universiteit Amsterdam* – Attentional selection of a target item that pops out from surrounding distractor items can be indexed with an event-related potential (ERP) component known as the N2pc. Several lines of evidence suggest that the N2pc reflects a fundamental mechanism of attention that acts upon the neural representation of the target to reduce ambiguity resulting from the presentation of nearby distractors. However, results from other methodologies suggest that attention can also act upon the neural representation of the distractors themselves. Here, we report the results of several experiments designed to identify ERP correlates of the direct suppression of distractor representations. In the first experiment, participants viewed sparse visual search arrays containing a target and a single distractor that was isoluminant with the background. When the target appeared on the vertical meridian and thus produced no lateralized activity, we observed a positive ERP component contralateral to the lateral distractor. We labeled this posterior contralateral ERP component the distractor positivity (PD). We found that the PD was present when participants discriminates the shape of the target but not when participants detected the target (Experiment 2) or when the distractor was presented with a non-target item that was task irrelevant (Experiment 3). These results indicate that the PD reflects suppression of the cortical representation of the distractor and that such suppression occurs only when participants are actively attending to another item in the display.

B34

ROLES OF SUPERIOR COLLICULUS AND FRONTAL EYE FIELD IN STIMULUS-DRIVEN AND TOP-DOWN ATTENTION SHIFTS *Robert McPeek[1], Byeong-Taek Lee[1]; [1]Smith-Kettlewell Eye Research Institute* – Covert spatial attention can be captured by a salient stimulus or voluntarily shifted using top-down mechanisms. To investigate whether the primate superior colliculus (SC) and frontal eye field (FEF) play different roles in attention, we recorded single-unit activity as monkeys fixated and discriminated the orientation of a briefly-presented peripheral target embedded in an array of distractors. In some blocks of trials, stimulus-driven attention was tested by cueing the target location with a color-oddity cue. In other blocks, top-down attention was tested by making the target more likely to appear in one location than in the others. Both manipulations had significant effects on the accuracy of discriminating the target's orientation, indicating that they influenced attention. If SC and FEF cells are involved in controlling attention, they should show a modulation in activity after presentation of the attentional precue and before the onset of the target. We found that activity during this "pre-target" time interval was strongly modulated by precues in the stimulus-driven attention task for a subpopulation of both SC and FEF cells. The activity was correlated with the locus and timecourse of attention, as well as with behavioral performance. In contrast, in the top-down attention task, only FEF cells showed strong pre-target activity modulations. These results suggest that stimulus-driven shifts involve both the SC and the FEF, while top-down shifts involve the FEF, but not the SC. This dissociation supports the idea that stimulus-driven and top-down shifts of attention are processed, at least in part, by different neural pathways.

B35

VISUAL STRATEGIES DURING TEXTBOOK READING *Lisa M. Meschino[1], Michael G. Reynolds[2], Daniel Smilek[1]; [1]University of Waterloo, [2]Trent University* – Textbook reading is a common student activity, yet very little is known about how visual attention is strategically deployed during this task. We addressed this issue by observing participants' eye movements as they read two four-page sections taken from two different chapters of an undergraduate textbook. The textbook pages were presented to participants on a wide-screen computer in two-page spreads. Participants could "turn" the pages by pressing the trigger on a gamepad. The layout of each textbook section included headings, sub-headings, text arranged in a two-column format, coloured figures, tables, photos and text boxes. Participants were given 10 minutes to read each section, during which time their eye movements were monitored. Each reading task was followed by a comprehension task that tested the participants' memory of the content. Finally, participants provided subjective reports of their reading strategies. The results show that there are several distinct phases of reading that are consistent across individuals. In addition, we found several different reading strategies within these phases that varied across individuals. These findings are discussed in terms of the relationship between the visual dimensions of text, reading strategies, and reading comprehension.

Higher level cognition: Disorders

B36

DIMINISHED PERCEPTION OF SADNESS IN HIGH FUNCTIONING AUTISM SPECTRUM DISORDERS *Laura Case[1], Lauren Kenworthy[2,1], Alex Martin[1], Gregory Wallace[1]; [1]National Institute of Mental Health, [2]Center for Autism Spectrum Disorders, Children's National Medical Center* – Facial emotion recognition tasks are one way of assessing social-emotional processing difficulties associated with autism spectrum disorders (ASD). We use a finely graduated morphing paradigm to evaluate differences in perceptual sensitivity (PS) to emotional expression between ASD and typically developing (TD) male adolescents and to clarify the relationship between PS and ASD symptomatology (Autism Diagnostic Observation Schedule [ADOS]). Neutral and emotional faces (happy, sad, fear, anger, surprise, disgust) were morphed to create series of 21 images for each emotion advancing from 0-100% emotion. High-functioning (IQ>80) ASD adolescents (N=28) and matched TD controls (N=23) viewed each series and named the emotion shown. Performance was assessed by accuracy and by PS (the number of morphs earlier than 100% emotional expression). The groups did not differ in accuracy. ASD adolescents showed overall lower PS than TD adolescents ($p<0.01$) and there was an interaction between group and emotion ($p<0.05$). Pairwise comparisons revealed lower PS in ASD participants to sad, happy, and disgust; only sad remained significant after controlling for overall PS. While sensitivity to sad was high for TD participants, it was the lowest of all six emotions for the ASD participants. In addition, PS to sad among ASD adolescents correlated with the ADOS social interaction score ($p<0.01$). These findings suggest a relation between perception of facial emotion, especially sadness, and real-life social difficulties in ASD.

B37

SLORETA REVEALS RESTING ANTERIOR CINGULATE THETA BAND POWER DIFFERENCES IN HIGH VS. LOW OBSESSIVE COMPULSIVE SYMPTOMOLOGY *James Cavanagh[1], Theo Gruendler[2], Christina Figueroa[1], Antonia Kaczkurkin[1], Michael Frank[1], John Allen[1]; [1]University of Arizona, [2]Max-Planck Institute for Neurological Research* – A hyperactive striatal-cortical circuit has been hypothesized to underlie the obtrusive thoughts and repetitive behaviors which comprise obsessive-compulsive (OC) symptoms. Larger error-related negativities (ERNs) generated from the anterior cingulate cortex (ACC) have been proposed to reflect hyperactive error signals originating from this network in OCD, as well as across OC symptom scores in non-patients. This study reveals that resting EEG power may reflect specific tonic alterations in ACC functioning as a function of OC symptom scores. Two minutes of resting EEG from 61 undergraduates scoring over a range of OC symptoms were investigated using the sLORETA source localization algorithm. High OC participants displayed significantly higher relative theta band power in rostral ACC, but lower relative theta band power in dorsal ACC when compared to either Middle or Low OC groups. Degree of self-reported obsession frequency demonstrated a similar correlation with resting ACC theta power (hotter rostral ACC, cooler dorsal ACC) across all participants. Region-of-interest analysis indicated that relative dorsal ACC theta power at rest directly predicted future ERN amplitude during a probabilistic learning task. However, ERN amplitudes were diminished in High OC; possibly conflicting with a hyperactive error monitoring account, but fitting with a hypoactive dorsal ACC account. A replication and extension study is currently underway to offer insight into: 1) the functional role of different ACC sub-regions in OCD, and 2) the specificity of the ERN as an index of error monitoring.

B38

CHILDREN WITH DYSLEXIA SHOW WEAKER BRAIN ACTIVATION IN ORTHOGRAPHIC AND PHONOLOGICAL PROCESSING REGIONS DURING SPOKEN LANGUAGE PROCESSING *Nadia Cone[1], Donald Bolger[1], Caroline Na[1], Douglas Burman[1,2], James Booth[1,2]; [1]Northwestern University, [2]Evanston Northwestern Healthcare* – We examined differences in brain activation between dyslexic and normally-achieving children (9- to 15-years of age) during an auditory rhyme decision task using functional magnetic resonance imaging (fMRI). Both groups showed activation across all conditions in bilateral superior and middle temporal gyri (BA 42, 22, 21) and medial frontal cortex (BA 6, 32), with no significant group differences in activation of these regions. Only the normally-achieving children showed activation of left fusiform cortex (BA 37), which has been previously implicated in orthographic processing, and direct comparison of the two groups revealed significantly greater activation in this region in the normally-achieving children. When comparing activation to conflicting (i.e., matching orthographic but non-matching phonological endings; e.g., PINT-MINT) versus nonconflicting (i.e., non-matching in terms of both phonological and orthographic endings; e.g., STAFF-GAIN) conditions, the normally-achieving children showed greater activation in left middle frontal cortex (BA 9) in the conflicting condition, and significantly more so than the dyslexic children. Activation in left middle frontal cortex (BA 9) has been shown to be correlated with phonological naming ability, so greater activation of this region by normally-achieving children in the conflicting condition suggests that they effectively recruit this region for task-relevant phonological processing in order to resolve conflict from the orthographic domain. Altogether, our results suggest that normally-achieving children more automatically activate orthographic representations of auditorily-presented words, yet also more effectively resolve conflict between phonological and orthographic representations, than do dyslexic children.

B39

FUNCTIONAL BRAIN ACTIVIATION AND SUBJECTIVE EMOTIONAL EXPERIENCE IN SCHIZOPHRENIA *Erin Connor[1], Yvette Sheline[1], Deanna Barch[1]; [1]Washington University in St. Louis* – Emotional disturbances are well-known clinical features of schizophrenia, but self-report data suggests that patients with schizophrenia experience intact emotions. In this study, we explored this disconnect by using fMRI to examine brain activity during emotional processing and its relationship to subsequent memory. Forty individuals with schizophrenia and 32 demographically matched controls made arousal and valence ratings to stimuli consisting of pictures, words, and faces that varied in both arousal and emotional valence. After scanning, the participants were given surprise recall and recognition tests. For both arousal and valence, the ratings were modulated by emotion in the same way in both patients and controls. The fMRI data showed decreased overall activity in patients in a number of regions including the basal ganglia, left DLPFC, and right amygdala. However, the activity in these regions interacted with emotion in the same way as in controls. In the memory tasks, patients showed poorer memory overall, but recall was facilitated by arousal in both groups, indicating an intact influence of emotion on memory. However, the relationship between brain activity during the rating task and subsequent recall differed between groups in regions such as the basal ganglia and amygdala. In these regions, increased activity during the rating task predicted subsequent recall in controls, but not in patients. These findings indicate that while patients with schizophrenia experience intact emotion and memory for emotional events, there are abnormalities in how these events are encoded in patients relative to controls.

B40

NORMAL SEMANTIC INTEGRATION IN HEALTHY SUBJECTS MORE PRONE TO DELUSIONS *J. Bruno Debruille[1], Marie Prévost[1], Mitchell Rodier[1], Louis Renoult[1], Mathieu Brodeur[1], Claire Lionnet[2]; [1]McGill University, [6]Douglas Mental Health University Institute* – In two previous studies, more delusional schizophrenia patients were found to have smaller N400 event-related potentials (ERPs) than less delusional patients, suggesting a deficit in semantic processes (Debruille, et al., 2007; Kiang et al. 2007). In the present study, we examined whether delusion proneness is also accompanied by an N400 amplitude reduction in healthy subjects who perform the same semantic categorization task as that used with patients. The schizotypal personality questionnaire (Raine, 1991) was utilized to assess the delusion proneness, the interpersonal and the disorganization factors scores. Subjects were presented with a semantic categorization task where the prime word, 'ANIMAL?' was followed either by an animal name (e. g., dog) or by a name of a 'thing' (e. g., table). No correlation between the delusion proneness scores and the N400 amplitudes was found. Thus, it seems that the semantic deficit found in delusional schizophrenia patients cannot be found in more prone to delusion healthy subjects. Disorganization scores correlated with enhanced N400 amplitudes, confirming previous results in schizophrenia patients (Andrews et al., 1993). Moreover, as in Kiang and Kutas (2005) the interpersonal scores correlated with reduced N400 effects. Our study thus showed that the semantic processes that are indexed by the N400 may be normal in healthy subjects who are more prone to delusion.

B41

AN ERP EXAMINATION OF LEXICO-SEMANTIC AND CONTEXTUAL INFLUENCES ACROSS SENTENCE BOUNDARIES IN SCHIZOPHRENIA *Tali Ditman[1,2], Gina Kuperberg[1,2]; [1]Massachusetts General Hospital, [2]Tufts University* – The present study investigated whether schizophrenia patients would use lexico-semantic and contextual information across several sentences to correctly resolve an ambiguous noun-phrase anaphor. We examined ERPs as schizophrenia patients and healthy demographically-matched controls read scenarios. Below is an example: 1. Champagne is served at a New Year's party. 2. Beer is served at a ballpark. 3. Cake is served at a birthday party. 4. At the New Year's party, Bill took a sip of the alcohol. 5. The champagne was good.

Sentences 1-3 introduced three possible antecedents (champagne, beer, cake). Two of these antecedents were exemplars of the anaphor (alcohol), presented at the end of sentence four. Sentence five began with one of three "reinstatement" words: contextually-appropriate and lexico-semantically related words (champagne), contextually-inappropriate but lexico-semantically related words (beer), or contextually-inappropriate and unrelated words (cake). Participants indicated whether the last two sentences referred to the same entity. N400 amplitude reflected the ease of semantically integrating the reinstatement word into its preceding context. Results demonstrated that, similar to controls, patients used context and lexico-semantic associations across sentences to resolve anaphors. Specifically, the largest N400 was evoked to contextually-inappropriate and unrelated words, a medium-sized N400 was evoked to contextually-inappropriate but lexico-semantically related words, and the smallest amplitude N400 was evoked to contextually-appropriate and lexico-semantically related words. Behaviorally, patients were more likely than controls to erroneously resolve anaphors with contextually-inappropriate, but lexico-semantically related, words. Thus, strong contextual constraints led to discourse-appropriate neural responses but later decisions were more likely guided by lexico-semantic associations.

B42

INTERACTIONS BETWEEN LANGUAGE AND MEMORY IN TOURETTE'S SYNDROME: NEW EVIDENCE *Cristina Dye[1], Dezso Nemeth[1,2], Matthew Walenski[3], Stewart Mostofsky[4], Michael Ullman[1]; [1]Georgetown University, [2]University of Szeged, [3]University of California at San Diego, [4]Kennedy Krieger Institute, Johns Hopkins University School of Medicine* – Tourette's Syndrome (TS) is a developmental disorder characterized by verbal and motor tics. The tics, which are fast and involuntary, are linked to abnormalities in frontal/basal-ganglia circuits. Few previous studies have examined language in the disorder. Recently we found that children with TS were significantly faster than typically developing control children at producing rule-governed real and novel past tenses (slip–slipped, bring–bringed, plim–plimmed) but not irregular and other unpredictable past tenses (bring–brought, splim–splam). They were also faster than controls in naming pictures of manipulated (hammer) but not non-manipulated (elephant) items (Walenski, Mostofsky and Ullman, 2007). These data were not explained by a wide range of potentially confounding subject- and item-level factors. The results were taken to suggest that the processing of procedurally based knowledge, both of grammar and of manipulated objects, is particularly speeded in TS. The present study on TS and typically-developing control children extends the previous investigation in two ways. First, we used revised versions of the past tense production and object naming tasks, controlling for additional confounding factors. Additionally and most importantly, we assessed receptive syntactic processing of active and passive sentences (e.g., John loves Mary > Mary is loved by John), receptive lexical-conceptual processing in an object judgment task, and phonological short-term memory with a non-word repetition task. Details of the analysis and results are presented, along with discussion and implications.

B43

RECREATIONAL MDMA USE AFFECTS FMRI BRAIN ACTIVATION IN FOREBRAIN SEROTONIN TARGET REGIONS DURING ASSOCIATIVE LEARNING *James Eliassen[1,2], Jane Allendorfer[1,2], Martine Lamy[1,2]; [1]University of Cincinnati, Center for Imaging Research, [2]University of Cincinnati* – Learning and memory impairments have been linked to recreational MDMA ("ecstasy") use. In animals MDMA damages serotonergic axons. Despite substantial research, the neurotoxic effects of human MDMA use remain uncertain, and MDMA may have medical uses for PTSD and anxiety. In order to ascertain the functional effects of recreational MDMA use on human associative learning circuits, we studied seven heavy current MDMA users and seven matched non-MDMA drug-using comparison subjects. After obtaining written informed consent, we interviewed participants for their drug use history and administered the Beck Depression Inventory and California Verbal Learning Test. We acquired functional MRI while participants performed an associative learning paradigm. We acquired standard gradient-echo echoplanar fMRI and anatomical images on a Varian 4T INOVA. Two 6-minute fMRI scans each consisted of 16 control trials and 32 associative learning trials. Subjects viewed the task through MR compatible goggles and responded with a button box in the right hand. FMRI processing included motion correction, smoothing, normalization, event-related modeling, and random effects analyses. The associative task required participants to learn associations between 4 easily named color pictures and two buttons through trial and error with using feedback. We observed significantly greater learning activation in MDMA users in right ventrolateral (BA10) and left dorsolateral PFC (BA9), precuneus (BA7) and right thalamus. There were no performance differences between groups. These data suggest that MDMA users exhibit compensatory brain activation, but the correspondence between fMRI group differences and forebrain serotonin targets is limited to thalamus and right ventrolateral PFC.

B44

NEURAL NETWORKS UNDERLYING SPATIAL ATTENTION AND VISUO-SPATIAL NEGLECT *Gail Eskes[1], John Christie[1], David Westwood[1], Patricia McMullen[1], Michael Noseworthy[2], Raymond Klein[1], Matthias Schmidt[1]; [1]Dalhousie University, [2]McMaster University* – Background: Visuo-spatial neglect is a heterogenous disorder that can be divided into perceptual neglect (i.e., impaired reception of perceptual information from the left side) vs motor neglect or directional hypokinesia (i.e., difficulty with responding leftward with the unaffected limb). Mattingley, Husain & colleagues developed a novel task to distinguish these subtypes, presumed to eliminate extraneous task requirements (e.g., conflict resolution) dependent upon frontal system function. The purpose of our study was to examine neurocognitive mechanisms in this task in normal subjects to provide converging evidence for its use in distinguishing neglect subtypes. Method: Ten normal subjects were tested with the Mattingley et al task modified for use while scanning with a 1.5T GE Twin Speed scanner in a block design. Subjects indicated the position of a target (left or right of fixation) by pressing one of two buttons. Variables included start position of the responding finger (center, left or right of response buttons) and RT to initiate movement to press was measured. Functional data sets were analyzed off-line with AFNI using t-tests corrected for multiple comparisons. Results: Behavioural results indicated slower RTs for response initiation when starting from peripheral positions compared to a central start. Peripheral start positions were also associated with increased activation in lateral prefrontal cortex compared to central start position. Conclusions: Both behavioural and imaging data are consistent with conflict processes associated with frontal involvement in this task in normals. These results suggest caution is warranted when using this task to distinguish neglect subtypes.

B45

PERSEVERATION ERRORS AND THE TEMPORAL DYNAMICS OF COGNITIVE PROCESSES *Simon Fischer-Baum[1], Brenda Rapp[1]; [1]Johns Hopkins University* – The study of perseveration errors, the intrusion of a previous response into a current trial, can provide information regarding the temporal dynamics of cognitive processing. However, the precise nature of the deficit/s which gives rise to perseveration errors subsequent to neural injury is not well understood. According to the deafferentation account, these errors occur because a level of representation is deprived of normal input (Cohen and Dehaene 1998). Given that in an intact system response activation persists and gradually decays, when damage reduces the input to a given processing level, the system will respond with recently produced items. An alternative, the abnormal persistence account, argues that previously produced representations persist at abnormally high rates, perhaps due to an imbalance of certain neurotransmitters (McNamara and Albert 2004). By this account, if the previous response cannot be suppressed, it may be selected in the place of a robustly activated target response. The current study examines a series of individuals with acquired dysgraphia subsequent to stroke who make errors in spelling-to-dictation. Careful analysis of these errors reveals that most individuals make more letter perseveration errors than would be expected by chance. However, a subset of these individuals perseverates at rates much higher than others despite comparable overall error rates. Various analyses are performed that indicate that while the deafferentation account is correct in predicting that neural injury may lead to greater than chance rates of perseveration, it alone cannot explain the extremely high rates of perseveration observed in some individuals.

B46

A CASE OF DEVELOPMENTAL PHONAGNOSIA *Lucia Garrido[1], Frank Eisner[1], Carolyn McGettigan[1], Lauren Stewart[2], Disa Sauter[3], Rick Hanley[4], Stefan Schweinberger[5], Bradley Duchaine[1]; [1]Institute of Cognitive Neuroscience, University College London, UK, [2]Goldsmiths, London, UK, [3]Birkbeck College, UK, [4]University of Essex, UK, [5]Institute of Psychology, Friedrich-Schiller-University of Jena, Germany* – The inability to recognize familiar voices is called phonagnosia. Since the term was first proposed by Van Lancker and Canter (1982), several studies have investigated cases of phonagnosia following brain damage, but cases due to developmental problems have not been reported. Here we will describe the case of KH, a 59 year-old active professional woman who reports that she has always experienced severe voice recognition difficulties. KH does not recognize even her closest relatives from their voices, such as when she answers the phone or hears them without seeing them. However, her hearing abilities are normal, and she does not report any brain damage. We tested KH on a number of behavioural tasks looking at voice recognition, recognition of vocal emotions, face recognition, speech perception and processing of other auditory stimuli such as environmental sounds and music. KH was impaired on tasks requiring the recognition of famous voices, and the learning and recognition of new voices. In contrast, she performed well on nearly all other tasks. This is, to our knowledge, the first report of a case of developmental phonagnosia, and its investigation provides a crucial means to test predictions from voice processing models.

B47

ABNORMAL FUNCTIONAL SPECIALIZATION WITHIN MEDIAL PREFRONTAL CORTEX IN HIGH-FUNCTIONING AUTISM: A MULTI-VOXEL CORRELATION APPROACH *Sam J. Gilbert[1], Julia Meuwese[1], Karren Towgood[1], Chris D. Frith[2], Paul W. Burgess[1]; [1]Institute of Cognitive Neuroscience, University College, London, [2]Wellcome Department of Imaging Neuroscience, Institute of Neurology, University College London* – In order to investigate functional specialization within medial rostral prefrontal cortex (mrPFC), we administered two tasks (spatial, verbal) previously shown to activate mrPFC to a group of high-functioning participants with autism spectrum disorder (ASD) and age- and IQ-matched controls. Each task manipulated a) attention towards perceptual versus self-generated information, and b) reflection on another person's mental state ('mentalizing' versus 'non-mentalizing') in a 2x2 factorial design. Behavioral performance and group-level analysis of the fMRI data was similar in the two groups. However, analysis of patterns of activity across voxels within mrPFC on a participant-by-participant basis revealed strong group differences. In the control group, the spatial distribution of attention-related activity generalised significantly between tasks (spatial, verbal), as did mentalizing-related activity, but attention-related and mentalizing-related activity patterns were uncorrelated with each other. This pattern was disrupted in the ASD group. These findings indicate abnormal fine-grained functional organisation of mrPFC in ASD, and suggest that multi-voxel pattern analysis is a sensitive method for identifying differences in brain organization in atypical populations.

B48

IMPAIRED ANTI-POINTING AND ANTI-SACCADE PERFORMANCE IN PATIENTS WITH HEMISPATIAL NEGLECT *Monika Harvey Stephanie Rossit, Stephen Butler, Bettina Olk, Keith Muir; University of Glasgow, UK, University of Strathclyde, UK, School of Humanities and Social Sciences, Jacobs University Bremen, Germany, Southern General Hospital, Glasgow, UK* – Hemispatial neglect is generally defined as the inability to spontaneously report, respond or orient towards events on the contralesional side of space. Milner and Goodale (2006) have claimed that the disorder results from a breakdown in a system that puts together visual information received via the ventral stream but that such patients are relatively unimpaired when programming goal-directed movements. We asked 6 neglect patients and right hemisphere lesioned patients without neglect as well as healthy elderly control subjects to perform both pro-and anti-pointing movements (anti-pointing movements require an explicit representation of the target location and are thus thought to rely more on ventral stream structures). We found no specific impairments in the pro-pointing condition, but neglect patients were selectively impaired in the anti-pointing in terms of final accuracy as well as in terms of directional errors in that they failed to inhibit a pro-pointing movement. We then investigated how these same patients would perform on an antisaccade task. Neglect patients showed relatively good prosaccade performance but clear impairments in the anti-saccade task in that they failed to suppress incorrect pro-saccades. These data confirm that on-line visuomotor processing is relatively normal in neglect patients but that they fail to acquire and/or transform the explicit spatial representation of targets for off-line remapping actions. Our data also further indicate that neglect patients suffer from deficits in response inhibition. Milner and Goodale (2006) The visual brain in action. OUP.

B49

ABNORMAL FUNCTIONAL CONNECTIVITY OF THE DEFAULT MODE NETWORK IN CHRONIC SCHIZOPHRENIA *Ryu-ichiro Hashimoto[1], KangUk Lee[1], Alexander Preus[1], Robert McCarley[1], Cynthia Wible[1]; [1]Schizophrenia Research Group, Harvard Medical School* – Previous functional imaging studies proposed that the brain has a default or intrinsic mode of functioning, which is active in the absence of presentation of sensory stimuli or engagement of cognitive tasks. In particular, the medial parietal area (MPA), the medial prefrontal area (MPFA), the lateral inferior parietal area (LIPA), and parts of the medial temporal structure (i.e. hippocampus) have been reported to show task-related reduction of activation. Although abnormality of the "default network" has been investigated in several clinical populations (i.e. autism), its association with schizophrenia has not yet been established. In the present fMRI study, we examined potential abnormality of areas in the default network in schizophrenia by comparing brain activity of 14 chronic schizophrenic (CSZ) patients and 14 normal control (NC) subjects under a verbal working memory paradigm. Comparing the magnitude of fMRI signals between the task and the rest period, we confirmed the previous findings that activity in the MPA, MPFA, the bilateral LIPA, and the hippocampus is larger during the rest period. In order to identify the possible deficiency in functional connectivity of the default network in schizophrenia, we examined the temporal correlation of the signals among these areas in each group. We found that, compared with NCs, CSZs had significantly reduced correlation between the MPA and the hippocampus, and between the MPA and MPFA ($p < 0.05$). These results suggest that schizophrenia may be associated with abnormalities in functional connectivity between areas in the default network, particularly the paths involving the MPA.

B50

AUTISM IN A 45 YEAR OLD MAN WITH A LARGE TEMPORAL ARACHNOID CYST. *Terence Hines[1,2], Alex Braun[2]; [1]Pace University, [2]New York Medical College* – We report the case of a male who died of gastric carcinoma at age 45. At autopsy a large (7 x 5 x 4 mm) arachnoid cyst was found in the left Sylvian fissure greatly displacing the frontoparietal and temporal operculae. The cyst probably dated from early childhood since there was considerable bony abnormality of the temporal bone at the base of the skull. A head CT taken two weeks prior to death showed a 2 to 3 mm midline shift from left to right. No other gross neuropathology was evident either on the scan or at autopsy. Postmortem studies of autistic brains have demonstrated a number of abnormalities at the cellular level. These include reduced number of Purkinje cells, differences in the thickness of the gray matter and abnormalities in the thickness of several cerebellar lobules. None of these abnormalities was found on gross or microscopic examination in the present case. fMRI studies have suggested abnormalities of function of the mirror neurons involved in the social aspects of disordered autistic behavior. These have been locatized to the inferior frontal areas. The cyst in this case was pressing strongly enough on this area on the left to cause the midline shift noted above. We speculate that in this case the autistic behavior was due not to any anatomical derangements at the cellular level, but to impaired function secondary to the cyst.

B51

CONGENITAL TOPOGRAPHICAL DISORIENTATION: A CASE STUDY. *Giuseppe Iaria[1], Nicholas Bogod[2], Christopher J Fox[1], Jason JJS Barton[1]; [1]University of British Columbia, Vancouver, Canada, [2]Neurosciences Program, Vancouver General Hospital, Vancouver, British Columbia, Canada* – Topographical disorientation is the impaired ability to orient within the environment. This selective impairment may result from acquired damage to different brain regions involved in the attentional, perceptual or mnemonic processes that participate in the human navigation and orientation. Despite a long history of reports of acquired topographagnosia, there are no prior reports of this occurring as a congenital deficit. We report a patient with apparently life-long topographical disorientation without obvious structural lesions on MRI, and without any other sensory or intellectual deficit. The patient was administered (1) a neuropsychological assessment (2) a variety of experimental tests to assess her ability to use different cognitive strategies in orientation and navigation, and (3) a functional Magnetic Resonance Imaging (fMRI) study aimed at investigating her neural pattern of activity while navigating in a virtual environment. Behavioural findings revealed a selective impairment in forming a mental representation of the environment (i.e. a cognitive map), and functional neuroimaging showed lack of neural activity within the hippocampus and retrosplenial cortex, brain regions that are critically involved during formation of cognitive maps, despite apparent normality of these regions on structural MRI. These findings suggest that, as with other cognitive disorders such as prosopagnosia, topographical disorientation may occur as a congenital defect, and result in a lifelong disorder affecting activities of daily living.

B52

SCHIZOTYPAL TENDENCIES, BRAIN STRUCTURE, AND PERSONALITY IN HEALTHY OLDER ADULTS *Marlisa Isom[1], Denise Head[1]; [1]Washington University in St. Louis* – Schizotypal personality disorder (SPD) is associated with volumetric reductions in frontostriatal and medial temporal circuits as well as impairments in executive functions and memory. However, it has not been established whether these changes are specific to the personality disorder or are instead linked to the personality traits of individuals with the disorder. While advancing age has been associated with a decline in the severity of symptoms of schizotypal personality disorder, the associated personality traits are still present. Studying older adults who are not frankly disordered and thus have not been exposed to psychiatric drugs will allow examination of brain structure, cognition, and personality relationships without psychiatric drug exposure confounds. The goal of the current study was to determine whether schizotypal tendencies, as measured with the Schizotypal Personality Questionnaire (SPQ), are predictive of structural and cognitive differences among a healthy older adult population. Twenty-three older adults aged 59-87 (14 female) were screened for mental and psychiatric illness. Participants completed the SPQ, a structural MRI, and a neuropsychological battery. A significant positive relationship between schizotypal tendency and left medial temporal lobe gray matter volume was observed, controlling for age. Scores on several subscales of the NEO-FFI also correlated with schizotypal tendencies. The results provide evidence of a relationship between schizotypal tendency, brain structure, and personality in an older adult sample without diagnosed SPD.

B53

PERFORMANCE ON NONVERBAL EXECUTIVE FUNCTION TASKS IN CHILDREN AND ADOLESCENTS WITH KLINEFELTER SYNDROME *Nancy Raitano Lee[1], Gregory Wallace[1], Liv Clasen[1], Jonathan Blumenthal[1], Rhoshel Lenroot[1], Jay Giedd[1]; [1]National Institute of Mental Health, National Institutes of Health* – Research has suggested that individuals with Klinefelter syndrome or XXY, a sex chromosome disorder in which males have an extra X-chromosome, have deficits on executive functioning (EF) tasks, tasks tapping higher level cognitive processes such as working memory and planning. However, findings have been mixed. Inconsistent findings may relate to differences in the verbal and motor demands of EF tasks used across studies, as research has documented verbal and motor weaknesses in the XXY group that may contribute to EF performance. The present study examined EF skills in a sample of 6-18 year old children and adolescents with XXY (n = 46) and typically developing male participants (n = 46) matched pairwise on age (mean age = 12.16 +/- 4.23) and groupwise on full scale IQ. EF tasks were chosen to have limited verbal and motor demands and were taken from the Cambridge Neuropsychological Test Automated Battery (Spatial Working Memory, Intra-Extra Dimensional Set Shift, and Stockings of Cambridge Tasks). While the XXY group demonstrated reductions in performance relative to the control group on this set of EF tasks, none of these differences was large enough to reach statistical significance. Therefore, these findings suggest that on certain EF tasks with minimal verbal and motor demands, children and adolescents with XXY perform similarly to typically developing control participants. Data collection is ongoing, and thus, these results will be explored further with a larger sample of individuals.

B54

WHAT DO LETTER AND COLOR PRIMING REVEAL ABOUT SYNASETHESIA? *Kelly A. Malcolmson[1], Daniel Smilek[1], Philip M. Merikle[1]; [1]University of Waterloo, Ontario, Canada* – Grapheme-color synaesthesia is a condition in which achromatic letters and digits elicit specific experiences of color. In a recent report on this condition, Mattingley, Rich, Yelland, and Bradshaw (2001) concluded that synaesthetic colors are not activated when the inducing graphemes are unavailable for conscious report. This conclusion was based on a finding that achromatic letters presented below the subjective threshold for awareness, do not prime color naming of a subsequent color patch even though they prime letter naming of a subsequent letter. As a comparison, we evaluated color and letter priming above and below the subjective threshold of awareness in non-synaesthetic participants. Across four experiments, participants were presented with a lower case letter prime that was either gray (letter priming) or colored (color priming), and an upper case target letter (letter priming) or colored patch (color priming). Participants named either the target letter or the color of the patch. The letter primes were presented either above or below the subjective threshold of awareness. The results showed that both letter and color priming were only obtained when primes were presented above the threshold for awareness, and only when an equal number of congruent and incongruent trials were used, leaving the possibility of strategic influences. When strategies were eliminated by increasing the proportion of incongruent trials, no priming occurred in any condition. These results suggest that both letter priming and color priming are unreliable. Therefore, we suggest caution when drawing conclusions about the nature of synaesthesia from unconscious priming results.

B55

THE ROLE OF THE CEREBELLUM IN SPATIAL ATTENTION IN AUTISM *Kristen Merkle[1,2], Rebecca Groen[1,2], Steve Dager[1,2], James Phillips[3], Geraldine Dawson[1,2], Sara Jane Webb[1,2]; [1]University of Washington Autism Center and Center on Human Development and Disability, [2]University* *of Washington, [3]Children's Hospital and Regional Medical Center, Seattle Washington* – While the specific cause of autism spectrum disorder (ASD) is still unknown, there has been a substantial amount of research documenting cerebellar dysfunction in individuals with ASD. Individuals with ASD have been found to have smaller cerebellum volume and vermal areas and perform worse on visual attention tasks than matched controls. Specifically, Harris et al. (1999) found that larger orienting deficits at 7.5 years were correlated with smaller vermal VI-VII areas at 4.5 years of age. To further explore the role of vermal area and visual attention, we examined the development of the vermis between 3 and 9 years of age, and spatial attention at 11 years of age in 13 children with ASD compared to matched controls. Magnetic resonance imaging was used to measure cerebellum volume and vermal area at 3, 6, and 9 years of age. Spatial attention was measured using a spatial target detection task. Differences in orienting based on the cue-target relation and the cue-target delay were analyzed. Preliminary results suggest that, in contrast to prior findings, children with ASD did not demonstrate impairments in orienting to targets at 11 years of age. Cerebellum volume at 3 years of age was related to the reaction time to invalid targets at 11 years. Further analyses examine whether or not changes in vermal area are also related to attention at 11 years.

B56

FACE BUILDING: AN FMRI INVESTIGATION OF BRAIN ACTIVATION OF FACES VERSUS HOUSES, OBJECTS, AND PATTERNS IN INDIVIDUALS WITH HIGH FUNCTIONING AUTISM *Laura Miller[1], Michal Assaf[1,2], Gregory Book[1], Godfrey Pearlson[1,2]; [1]Olin Neuropsychiatry Research Center, Insitute of Living, Hartford Hospital, CT, [2]Yale School of Medicine* – Background: Social interaction impairments are key deficits in individuals with autism spectrum disorders (ASD). An important aspect of social interaction is facial perception. We used an fMRI task to further explore brain regions associated with face processing in individuals with ASD. Methods: We tested 8 high functioning ASD patients (ages 12-21, all male) and 13 healthy controls (ages 14-25, 1 female) using BOLD fMRI. Subjects performed a face, building and object localization task. They were presented with static drawings of faces, houses, objects, and patterns and were asked to press a button with their right index finger whenever the same stimuli were presented twice in a row. The data were realigned, normalized, and smoothed using SPM2 neuroimaging software. Two sample t-tests were performed comparing activation between the groups in faces v. objects, houses, and patterns. Results: Preliminary results showed that individuals with ASD had significant differences in the fusiform gyrus (FG), when comparing activation during the presentation of faces versus objects, houses, and patterns. There were no significant differences between ASD and healthy controls. Conclusions: Our data suggest that individuals with ASD activate the FG in response to static faces similarly to healthy controls, when compared to static drawings of other, non-face categories. Implications of these results to patients' social impairments and clinical presentation will be discussed.

B57

DELAYED MIMICRY RESPONSE IN CHILDREN WITH AUTISM SPECTRUM DISORDERS: AN EMG STUDY *Lindsay Oberman[1,2,3], Piotr Winkielman[2], V.S. Ramachandran[1,2,4]; [1]Center for Brain and Cognition, UC San Diego, [2]UC San Diego, [3]Berenson-Allen Center for Noninvasive Brain Stimulation, Beth Israel Deconess Medical Center, Boston, MA, [4]UC San Diego* – "One may find by one's own observation that the imitation of the bodily expression of a mental condition makes us understand it much better than the merely looking on" (W. Fechner, as quoted in James, 1890). Spontaneous mimicry, including that of emotional facial expressions, is imporant for socio-emotional skills such as empathy and communication. Those skills are often impacted in autism spectrum disorders (ASD). Successful mimicry requires not only the activation of the response, but also its appropriate speed. Yet, previous studies only examined ASD differences in response magnitude. The current study investigated timing and magnitude of spontaneous and voluntary mimicry in ASD children and matched controls using facial electromyography (EMG). First, participants viewed and recognized happy, sad, fear, anger, disgust and neutral expressions presented at different durations. Later, participants voluntarily mimicked the expressions. There were no group differences on emotion recognition and amplitude of expression-appropriate EMG activity. However, ASD participants' spontaneous, but not voluntary, mimicry activity was delayed about 160 ms. This delay occurred across different expressions and presentation durations. We relate these findings to the literature on temporal dynamics in social interaction and ASD impairments in sensory-motor coordination.

B58

VOXEL-BASED MORPHOMETRY REVEALS DIFFERENTIAL PATTERNS OF ATROPHY IN DYSEXECUTIVE AND AMNESTIC MCI SUBGROUPS *Judy Pa[1], Adam L. Boxer[1], Katie Freeman[1], Michael W. Weiner[2], Julene K. Johnson[1]; [1]University of California, San Francisco, Memory and Aging Center, [2]San Francisco VA Medical Center, Center for Imaging of Neurodegenerative Diseases* – Mild Cognitive Impairment (MCI) is considered a transitional period between healthy aging and dementia. Many studies have investigated patients with amnestic MCI who have focal deficits in memory, while few studies have investigated non-amnestic MCI. Thus, the aim of this study was to compare brain atrophy patterns in two subgroups: amnestic and dysexcutive MCI. Dysexecutive MCI (dMCI) was operationally defined as patients who complained of recent onset of dysexecutive symptoms (e.g., attention, multi-tasking, behavior) or had impaired scores on executive, but not memory, measures. Amnestic MCI (aMCI) patients had impaired scores on memory, but not executive function. We used 1.5 Tesla T1-weighted MR images and investigated differences in the gray matter atrophy of 35 dMCI patients, 24 aMCI, and 35 healthy controls using voxel-based morphometry (VBM) in SPM5. We included age, gender, and total intracranial volume as nuisance variables. We examined differences in four a priori regions of interest: prefrontal cortex (PFC), posterior cingulate gyrus (pCG), precuneus, and medial temporal lobe (MTL). We predicted that dMCI would show more atrophy in PFC while aMCI would show more atrophy in MTL, pCG, and precuneus, compared to healthy controls. We found that dMCI patients had more atrophy in the PFC and precuneus when compared to controls. In contrast, aMCI had more atrophy in pCG and parahippocampal gyrus when compared to controls. We conclude that two distinct subgroups of MCI exist, and that dMCI and aMCI patients present with differential patterns of atrophy when compared to healthy aging.

B59

LOCALIZATION OF SEMANTIC PROCESSES ASSOCIATED WITH PRODUCING AND UNDERSTANDING TRANSITIVE ACTION *Norman Park[1,2], Eric Roy[3,4], Sandra Black[5,2,4], Jill Rich[1,2], Tobi Lubinsky[1], Quincy Almeida[6], Vessela Stamenova[5,4]; [1]York University, [2]Baycrest, University of Toronto, [3]University of Waterloo, [4]Rehabilitation Sciences, University of Toronto, [5]Sunnybrook Health Sciences Centre, University of Toronto, [6]Movement Disorders Research & Rehabilitation Centre, Wilfrid Laurier University* – The goals of this study were: to determine the relation of stored tool-action knowledge of tools to the production of gestures involving those tools (transitive gestures), to examine whether this knowledge is lateralized in the brain, and to investigate whether two types of semantic knowledge are distinct. Thirty-six participants with unilateral stroke were examined on their production of transitive gestures and on tasks requiring conceptual knowledge of actions. Two conceptual tests examined their ability to identify tools based on function and manipulation (function + manipulation knowledge) and two other tests examined their ability to make conceptual judgments when gestures were shown (visual-gesture knowledge). Performance on tests of function + manipulation knowledge and transitive gesture production were both impaired with damage to the left hemisphere. Visual-gestural knowledge performance was impaired with damage to either hemisphere. Impairments of function + manipulation knowledge generally co-occurred with apraxia (determined by impaired transitive gesture production), but apraxia was observed in the absence of conceptual impairment. Visual-gestural knowledge impairment was associated with apraxia after left but not right hemisphere damage. Impaired visual-gestural knowledge performance occurred in the absence of function + manipulation impairment with right hemisphere damage. We propose that function + manipulation knowledge is represented in the left hemisphere and is closely associated with cognitive processes involved in the production of transitive gestures. Visual-gestural knowledge appears to be bilaterally represented and it is less strongly associated to transitive gesture production. Function + manipulation knowledge and visual-gestural knowledge appear to represent distinct forms of tool-action knowledge.

B60

BASAL GANGLIA AND CEREBELLAR MOTOR CONTRIBUTIONS TO ATTENTIONAL PROCESSES IN AUTISM SPECTRUM DISORDERS *Susan Ravizza[1], Marjorie Solomon[2,3], Petrina Kaluzhny[2,3], Richard Ivry[4], Cameron Carter[2,5]; [1]Michigan State University, [2]UC Davis, [3]MIND Institute/UC Davis, [4]UC Berkeley, [5]Imaging Research Center/UC Davis* – Adolescents with autism often show difficulty allocating and shifting selective attention. In addition to abnormalities of the parietal and prefrontal cortices, autism is marked by widespread pathology in neural regions associated with movement disorders such as the cerebellum and the basal ganglia. Individuals with autism-spectrum disorders (ASD) often present with abnormal motor signs (e.g., mirror movements). We sought to assess the degree to which attentional impairments may be modulated by motor demands and evaluate if any such relationship was correlated with soft neurological signs of cerebellar or basal ganglia dysfunction. We tested a group of high-functioning adolescents with ASD (high-functioning autism (n=15) or Asperger's Disorder (n= 9)) and typically-developing participants (n=20) on tests of selective attention and attention switching under varying motor demands. We also rated soft neurological signs of cerebellar and basal ganglia pathology. In the Posner cuing task of spatial attention, no differences were observed between the groups on measures assessing the benefits and costs associated with valid and invalid cues, respectively, regardless of the motor demands of the tasks. In contrast, the ASD group was less accurate on trials requiring either rapid or slow shifts of attention. This impairment was evident even when the motor demands were reduced. When we correlated attentional performance with severity of motor symptoms, measures of attentional performance were related to soft neurological signs of basal ganglia dysfunction. These results suggest that some of the attentional deficits in ASD may be related to abnormal function of the basal ganglia rather than the cerebellum.

B61

CONFLICT RELATED ADJUSTMENTS OF COGNITIVE CONTROL IN SCHIZOPHRENIA AND INDIVIDUALS AT INCREASED GENETIC RISK FOR THE ILLNESS *Alexandra Roach[1,2], Raechel Steckley[1,2], Cameron Carter[1,2]; [1]Translational Cognitive and Affective Neuroscience Laboratory, [2]University of California, Davis* – People with schizophrenia have impairments in cognitive control related to impaired function of the dorsolateral prefrontal cortex (DLPFC) and anterior cingulate (ACC). Abnormalities have been observed in chronically ill and first-episode patients. Unaffected first-degree relatives of patients also have less clearly characterized cognitive control deficits. fMRI studies suggest that DLPFC function is impaired in relatives to a level intermediate between that seen in patients and healthy subjects, suggesting DLPFC-related cognitive deficits reflect a marker of genetic risk for the illness. Less clear is whether cognitive control functions related to the ACC are impaired in relatives. Some studies suggest impairment, others an intact ACC and associated behaviors. In the present study we measured behavioral and brain activity during EEG recordings while subjects performed the Stroop color-naming task. Analyses focused on behavioral effects associated with ACC function: conflict adaptation (increased cognitive control on trials following incongruent trials) and post error adjustments (speed accuracy trade off following errors). Thirty three first-episode schizophrenia patients were compared to 25 demographically matched controls; 17 unaffected first-degree relatives were compared to 22 matched controls. Schizophrenia patients showed behavioral evidence of impaired ACC function (reduced conflict adaptation, post error adjustments). Unaffected relatives demonstrated attenuated reduction in these behavioral markers of ACC function. ERP analyses focusing on the conflict-associated N450 ERP and error related negativity (ERN) will also be presented to provide converging evidence for a possible role for dysfunction of the ACC in individuals with schizophrenia as well as those at increased genetic risk of the illness.

B62

POINTING TO THE PAST IN PATIENTS WITH HEMISPATIAL NEGLECT *Stephanie Rossit[1], Keith Muir[2], Duncan George[2], Reeves Ian[2], Livingstone Katrina[2], Hazel Clark[2], Pauline Castle[2], Monika Harvey[1]; [1]University of Glasgow, Scotland, UK, [2]Care of the Elderly, Southern General Hospital, Glasgow, Scotland, UK* – D.F. a famous visual form agnosic patient, has been shown to be able to perform immediate actions towards objects that she can't recognize, but is selectively impaired when asked to store suitable information about the object for future movements. In marked contrast, patients with optic ataxia, a reaching disorder due to bilateral damage of posterior parietal areas, show a paradoxical improvement of their movement accuracy when an action is delayed. However, whether hemispatial neglect affects visuomotor control has been controversially debated in the literature. Therefore, here we analysed the ability of 6 patients with hemispatial neglect to perform immediate movements and movements that were delayed by 5 seconds in response to target presentation. In both conditions responses were made to left, centred and rightwardly presented targets. A group of 10 age-matched healthy controls and 8 patients with right-hemisphere lesions but no neglect served as controls. When asked to perform an immediate action towards a target or a delayed action towards a target which they had seen before but was no longer present, the performance of patients with hemispatial neglect was similar to the one of patients without neglect and healthy controls for both sides of space both in terms of speed and accuracy. These results confirm that patients with neglect are not specifically impaired when performing goal-directed actions, as this would be accomplished by posterior parietal areas which are presumably spared in these patients.

B63

TRIAL TO TRIAL BEHAVIORAL ADJUSTMENTS IN METHAMPHETAMINE ABUSE: EVIDENCE FOR IMPAIRED COGNITIVE CONTROL *Ruth Salo[1], Stefan Ursu[1], Thomas Nordahl[1], Martin Leamon[1]; [1]University of California Davis Medical Center* – Deficits in top-down behavioral control are one contributing factor to the sustainment of addictive behaviors. Neurobiological models of addiction propose that ventral pathways within the brain contribute to the impulse to seek drugs, whereas the recruitment of prefrontal dorsal pathways may be critical to control those prepotent impulses. In order to selectively examine patterns of behavioral control relevant to addiction, we examined trial to trial reaction time (RT) adjustments using a single-trial Stroop task in 17 chronic methamphetamine (MA) abusers who met DSM-IV criteria for MA dependence (mean age= 35.6 + 7.3), and 14 non-substance abusing controls. Eight male and nine female MA abusers were tested with a mean duration of 13.1 years MA use. Preliminary analyses reveal that MA abusers failed to exhibit RT trial to trial adjustments (i.e. reduced RT on conflict trials that follow other conflict trials) compared to controls (p=.036). In contrast, the MA abusers and controls exhibited equivalent post-error RT adjustment (i.e. slowed RT following an error trial) (p=.19) as well as equivalent rates of conflict errors (p=.20). As trial to trial RT adjustments have been shown to be related to the function of an anterior cingulate/prefrontal cortex circuit these behavioral findings may reflect underlying neural dysfunction within these regions and pathways. The observed dissociation in behavioral regulation suggests that

MA abusers may recognize conflict situations, but the ability to modify and adapt a sustained behavioral response to that situation may be compromised [K01DA16293-01 to RS]

B64

REWARD-BASED LEARNING IN AUTISM SPECTRUM DISORDERS: PROBABILISTIC SELECTION AND TRANSITIVE INFERENCE *Marjorie Solomon[1,2,3], Michael Frank[4], Petrina Kaluzhny[1,2], Cameron Carter[1,3]; [1]U.C. Davis, [2]MIND Institute, [3]U.C. Davis Imaging Research Center, [4]University of Arizona* – Individuals with autism spectrum disorders (ASDs) exhibit atypical motivation in social and nonsocial contexts. Theories about social motivation impairments, including those found in joint attention and face processing, recently have been articulated. However, there has been little study of autism-related deficits in processing rewards that are not explicitly social such as those in reward-based learning. The goal of this study was to investigate performance on two learning tasks involving feedback in 15 high functioning adults with ASDs versus 15 age, gender, and IQ matched typically developing adults. In a probabilistic selection task where individuals were first trained on 3 stimulus pairs of Japanese Hiragana in which one of the stimuli was correct a majority (but different percentage) of the time, individuals with ASDs were slower to learn the task. When tested on novel stimulus pairs, they exhibited enhanced learning to avoid the most punished stimuli (as opposed to chosing frequently rewarded ones) relative to individuals with typical development. On a transitive inference task, which required learning a stimulus hierarchy consisting of pairs of letters in alphabetical order with later testing on implicit awareness of the hierarchy, individuals with ASDs showed a generalized performance deficit. Preliminary results suggest that autism spectrum disorders involve learning atypicalities resembling those associated with dopaminergic modulation of basal ganglia. Relatively enhanced negative feedback learning in the PSS task is similar to the pattern found in Parkinson's Disease, which is thought to involve tonic dysregulation of the direct and indirect pathways of the basal ganglia

B65

KINDERGARTEN CHILDREN AT-RISK FOR READING FAILURE: ELECTROPHYSIOLOGICAL MEASURES OF SELECTIVE AUDITORY ATTENTION BEFORE AND AFTER THE EARLY READING INTERVENTION *Courtney Stevens[1], Jeff Currin[1], David Paulsen[1], Beth Harn[1], David Chard[1], David Larsen[1], Danielle Parisi[1], Helen Neville[1]; [1]University of Oregon* – Previous research indicates that children with language impairment have deficits in the early neural mechanisms of selective attention (Stevens et al., 2006) that can be ameliorated following computerized language training (Stevens et al., in press) The present study investigated (1) Whether kindergarten children at-risk for reading failure have similar deficits in selective attention and, if so, (2) Whether such deficits could be habilitated following an interpersonally-delivered reading intervention. Twenty-eight kindergarten children, either at-risk for reading failure (<35th percentile, n=20) or above-average in preliteracy skills (35th-75th percentile, n=8), participated. Children at-risk for reading failure received supplemental reading instruction with the Early Reading Intervention (ERI), a previously-validated program (Simmons et al., 2003; 2007). Before and after eight weeks of intervention, children completed an early literacy battery (also administered at follow-up points in the winter and spring) and an event-related brain potential (ERP) measure of selective auditory attention (Sanders et al, 2005). Prior to intervention, children in the ERI group showed reduced effects of attention on sensorineural processing compared to the above-average group. However, following training, children in the ERI group showed a large increase in the effects of attention on sensorineural processing. This increase exceeded changes in the above-average readers. Children receiving ERI also showed accelerated growth on several preliteracy measures, raising their scores closer to those of the above-average group by the end of the year. These data are consistent with the hypothesis that effective reading and language interventions may work in part by training aspects of selective attention.

B66

BEHAVIORAL CORRELATES OF SUBTLE ANATOMICAL ABNORMALITIES FOLLOWING TRAUMATIC BRAIN INJURY: A CASE REPORT *And Turken[1], Timothy Herron[1], Xiaojiang Kang[1,2], William Yund[1], David Woods[1,2]; [1]Veterans Affairs Northern California Health Care System, [2]University of California, Davis* – Unlike focal brain injury, the diffuse damage caused by traumatic brain injury (TBI) presents a special challenge for establishing the structural correlates of TBI-related cognitive impairments. We report the case of a TBI patient who has severe cognitive impairments, with apparently normal brain structure when evaluated with standard MRI scans. We used multi-modal imaging (high-resolution anatomical imaging and diffusion tensor MRI) and automated quantitative image analysis to detect statistically significant alterations in brain tissue properties with respect to a database of normal subjects. Neurocognitive assessment revealed reduced processing speed, impaired executive function, memory problems and poor performance on visual-perceptual tasks. Cortical surface-based analyses revealed thinning and increased diffusivity in the cortex and reduced pericortical white matter anisotropy. Regional abnormalities were pronounced in orbitofrontal, prefrontal and occipital regions bilaterally. Fiber integrity was reduced in major white matter tracts. The genu, isthmus and splenium of the corpus callosum had low anisotropy and high diffusivity, with significant thinning of the isthmus. These brain abnormalities were predictive of behavioral impairments. Perceptual-motor slowing is consistent with diffuse white matter injury, impaired executive control with frontal lobe dysfunction, and visual deficits with occipital lobe damage. Memory problems are likely to be associated with disruption of the prefrontal-hippocampal connections through the cingulum bundle. Consistent with posterior callosal damage, the patient was disproportionately impaired in comparing simultaneously presented visual stimuli. These findings highlight the importance of novel brain imaging and behavioral assessment procedures for assessing brain-behavior relationships in TBI research, an area receiving increasing attention from cognitive neuroscientists.

B67

FRONTOTEMPORAL DEMENTIA SELECTIVELY IMPAIRS TRANSITIVE REASONING ABOUT FAMILIAR MATERIAL *Oshin Vartanian[1], Vinod Goel[1], Michael Tierney[2], Edward Huey[2], Jordan Grafman[2]; [1]York University, [2]National Institute of Neurological Disorders and Stroke, NIH* – Neuroimaging studies in humans have linked a frontal-temporal lobe system to reasoning about meaningful, familiar material and a parietal system to reasoning about unfamiliar or nonspecific material. Motivated by these findings, we tested the necessity of the frontal-temporal system in reasoning about familiar material in 14 patients with frontotemporal dementia and compared their performance to that of 21 normal controls. Our results demonstrated that patients with frontotemporal dementia were less accurate than normal controls only when the content of transitive relational arguments involved familiar material. They performed as well as normal controls on identical logical arguments with nonspecific material. These results suggest that the frontal-temporal lobe system plays a necessary role in reasoning about meaningful, familiar material.

B68

ANOSOGNOSIA: A PROSPECTIVE STUDY *Roland Vocat[1,2], Fabienne Staub[3], Patrik Vuilleumier[1,2]; [1]University Medical Center, Geneva, [2]Faculty of Psychology, University of Geneva, Geneva, [3]CHUV, Lausanne* – Anosognosia is defined as a lack of awareness of a neurological deficit (e.g. hemiplegia) due to focal brain damage. We prospectively screened a population of 337 patients with an acute right hemispheric stroke, among whom 58 cases showed significant motor deficit of the left hemibody. Anosognosia was present in 32% of these patients during the hyperacute phase (up to 3 days after stroke). This frequency is much higher than previous reports in the literature (10 to 18% according to Baier and Karnath, 2005) and likely to reflect the precocity of our evaluation. Indeed, follow-up testing showed that the frequency of anosognosia was reduced to 18% one week later and to 5% after six months. Other rare phenomena associated with anosognosia, such as kinesthesic hallucinations, feelings of non-belonging, misoplegia, personification of the arm, strange sensations, or supernumerary phantom limb, were also found with a high frequency during the hyperacute phase, followed by a similar decrease over time. In terms of clinical characteristics, anosognosia was correlated with the presence of severe sensorimotor deficits, hemianopsia, neglect, impaired vigilance, spatio-temporal disorientation, and overestimation of self-performance in motor tasks, though none of these deficits was uniquely associated with anosognosia. Taken together, our data indicate that anosognosia is a major but transitory and hyperacute manifestation of stroke, highlighting the importance to study it as early as possible to understand the underlying neuropsychological mechanisms. The frequent dissociations with other clinical symptoms points to the complexity of the phenomenology of this deficit, and multiple causal factors.

B69

THE SENSE OF AGENCY IN SCHIZOPHRENIA: DISTURBANCES IN PREDICTING ACTION-EFFECT RELATIONS CAN EXPLAIN ABNORMALITIES IN ACTION AWARENESS *Martin Voss[1], James Moore[2], Marta Hauser[1], Dieter Kunz[1], Juergen Gallinat[1], Andreas Heinz[1], Patrick Haggard[2]; [1]Charité University Hospital & St. Hedwig Hospital, Berlin, Germany, [2]Institute of Cognitive Neuroscience, Queen Square, London, UK* – There has been some debate over the last years whether the conscious awareness of action is mainly a predictive process based on the motor command or whether retrospective mechanisms such as backward masking and inferential "sense-making" are more important. While empirical evidence suggests that the conscious experience of action results from a dynamic interplay between such mechanisms, its disturbances in schizophrenia remain elusive. To address this question, we have used the intentional binding effect (Haggard et al., 2002) to measure the extent to which perceptual estimates of action are influenced by subsequent effects in a population of schizophrenic patients and matched controls. In our experiment, we varied the probability with which a simple manual action (a key-press) produced an effect (a tone). In healthy volunteers, a high probability of causing an effect led to a predictive shift of the perceptual estimate of the action towards the effect, even on those trials where the action produced no effect. Conversely, when predictability of the effect to occur was low, temporal binding was seen only on those trials where the effect actually occurred. Schizophrenic patients showed absence of the predictive effect and a highly exaggerated temporal binding whenever an effect occurred. The result suggests a disturbance in predicting action-effect relations, which may lead to abnormalities in experiencing a sense of agency in schizophrenia.

B70

CAN PLASTICITY-RELATED RELEARNING ACCOUNT FOR "SPONTANEOUS" RECOVERY OF COGNITIVE FUNCTION AFTER ACUTE BRAIN DAMAGE? *Stephen Welbourne[1], Jennifer Read[1], Karen Sage[1], Matthew Lambon Ralph[1], James McClelland[2]; [1]School of Psychological Sciences, University of Manchester, England, [2]Stanford University* – Much of cognitive neuropsychology relies on data collected from brain damaged patients when they have reached a "stable", chronic state (typically six-nine months post onset). Clinical observations indicate that patients exhibit considerable "spontaneous" recovery to varying degrees during this phase. The standard explanations for recovery usually involve the idea that a reduction in oedema allows some temporarily incapacitated systems to come back online. If one takes seriously the idea from computational modelling that knowledge is encoded in the pattern of synaptic weights then another possible explanation presents itself: namely that "spontaneous" recovery may be a genuine re-learning process. This study aims to explore how realistic an explanation this is. To get direct evidence of the extent of "spontaneous" recovery, detailed assessment of patients was conducted within one month of their stroke and again three months later. Data on single word reading in the patients was compared with a connectionist reading model, which had been damaged and allowed to recover. The patients exhibited a remarkable degree of recovery in their word reading skills, and this was mirrored in the model. In both patients and model recovery was faster than initial learning. Analysis of recovery in a simpler encoder model suggests that rapid recovery depends on the fact that the structure of the weights in the model is optimised to learn the task. When the model is damaged the ability to perform the task is lost, but the model is still optimised for relearning allowing for a very rapid "spontaneous" recovery.

B71

REVERSAL LEARNING DEFICITS IN RUMINATORS *Anson Whitmer[1], Marie Banich[3]; [1]University of Colorado at Boulder, [2]University of Colorado at Boulder, Institute of Cognitive Science, [3]University of Colorado Health Sciences Center* – Individuals who often ruminate or repetitively think about their current dysphoria tend to experience worse and longer lasting periods of depression. Because of these serious consequences of depressive rumination, it is important to determine the mechanisms underlying rumination. Ruminators perseverate more than non-ruminators in the Wisconsin Card Sorting Task (WCST), a pattern that has been suggested to occur because ruminators are attentionally inflexible (Davis & Nolen-Hoeksema, 2000). The goal of the current work was to distinguish between two potential mechanisms driving perseveration in ruminators: a) an inability to reverse stimulus-reward associations and b) inability to switch between higher order attentional sets. To do so, we used a probabilistic version of the intradimensional-extradimensional task. In this task individuals learn which of two items is probabilistically associated with a reward. In two studies, we found that tendency to depressively ruminate is related to difficulties using probabilistic negative feedback to reverse learned stimulus-reward associations. However, it was not associated with difficulties in switching between attentional sets when a new dimension of the stimulus signaled the item's reward value. These results raise the possibility that, even though increases in depression and negative mood should negatively reinforce the value of ruminative thoughts, the inability of ruminators to learn from negative reward may mistakenly lead them to continue to believe that those ruminative thoughts will eventually help overcome their problems.

B72

IMPAIRED FORWARD MODELS IN SCHIZOPHRENIA AS ASSESSED BY THE SIZE-WEIGHT ILLUSION *Lisa Williams[1,2], Greg Light[2], Vilayanur Ramachandran[1,2]; [1]Center for Brain and Cognition, UCSD, [2]UCSD* – The size-weight illusion (SWI) is a striking perceptual effect wherein an individual asked to compare the weight of two objects of identical physical weight but different sizes will feel the smaller object is substantially heavier. The forward model of motor control proposes that when a motor act is initiated an efference copy of the action is also generated. Comparisons between this copy and actual sensory feedback are used for a variety of purposes, including online movement adjustments, cancelling sensory reafference, and movement prediction and planning. Previously, our lab has suggested the source of the SWI may be a central mismatch between expected sensory feedback – efference copy - and actual proprioceptive feedback of the two stimuli. Disruptions in this mechanism have also been proposed to explain various positive symptoms of schizophrenia, including auditory hallucinations and delusions of control. We tested the SWI in individuals with schizophrenia and control participants by asking them to report which of two disks was heavier. Disks were large (5 inches diameter) or small (2 inches diameter), and weighed 90, 120, 150, 180 or 210 grams. Testing included illusion trials (90 small vs. 120-210 large) and control trials (comparisons between same size weights). We found that on the two most difficult size-weight discriminations (90 small vs. 120 and 150 large), as a group, individuals with schizophrenia experience the size-weight illusion on fewer trials than control participants, despite demonstrating comparable weight discrimination, offering further support to the idea of a dysfunctional motor control comparator mechanism in schizophrenia.

B73

FMRI ACTIVATION PATTERNS PREDICT READING ABILITY IN ADULTS WITH AND WITHOUT DEVELOPMENTAL DYSLEXIA *Allison Zumberge[1], Jennifer Bruno[1], Frank Manis[1], Zhong-lin Lu[1], Jason Goldman[1], Rachel Beattie[1], Jason Batten[1]; [1]University of Southern California* – Neuroimaging studies of developmental dyslexia, a biologically-based disorder affecting phonological processing, have suggested deficiencies in one or more posterior regions within the reading network. fMRI studies of skilled reading have demonstrated a positive relationship between reading skill and activation in one posterior region, the occipito-temporal junction; and a negative relationship between reading skill and activaton in an anterior region, the inferior frontal gyrus (e.g., Bruno & Zumberge et al., in press). The current study extends these findings across a broad range of reading ability, including individuals with dyslexia. Preliminary results indicate a similar pattern of correlations between reading skill and activation measures for dyslexic and non-dyslexic participants, suggesting that allocation of resources across the reading network depends on reading skill. This study supports—using neuroimaging measures—the hypothesis that developmental dyslexia represents the bottom end of a continuous distribution of reading skill in the population (Shaywitz et al., 1992). Further analyses will employ methods of functional and effective connectivity to better explain the relationship between regional activation and reading skill.

Higher level cognition: Problem solving

B74

CAN ELECTRICAL STIMULATION OF FRONTAL CORTEX IMPROVE COMPLEX VERBAL PERFORMANCE? *Carlo Cerruti[1,2], Gottfried Schlaug[2]; [1]Harvard Graduate School of Education, [2]Music, Neuroimaging, and Stroke Recovery Laboratories, Beth Israel Deaconess Medical Center and Harvard Medical School* – Previous studies have provided evidence that verbal cognition can be enhanced by transcranial direct current stimulation (tDCS). These studies have focused largely on site F3 of left dorsolateral prefrontal cortex and have used tests of working memory. One tDCS study found that relatively strong stimulation produced a significant enhancement of performance on a relatively complex verbal task, verbal fluency (Iyer, et al. 2005). The present study attempted to partially replicate Iyer et al. and also to extend it by employing a complex verbal task with problem-solving and working memory components, the Remote Associates Test (RAT). Seventeen subjects underwent 1 milliampere anodal, cathodal and sham tDCS sessions with the active electrode on F3. We found no effect on verbal fluency scores across conditions. RAT performance was significantly enhanced by anodal stimulation. The data provide evidence that complex verbal problem-solving can be enhanced by tDCS. The data also reflect on the nature of remote association, a task associated with both creative and logical problem-solving. Given the association between F3 and working memory, it appears that the RAT may engage considerable working memory or executive function processing. To our knowledge, this is the first tDCS study to use a highly complex verbal task. Future studies may help link neuroscience and fields such as education by using complex cognitive tasks while also parsing the effects of subcomponent processes such as working memory and others.

B75

CAUSAL REASONING AND INTENTIONALITY JUDGMENTS AFTER FOCAL BRAIN LESIONS *Shelley Channon[1], David Lagnado[1], Helena Drury[1], Elizabeth Matheson[1], Lyndsay Taylor[1], Roxanne Barrett[1], Claire Doyle[1], Mary-Beth Young[1], Sian Fitzpatrick[1], Colin Shieff[2], Nigel Mendoza[3], Dave Maudgil[4]; [1]University College London, UK, [2]Royal Free Hospital, UK, [3]Charing Cross Hospital, UK, [4]Heatherwood and Wexham Park Hospitals NHS Trust, UK* – This study focused on sequences of everyday events that led to adverse outcomes, and examined people's judgments of key events in these sequences. Intuitively, the mentalistic versus non-mentalistic distinction appears critical to how people make everyday judgments of cause and blame. Whether an agent intends or foresees the effects of an action is likely to influence the extent to which they are perceived to be responsible. This study was designed to investigate the impact of focal brain lesions on causal reasoning. Participants with focal lesions and matched healthy control participants were compared in their judgments about intentional human actions, unintentional human actions and physical events. The results showed that, compared to the control group, the lesion participants differentiated less between intentional and unintentional acts in assigning blame. The role of frontal regions in contributing to this pattern of performance was evaluated.

B76

SEQUENCE LEARNING: EXTERNAL VERSUS INTERNAL ERROR EVALUATION *Jeffrey Cockburn[1], Olav Krigolson[1], Kyle Matheson[1], Clay Holroyd[1]; [1]University of Victoria* – The error-related negativity (ERN) is a component of the event-related brain potential that occurs following negative feedback (fERN) and erroneous responses (rERN). Recently, it has been proposed that the ERN reflects a reward prediction error carried by the midbrain dopamine system. Importantly, this prediction error signal occurs at the earliest indication that events are worse than expected. As such, during the time course of learning, people should shift from external error evaluation (i.e., feedback: fERN) to internal error evaluation (i.e., efference copy: rERN). To examine this contention we had participants learn a seven-item sequence by trial-and-error. Our results indicated that in the initial stages of learning error feedback evoked a fERN. Furthermore, response errors in the learning phase of the experiment did not elicit a rERN. After learning had occurred, our results indicated that error feedback no longer elicited a fERN. While we did not find a typical rERN associated with response errors made after the sequence had been learned, we did find differences in the event-related brain potentials between the waveforms associated with response errors and correct guesses. Importantly, our results suggest that during the time course of learning participants in the present experiment shifted from an external to internal mode of error evaluation.

B77

THE EFFECTS OF SLEEP DEPRIVATION ON THE EXPLORATION-EXPLOITATION TRADEOFF *Brian D. Glass[1], Arthur B. Markman[1], David M. Schnyer[2], W. Todd Maddox[2]; [1]The University of Texas at Austin, [2]Institute for Neuroscience, The University of Texas at Austin* – We examined the cognitive deficits exhibited by sleep deprived individuals by utilizing a computerized resource acquisition task to assess the tradeoff between exploration and exploitation in decision making. The subjects were tested over a two day period (24 hours apart), with sleep (control) or without sleep (sleep deprived). The exploration-exploitation tradeoff is the balancing of previously successful strategies with the adoption of new strategies. The locus coeruleus-norepinephrine system has been implicated as driving this tradeoff process via connections with brain areas that monitor the effectiveness of currently employed strategies, such as the anterior cingulate and orbitofrontal cortices (Aston-Jones & Cohen, 2005). The resource acquisition task is a computer game in which subjects compete against simulated opponents for resources in a virtual environment (see Goldstone & Ashpole, 2004). Different game environments were used that required either an exploratory or exploitative strategy. The simulated competitors were driven by the Generalized Exploration Model (GEM; Glass, Maddox & Markman, 2007). Model simulation provides information about whether the optimal strategy in an environment requires individuals to adopt exploratory or exploitative strategies. By comparing subject data to model output and matched controls, subject's decision making processes are assessed. Sleep deprived subjects demonstrated improved performance on the exploration task and impaired performance on the exploitative task relative to themselves when fresh and relative to controls. These results provide evidence that sleep deprivation impairs the ability to adopt exploitative strategies, while facilitating the adoption of exploratory strategies.

B78

NEURAL CORRELATES OF LEARNING IN A VISUAL CATEGORIZATION TASK *Andrew Kayser[1,2], Mark D'Esposito[1,2]; [1]UC Berkeley, [2]UC San Francisco* – Learning new concepts in the setting of minimal previous experience with them is a critical skill we employ routinely in our everyday lives. In this fMRI study of healthy undergraduates, we investigated the role of frontal, basal ganglia, and medial temporal structures in the acquisition of a series of rule-based category discriminations. Subjects received a standardized set of instructions but minimal practice on the task, which involved sorting rectangles into two (initially unknown) groups based on their length and width. Subjects learned each task via feedback over the course of 63 trials. In our ROI-based analysis, we found significant univariate activations that correlated with each subject's learning curves in the bilateral head of the caudate, bilateral middle frontal gyrus (MFG), and left anterior parahippocampal gyrus (PHG). Timecourse and anatomical data suggested that these results could not be explained by differential activation to correct versus incorrect responses, late versus early time sensitivity, or motor preparation. Interestingly, multivariate activity could distinguish good from poor learning: over the course of successful rule acquisition, the right MFG became differentially coherent with separate regions in the right MFG and left posterior PHG, whereas in poor learning it became more coherent with general task-active areas in the right parietal lobe. The above results confirm previous findings that the caudate and bilateral MFG are active during learning of a visual categorization task; and extend them to demonstrate that this univariate activity correlates with the learning curve, while right MFG connectivity distinguishes good from poor learning runs.

B79

THE EFFECTS OF VENTROMEDIAL PREFRONTAL CORTEX DAMAGE ON EVERYDAY SOCIAL PROBLEM SOLVING *Frank Krueger[1], Michael Koenigs[1], Andrew Snyder[2], Edward D. Huey[1], Aron Barbey[1], Vanessa Raymont[3], Jordan Grafman[1]; [1]NINDS/ NIH, [2]University of Chicago, [3]Mount Sinai School of Medicine* – The prefrontal cortex (PFC) is responsible for regulating human social behavior. More specifically, ventromedial PFC (VMPFC) lesions result in deficits in social decision-making, problems in interpersonal interactions, and diminished sensitivity to socially relevant situations. However, little is known about the role of the VMPFC in everyday social problem solving. We administered the Everyday Problem Solving Inventory (EPSI) to 31 VMPFC lesion patients, who were matched by handedness, age, education, and intelligence with non-ventromedial frontal lobe (NVMFC=44) lesion patients, posterior cortex (PC=29) lesion patients, and normal controls (NC=50). The EPSI is composed of scenarios depicting everyday problems. Participants were asked to imagine themselves in social and non-social problem situations and to rate given emotion- and cognitive-focused solution strategies for their effectiveness. Ratings were compared with judges' ratings, which were considered a good approximation of optimal solutions to the problem situations. Our results demonstrate that the VMPFC patients' EPSI rank orderings for social but not for non-social problem situation were significantly less optimal compared to the performances of the NVMFC, PC, and NC groups. Furthermore, VMPFC patients' rankings were significantly worse for emotion- than for cognitive-focused solution strategies. Finally, VMPFC patients' performance for the social problems correlated significantly with their total Neurobehavioral Rating Scale scores (a behavioral scale on the patient completed by a trained observer) suggesting a relationship between patients' failure to choose an optimal social problem solution and their actual social behavior. In conclusion, our study emphasizes the unique role of the VMPFC in representing social knowledge utilized to solve everyday problems.

B80

STRATEGY VARIATION IN MULTI-DIGIT MENTAL MULTIPLICATION: FMRI, BEHAVIORAL AND MODELING PERSPECTIVES *Miriam Rosenberg-Lee[1,2], Marsha Lovett[1,3], John Anderson[1,2]; [1]Carnegie Mellon, [2]Center for the Neural Basis of Cognition, Carnegie Mellon, [3]Eberly Center for Teaching Excellence, Carnegie Mellon* – Recent research into math cognition has identified areas of the brain involved in number processing (Dehaene et al., 2003) and complex problem solving (Anderson, 2007). Much of this research assumes that participants use the same strategies; yet, cognitive psychology tells us people use a variety of strategies (Siegler et al., 1987, 1997, LeFevre et al., 1996). In an fMRI experiment, we examined cortical activation as a function of two different calculation strategies for solving multi-digit multiplication problems. The School strategy, equivalent to long multiplication without pen and paper, involves working from right-to-left. The Expert strategy, used by "lightning" mental calculators (Staszewski, 1988), proceeds from left-to-right. The two strategies require essentially the same calculations but have different working memory demands (School incurring greater demands). In a slow event-related design, we compared activity on short and long multiplication problems solved by both strategies. We found significantly greater early activity for the School strategy in areas involved in attentional aspects of number processing (PSPL) and mental representation (BA 40/7), but not in a numerical magnitude area (HIPS). A prefrontal declarative memory retrieval area (BA 9/46) did not differentiate between the strategies. We extend these results with two behavioral experiments examining the effects of training on strategy choice. In a choice/no choice paradigm, we found greater practice leads to more selection of the Expert strategy, but more difficult training problems (implemented by number of carries) leads to less selection of the Expert strategy. An ACT-R model accounts for choice behavior and predicts cortical activity.

B81

THE EFFECTS OF ATTENTIONAL STATES ON VERBAL PROBLEM SOLVING PROCESSES *Ezra Wegbreit[1], Satoru Suzuki[1], Marcia Grabowecky[1], Mark Jung-Beeman[1]; [1]Northwestern University* – People who are in a positive mood show states of broadened attention and are more likely to solve a problem with a sudden restructuring known as an insight. Behavioral priming and neuroimaging findings indicate that distinct cognitive and neural processes underlie insights. However, it remains to be seen if specific attentional states, such as a state of broadened attention, are related to solving problems with an insight. Thirty-two healthy, right-handed, native English-speaking undergraduates completed four visual attention tasks selected to manipulate their attention into a broadened or narrowed state. In order, participants responded to a center letter while ignoring flankers, identified briefly presented objects, attentively tracked multiple moving objects, and determined the direction of spatially distributed coherent motion. Before and after the administration of the attention tasks, participants completed a set of short three-word problems that could be solved with insight or with analytic processing. Participants solved reliably more word problems after completing the four attention tasks than before the tasks. Furthermore, participants solved reliably more problems with insight after the visual attention tasks than before. Participants did not show significant differences in the number of analytic solutions or incorrect responses they produced before and after the attention tasks. Thus, the four intervening attention tasks principally helped participants solve more word problems by increasing the number of problems participants solved with insight. Further research will determine which specific attentional states engendered by the four tasks facilitated insightful solutions, and will investigate the neural correlates of such facilitation.

B82

ROSTROLATERAL PREFRONTAL CORTEX AND HIPPOCAMPUS IN RELATIONAL REASONING AND TRANSITIVE INFERENCE *Carter Wendelken[1], Sandeep Sabhlok[1], Silvia Bunge[1,2]; [1]Helen Wills Neuroscience Institute, UC-Berkeley, [2]UC-Berkeley* — Prior studies implicate the rostral part of lateral prefrontal cortex (RLPFC) in relational integration (e.g. Christoff et al, 2001; Bunge et al, 2005). Based on these findings, we hypothesized that RLPFC should be particularly involved in transitive inference, which involves combining multiple relational instances in order to draw some conclusion. However, multiple prior studies, mainly in rats but also with human fMRI, have pointed to hippocampus as a primary locus of transitive inference (e.g. Duseck and Eichenbaum 1997; Heckers et al, 2004), at least when long-term memory retrieval is involved. Our goal was to test the hypothesis that RLPFC should be a primary locus of transitive inference processing, especially in the absence of long-term retrieval demands. To this end, we designed a task in which subjects were presented with four relational instances (depicted as colored balls on iconic balance scales) and then were asked to judge the validity of a fifth relationship, given the first four. On inference trials, subjects had to infer across two of the initial relationships in order to confirm or deny the query relation. On direct trials, a single initial relation was sufficient. Results confirm our main predictions: the most prominent activation associated with inference was RLPFC, and hippocampus showed no inference effect. The necessity of attending to predicate-argument structure was a second experimental factor. Hippocampus was more active for specific relations where predicate-argument structure mattered than for generic relations where it did not; however, this manipulation had no effect on RLPFC activation.

B83

THINKING ANEW: NEURAL CORRELATES OF PROCESSING INNOVATIVE OPTIONS *Stacy L. Wood[1], Jennifer Vendemia[1], Yuliya Komarova[1], Adam Craig[1]; [1]University of South Carolina* – The goal of this research is to better understand the diffusion of innovations (Rogers 1996) by determining individual processes of evaluation, especially in affective responses to new options (Wood and Moreau 2006). Differences in BOLD activations during processing of innovative and familiar options were examined in a product evaluation task. College-aged students (N=25) attended an experimental session in which they were scanned using a Siemens 3T magnet while performing a task with directed evaluations of six different product descriptions. Three products were considered (as determined by pretesting in the same population as the experimental task) to be innovative and three were considered to be not innovative. The product description consisted of a picture and descriptive paragraph similar to a catalog format. Blank screens were interspersed randomly between the descriptions to prevent carryover effects from one description to another. Participants were given an evaluative goal prior to being exposed to these descriptions. This research goes beyond a more basic investigation of novel stimuli to examine complex and self-relevant novel evaluations. Evidence for the differential activation in the hippocampus denoting declarative versus episodic memory and differential activation in affective systems (amygdala and inferior frontal cortex) will be discussed. This imaging data will be discussed in conjunction with behavioral data from two other studies that assessed explicit attitudinal responses to the same familiar and innovative products.

B84

ARE REWARD EXPECTANCIES IN CHOICE TASKS PROCESSED AS RATIOS OR DIFFERENCES?: IMPLICATIONS FOR THEORIES OF REWARD PROCESSING IN THE ORBITOFRONTAL CORTEX *Darrell A. Worthy[1], Arthur B. Markman[1], W. Todd Maddox[1]; [1]University of Texas at Austin* — The Orbitofrontal Cortex (OFC) has been implicated in processing the magnitude of rewards in choice tasks (Wallis and Miller, 2003; Schultz, 2000). However, it is unclear if the relative magnitude of an expected reward relative to the alternatives is processed in the OFC by comparing the ratio or the distance of the expected rewards. We designed a behavioral experiment in which healthy young adult subjects chose from two or more decks of cards and gained points on each trial. One group of subjects earned between 1 and 10 points on each draw. A second group of subjects performed the same task, but each reward value was shifted by 80 points such that they earned between 81 and 90 points on each draw. A third group of subjects performed the same task as the first group, but each reward value was multiplied by ten such that they received between 10 and 100 points on each draw. Thus for the shifted reward values group the distance between the expected rewards was maintained, and for the multiplied reward values group the ratio between the expected rewards was maintained. Behavioral and computational model-based analyses indicate that subjects with shifted reward values significantly underperformed subjects in the other two groups due to an initial failure to exploit the most advantageous option. This suggests that the reward system initially processes the relative magnitude of a reward by comparing the ratio and not the distance between the expected rewards.

Methodological Issues: Electrophysiology

B85

SYNCHRONIZED OSCILLATIONS IN DISTRIBUTED NEURAL CIRCUITS UNDERLIE COGNITIVE AND PERCEPTUAL PROCESSES IN THE HUMAN BRAIN *Michael Cohen[1]; [1]University of Bonn, Germany* — Phrenology—the idea that modular pieces of the brain are responsible for specific perceptual, cognitive, and psychological functions—was discredited over a century ago, and yet the "localization" approach remains the dominant (though sometimes polemic) method of mapping neural mechanisms onto specific mental processes. An alternative is the "network" approach: Functions in the brain, though localized to some extent, are supported by spatially distributed networks. How might the brain coordinate the activity of anatomically distributed but functionally linked networks? One possibility is through oscillations—coherent and rhythmic fluctuations of neural populations—which are thought to act as the "glue" that binds both local and distal neural networks. Data from intracranial EEG recorded in epilepsy patients from several experiments (perceptual, decision-making, etc.) are presented to support the idea that cognitive functions arise from the coherent activity of functionally linked networks. In some cases, localized activity does not statistically distinguish different experimental conditions, whereas patterns of inter-region oscillatory synchrony do. Synchronized activity was measured through inter-electrode phase and power coherence in frequency bands ranging from delta (2-4 Hz) to upper gamma (80-150 Hz). Theta (4-8 Hz) and lower gamma (30-80 Hz) oscillations appear to play special roles in coordinating inter-regional task-related activity, and often interact, with theta putatively gating the power and/or phase synchrony in gamma-oscillating networks. Together, these findings suggest that a systems-level approach (e.g., functional connectivity) might yield fruitful insights into how the brain supports complex cognitive, perceptual, and social phenomena beyond what can be gleaned from localization approaches.

B86

HIGH IMPEDANCE ERP RECORDINGS: WILL YOU NEED MORE TRIALS TO GET THE SAME P-VALUE? *Emily S. Kappenman[1], Steven J. Luck[1]; [1]University of California, Davis* — High impedance recording systems have become increasingly popular for ERP research, largely because they make it possible to apply a large number of electrodes in a small amount of time. However, the effects of high impedance recordings on the quality of ERP data have not been examined systematically by a neutral third party. If high-impedance recordings yield a poorer signal-to-noise ratio, more trials or subjects will be needed to achieve a given level of statistical significance, and this may more than offset the savings in electrode application time. To measure the effects of electrode impedance on signal-to-noise ratio, we performed simultaneous low- and high-impedance recordings using a Biosemi Active-2 system and an oddball paradigm. In each subject, we abraded the skin for the electrode sites in one hemisphere (yielding impedances of <5 k?) but not in the other hemisphere (yielding impedances of 20-190 k?). In addition, because noise may be affected by temperature and humidity, subjects were tested under both cool/dry and warm/humid conditions. Data quality was comparable for low- and high-impedance recordings in the cool condition. In the warm condition, however, P300 amplitude variance was substantially higher for the high impedance recording sites. The usefulness of various filters to attenuate these effects will be presented. Overall, these results suggest that high impedance recording systems can provide adequate data quality in an optimal recording environment but may lead to a net increase in subject testing time in suboptimal environments.

B87

THE NOVELTY, TASK-SWITCH, AND GO/NO-GO P3A ARE THE SAME COMPONENT *Aminda O'Hare[1], Cody Wolcott[1], Joseph Dien[1]; [1]University of Kansas, Lawrence, KS* – While the P3a produced by novel and rare stimuli in the oddball paradigm and the P3a produced by task-switch paradigms have been shown to share the same scalp topography, and thus are likely be the same component (Bechara, et al., 2006), no direct comparisons between the P3a that is produced by “no-go” stimuli in a go/no-go task have been conducted. In the current study, 24 participants completed auditory novelty-oddball, auditory go/no-go, and Wisconsin Card Sorting (WISC) (with auditory feedback) tasks all in one session while event-related potentials (ERPs) were recorded from a high-density, 128 channel system. The P3a components produced by each task were found to have similar scalp topographies and latencies via principal component analyses (PCA). Additionally, dipole source localizations found the anterior cingulate cortex (ACC) to be the most likely source for each P3a component (Oddball: R.V. = .82%, Go/No-go: R.V. = .68%, WCST: R.V. = .67%). These results strongly suggest that the P3a is the same component for each of these tasks. This provides new information for the go/no-go task, as the cognitive function for its P3a has been unclear. Additionally, these results support the idea that the P3a represents processing a task change, as this is the major similarity among these tasks. Additional ERPs that were specific to each task are also reported.

B88

NEURAL CORRELATES OF CONCEALED KNOWLEDGE: AN ERPS INVESTIGATION *Giuseppe Sartori[1], Sara Agosta[1], Claudia Civai[1], Maddalena Marini[1]; [1]Università degli Studi di Padova, via Venezia, Padova, Italy* – Objective: The IAT-A (Autobiographical Implicit Association Test) is based on a modified version of Implicit Association Test. The method measures the positive and negative associations a participant has between a verbal description of an event (autobiographical implicit memory) and the logical dimension TRUE. Here we investigate the neural correlates of concealed knowledge using the IAT-A (Card Test Paradigm). Participants and methods. Thirty-two participants were asked to select one of two playing cards (“4 of diamonds” and “7 of clubs”). Then they were administered the F-IAT combined with ERPs registration. In one stage, participants categorized both sentences referred to the card that they had chosen and TRUE sentences on the same computer key and both sentences referred to the non chosen card and FALSE sentences on the other computer key (congruent condition). In a later stage, the tasks were reversed and participants categorized sentences referred to the non-chosen card and TRUE sentences on the same computer key and sentences referred to the chosen card and FALSE sentences on the other computer key (incongruent condition). Results: RT analysis confirmed that IAT-A is highly accurate in identifying the card selected by participants. We found a larger negative deflection peaking at about 300 msec (N200) in the incongruent condition with respect to the congruent condition. Conclusions: Our results show that the N200 is the neural marker of the incongruency using IAT-A.

B89

COHERENCE MAPPING OF BEHAVIORAL ECOG MIGROGRID DATA *Minna Silfverhuth[1], Felix Darvas[1], Adam O. Hebb[1], Heracles Panagiotides[1], Jeffrey G. Ojemann[1], Mark D. Holmes[2]; [1]University of Washington, Seattle, WA, [2]EEG and Clinical Neurophysiology Laboratory, University of Washington, Seattle* – GOAL. In order to demonstrate ‘micromapping’ of brain function, we applied coherence analysis, using integrated coherence over a frequency band, while the subject performed distinct behaviors during unconstrained interactions. METHODS. Microgrid data was recorded through a 8x8 electrodes grid (10 × 10mm area, sampling rate 200Hz) over the right middle temporal gyrus during evaluation for epilepsy surgery [1]. By reviewing video, periods were determined when subject was facing and talking to a friend (FACE), on the telephone (PHONE), looking at photos (PHOTOS) and reading a book (READING). Average integrated coherence was calculated over 1-30Hz and 31-100Hz frequency bands between microgrid and electrocorticography (ECoG) electrodes over right and left hemisphere. RESULTS. Average integrated coherence values were highest in 31-100 Hz band between migrogrid and ECoG electrodes in the right side, up to 0.68 (vs. 0.62 in left side). Both frequency bands showed values over noise level (0.52). The strongest interactions were with ECoG electrodes over areas BA 20 and 21 (anterior temporal lobe), BA 11 and BA 9/46 (orbitofrontal and dorsiolateral frontal cortex), during FACE and PHOTOS, and less in the other behaviors. Inside the microgrid, the pattern of coherence values varied with conditions and the ECoG electrode pair. CONCLUSIONS. We have shown, using coherence as a measure of connectivity between electrode sites, that selective interaction between regions exists for specific, unconstrained behaviors, below the 1 cm resolution. This connectivity is most pronounced and specific for the higher (gamma) frequency band. [1] Freeman et al., 2006.

B90

REASSESSMENT OF THE ORIGINS OF INDUCED GAMMA BAND RESPONSES – A SINGLE TRIAL ANALYSIS *Shlomit Yuval-Greenberg[1], Orr Tomer[2], Leon Y. Deouell[1,3]; [1]The Hebrew University of Jerusalem, [2]The Hebrew University of Jerusalem, School of Medicine, [3]The Hebrew University of Jerusalem, Interdisciplinary Center for Neural Computation* – The induced gamma response (iGBR) is a typical increase in the gamma band (>30Hz) peaking around 250ms post stimulus, following the presentation of a visual stimulus. The iGBR was hypothesized to represent the neural synchronized oscillatory activity involved in various cognitive functions such as binding and consciousness. The iGBR is calculated by averaging single trials’ spectral data, circumventing phase cancellation due to inter-trial latency jitter. Subjects in our study were presented with objects which were masked with 2 thick or 30 thin vertical white stripes. In half of these trials the visible segments were left in their native order (Coherent 2, Coherent 30) while in the other half the segments were shuffled (Incoherent2, Incoherent 30). In the Incoherent 30 condition the objects could not be identified, whereas in the incoherent 2 they were still identifiable. We found the iGBR decreases significantly, across subjects, only in the Incoherent 30 condition. Thus, it was related to the semantic content rather than to object coherence or ‘binding’. Moreover, to address the nature of the iGBR we examined single trial data. A gamma increase at a similar latency, topography and frequencies as the average iGBR could be detected in many single trials. Whereas previously iGBR was discussed in terms of gamma ‘oscillations’, we find the gamma increase to be brief, on the order of one or two cycles only. The single trials data leads to a reassessment of the origins of the scalped-recorded iGBR.

Methodological Issues: Neuroimaging

B91

FUNCTIONAL DIFFERENTIATION WITHIN THE MONKEY CORTEX AS REVEALED BY NEAR-INFRARED SPECTROSCOPY *Allen Ardestani[1,2], Felix Darvas[3], Jens Steinbrink[4], Richard Leahy[5], Arthur Toga[6], Joaquin Fuster[1,2]; [1]Semel Institute for Neuroscience and Human Behavior, UCLA, [2]Brain Research Institute, UCLA, [3]University of Washington, [4]Charité, Humboldt University, [5]Signal and Image Processing Institute, USC, [6]Laboratory of Neuroimaging, UCLA* – The role of prefrontal cortex in working memory (WM) is well established. However, questions remain regarding the topography and "domain-specific differentiation" of different types of information processing in the cortex. While it has been theorized that dorsolateral (DPFC) and ventrolateral (VPFC) prefrontal cortex preferentially process spatial and object WM, respectively, both electrophysiological evidence in the monkey and neuroimaging in the human have largely failed to demonstrate such regional differentiation. In this study we use near-infrared spectroscopy (NIRS) to detect functional changes, across relatively large cortical cell populations, simultaneously from prefrontal and posterior parietal cortices. Imaging data were recorded from a Rhesus macaque performing two types of WM tasks: a spatial task in which the animal had to retain the spatial position of a visual stimulus, and a non-spatial task where he had to retain its color (red or green) during a 20s delay. During performance of the spatial WM task, cerebral activation trends were found in which DPFC exhibited stronger covariance with posterior parietal cortex than did VPFC. These correlations were more pronounced during performance of the spatial task than during the non-spatial task. Additionally, incorrect trials generally elicited lower activations during the delay period than did trials ending with a correct response. Furthermore, NIRS data collected during the performance of a haptic WM task also appear to exhibit inter-regional differences in delay activation. The data thus suggest the presence of preferential cognitive processing between and within posterior and frontal cortical regions.

B92

FUNCTIONAL LOCALIZERS *Marc Berman[1], John Jonides[1]; [1]The University of Michigan* – There is an increasing trend in fMRI research for researchers to conduct simple functional localizer tasks to establish regions of interest (ROI) which are then used to analyze a task of interest (e.g., a more complex memory or attention task). This two-stage process is quite common in research that uses faces, objects, or words as stimuli. This procedure, however, begs two questions: 1) whether functional localization depends on the task a researcher uses (e.g., a passive viewing task vs. a 1-back task) and 2) whether functional localization hinges on the contrasting stimuli that are used as the control. Here we review the literature on functional localizers for face stimuli, which are used to localize activation in the Fusiform Face Area (FFA). We find that the type of localizer task (e.g., passive-viewing, 1-back, etc.) does not localize to different areas of FFA. In addition, the contrasting stimuli with which the face stimuli are contrasted (e.g., houses, objects, words, etc.) also do not produce different localization in FFA. These data suggest that the choice of functional localizer is robust against the task used for localization and the contrasting stimuli which the localized stimuli are compared.

B93

FUSION OF FMRI AND THE PUPIL RESPONSE DURING AN AUDITORY ODDBALL TASK *Gregory Book[1], Michael Stevens[1,2], Godfrey Pearlson[1,2,3], Kent Kiehl[4]; [1]Olin Neuropsychiatry Research Center, Institute of Living at Hartford Hospital, Hartford, CT, [2]Yale University School of Medicine, New Haven, CT, [3]Johns Hopkins University, Baltimore, MD, [4]MIND Institute, Albuquerque, New Mexico* – Background: Pupillary dilatation has been used as a robust measure of cognitive processes, and associated neural pathways are well understood. However, brain regions responsible for dilatation during the orienting response are unexplored. We used a method involving fusing fMRI and pupil response data to identify areas implicated in this pupil response. Methods: We tested 19 healthy control subjects (ages 18-49, 37% male) using BOLD fMRI (TR=1500ms) in a Siemens Allegra 3T magnet while simultaneously collecting pupillary data using an ASL model 5000 eye-tracker. Subjects performed an auditory oddball task consisting of 10% target, 10% novel, and 80% standard tones. They pressed a button to respond only to target tones. fMRI data were realigned, normalized, smoothed, and statistics were generated using the general linear model. Pupil response data were processed by removing blinks, and averaging the time courses surrounding the button presses. The fMRI and pupil data for all subjects were entered into the Fusion ICA Toolbox (FIT, Calhoun et al), and statistics were generated for the correctly identified target condition. Results: Pupil response averages showed dilatation of 0.203mm for targets, 0.08mm for novels, and 0.006mm for standards. Fusion analysis produced one component for target tones and one for novels. Fusion of target fMRI and pupil diameter showed significant mutual information in the parahippocampal gyrus and midbrain [$p<0.05$ uncorr]. Fusion of novels produced no significant mutual information. Conclusions: Our data suggest that the parahippocampal gyrus, known to activate during memory retrieval and recognition, activates concomitant with pupil dilatation.

B94

COMPARING APPLES AND ORANGES: SIMILARITY AMONG PATTERNS OF NEURAL ACTIVATION REFLECTS BEHAVIORAL JUDGMENTS OF CONCEPT SIMILARITY *Andrew C. Connolly[1], Matthew Weber[2], Daniel Osherson[2], Kenneth A. Norman[2], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania, [2]Princeton University* – We investigated the similarity structure present among patterns of neural activation associated with a set of category exemplars within a single superordinate category, namely, FRUIT. Pairwise similarities derived from neural data were compared with similarities based on behavioral judgments. During fMRI scanning, subjects (n = 12) viewed colored photographs of 16 different types of fruit (e.g., apple, oranges) while performing a category verification task. After the scanning session, subjects made pair-wise similarity judgments for all pairs of fruit viewed during scanning. Other measures of behavioral similarity involved a different group of subjects making judgments in an odd-man-out triad task with either naïve similarity instructions, color similarity instructions, or biological taxonomic similarity instructions. Significant correlations between neural and behavioral similarity were observed for similarities based on activation throughout the occipital lobe and adjacent regions in the posterior temporal and parietal lobes in a group analysis. Variation across brain regions for comparisons with different types of behavioral similarity (e.g., color similarity vs. biological similarity), suggest that similarities among neural activation patterns reflect relationships among represented features of the stimulus, and that the types of features represented differ as a function of brain region. For example, a small effect for color was only observed in the most posterior region of the occipital lobe, while an effect for biological similarity was observed more anteriorly. These findings demonstrate how analysis of patterns in fMRI data can help illuminate how objects are represented in the brain, in addition to where they are represented.

B95

THE MULTILEVEL MEDIATION/MODERATION (M3) FRAMEWORK: A STRATEGY FOR CONNECTIVITY ANALYSIS FOR FMRI DATA *Matthew Davidson[1], Lauren Atlas[1], Martin Lindquist[1], Niall Bolger[1], Tor Wager[1]; [1]Columbia University* – The ability to characterize and test pathways and circuits is critically important for understanding how psychological processes map onto brain function. Few existing methods allow for population inferences on functional connectivity between brain regions, and none provide a way to search for connectivity in a whole-brain analysis. The multilevel mediation/moderation (M3) framework we have developed allows researchers to localize and test functional pathways in humans. The M3 approach combines two concepts that have been enormously successful for modeling multivariate relationships in behavioral research: the concept of mediation/moderation in path analysis, and the concept of mixed-effects (or hierarchical) models. Mediation analyses provide tests of whether the relationship between two variables is explained (mediated) by a third, thereby establishing either a direct linkage between two variables or an indirect linkage in a three-variable pathway. Moderation analyses test whether the relationship between two variables depends on a third (sometimes referred to as modulation.) Mixed-effects models allow population inferences on functional pathways identified within-subjects. In this poster we outline the M3 framework and discuss its potentials and pitfalls. We contrast the method to related procedures, including linear decomposition methods and structural and dynamic confirmatory modeling. We also discuss Matlab-based software, developed in our lab, that will soon be available to the broader neuroimaging community. The beta version is available from http://www.columbia.edu/cu/psychology/tor/.

B96

A META-ANALYSIS TOOLBOX FOR ANALYZING REGIONAL CORTICAL FUNCTIONAL ORGANIZATION *Timothy Herron[1], Xiaojian Kang[1,3], Kimmo Alho[2], David Woods[1,3,4]; [1]Veterans Affairs, Martinez, CA, [2]University of Helsinki, [3]UC Davis, [4]Center for Mind and Brain, UC Davis* – Meta-analytic studies of the localization of cortical functions are faced with two problems: (1) Visualizing activations reported as 3D coordinates (MNI or Talairach space) in relation to cortical surface anatomy; (2) Evaluating the statistical significance of differences in cortical activation foci in different categories of experiments. We describe a meta-analysis toolbox that permits 3D activation foci to be mapped to a standardized representation of the inflated cortical surface and that statistically analyzes differences in location on both the cortical surface and in 3D space. Three steps are involved. First, each 3D coordinate in MNI or Talairach space is transformed into Freesurfer spherical coordinates by identifying the cortical surface voxel nearest to the 3D coordinate in each of 63 normal, right-handed brains and by computing the median location of those 63 cortical surface points on a standardized hemispheric atlas. Second, topographic maps showing cortical surface foci locations in relation to average gyral and sulcal structures are displayed on Mollweide whole hemisphere projections either for different groups of studies or for different subjects in a single experiment. 3D foci distributions and median locations can also be visualized on the Colin MNI brain. Third, cortical surface and 3D locations from two different categories of experiments or from two different conditions in a single experiment are statistically analyzed for group location differences using non-parametric permutation testing. A MatLab toolbox that includes the display and statistical tools as well as the anatomical database will be available at www.ebire.org/hcnlab.

B97

NAVIGATION ABILITY AND RIGHT HIPPOCAMPAL ACTIVATION IN UNSELECTED PARTICIPANTS *Lars Bagger Hviid[1], Jamila Ahdidan[1], Barbara Ravnkilde[1], Raben Rosenberg[1], Poul Videbech[1]; [1]Centre for Psychiatric Research, Aarhus University Hospital, Risskov, Denmark* – Aim: The interest in neuropsychological tasks that may provide sensitive measures of hippocampal impairment is growing. Hippocampus specific tasks are particularly relevant when it comes to assessing the impact of syndromes such as epilepsy, Alzheimer's and major depression on the hippocampus. Previous studies investigating hippocampal involvement in visuo-spatial navigation have mainly included healthy participants with either extensive navigation or gaming expertise. When testing clinical populations, these types of control populations seldom fit the clinical populations. Here we investigated whether previous findings could be replicated for unselected healthy participants of mixed gender and age and with little previous navigation or gaming experience. Methods: We compared regional cerebral blood flow (rCBF) in the right hippocampus and cognitive performance of 13 healthy participants, while participants performed a 3D-virtual reality navigation task (3DVRNT) during Positron Emission Tomography (PET). Besides the 3DVRNT, participants underwent PET rest-measurements (baseline), magnetic resonance imaging (co-registration) and extensive neuropsychological and gaming ability assessment. Results: Our results indicate a significant correlation between navigation ability on the 3DVRNT and rCBF in the right hippocampus when correcting for age and gender. Conclusion: We examined the relationship between the ability to successfully navigate a 3DVRNT and rCBF in the right hippocampus of a group of unselected healthy subjects. Previous studies have mainly focused on highly specialized subject groups, thus bringing into question whether such results can be replicated for "normal control participants". Our results suggest that it is possible to replicate previous findings despite of the participants' lack of extensive navigation or gaming expertise.

B98

ALTERATIONS IN BRAIN ACTIVATION DURING IMPULSIVE BEHAVIOR IS ASSOCIATED WITH BIOCHEMICAL ABNORMALITIES IN BIPOLAR DISORDER *Martine Lamy[1,2,5], Wenjang Chu[3,5], Xing Wang[3,5], Stephen Strakowski[3,5], Jing-Huei Lee[3,5], James Eliassen[3,5]; [1]University of Cincinnati Neuroscience Graduate Program, [2]University of Cincinnati Physician Scientist Training Program, [3]University of Cincinnati, [4]University of Cincinnati Center for Imaging Research* – Impulsivity is a prominent aspect of bipolar disorder (BD). We assessed impulsivity in euthymic bipolar patients and healthy subjects using the Balloon Analogue Risk Task (BART) while undergoing fMRI. The BART is a novel behavioral measure of risk taking and impulsive behavior. Resting-state 31P magnetic resonance spectroscopic imaging (MRSI) was also performed to investigate regional phosphate metabolism. We hypothesized that alterations in brain regions associated with impulsive behavior on the BART (as measured by fMRI) would also show changes in resting-state high-energy phosphate metabolites (as measured by 31P MRSI) in BD. Participants included 6 medicated, euthymic bipolar patients (3 female, average age 35). Three demographically matched healthy subjects served as controls. 31P MR spectra were reconstructed from six regions of interest (ROIs) activated by euthymic patients during BART performance. The ROIs included the anterior cingulate cortex, left and right inferior frontal gyrus, left and right thalamus, and the cerebellar vermis. The PCr/ATP ratio, a marker of energy change, was decreased in the vermis of BD patients as compared to healthy subjects (1.43 ± 0.49 vs. 2.15 ± 0.50, $p=0.03$). No significant differences in 31P metabolites were found in the other ROIs. Previous work suggests that structural abnormalities in the vermis are associated with multiple affective episodes and deficits in emotional modulation in BD. This preliminary evidence suggests that functional brain activation abnormalities are associated with resting-state biochemical abnormalities in BD, and that further work should be done to investigate the relationship between functional, structural and biochemical abnormalities found in psychiatric disorders.

B99

AMELIORATION OF MOVEMENT ARTIFACTS IN SLOW AND FAST OPTICAL RECORDINGS *Edward Maclin[1], Schneider Nils[1], Gabriele Gratton[1], Monica Fabiani[1]; [1]University of Illinois Urbana-Champaign* – Near-infrared spectroscopy (NIRS) and the event related optical signal (EROS) are relatively immune to electrical and magnetic interference. It has long been recognized, however, that these methods, particularly intensity measures, are susceptible to movement artifacts arising from variations in the source and detector to scalp interfaces. While these artifacts can be greatly reduced by good interface design and recording procedures, in large data sets some artifacts will inevitably occur. We have developed a program for detecting and either correcting, interpolating or rejecting data segments in frequency domain data. First we discard channels whose source-detector distance is too large, or whose phase variability is too great. Abrupt changes in the data, likely due to movement, are then detected and classified as either "spikes" or "steps". "Spikes" are replaced with interpolated data, and "steps" are corrected by subtracting the pre and post means. Finally, as the data are averaged channels whose range within in a given epoch exceeds a specified value are ignored. The number of accepted trials is accumulated separately for each channel. We investigated the utility of this program in a large dataset (10 blocks of 4 minutes with 1024 channels, in 48 subjects). We compared main effects in the NIRS data across subsamples of “clean” subjects and “noisy” subjects before and after cleaning and found cleaning to improve the consistency of results between the “clean” and “noisy” groups, without introducing noticeable spurious effects.

B100

ANATOMICAL AND FUNCTIONAL SEGMENTATION OF THE COGNITIVE CONTROL NETWORK *Sudhir Pathak[1,2], Bruna Martins[2], Michael W. Cole[1,3,2], Walter Schneider[1,2,3]; [1]Center for Neuroscience, University of Pittsburgh, [2]University of Pittsburgh, [3]Center for the Neural Basis of Cognition, University of Pittsburgh* – Diffusion tensor imaging (DTI) was used to segment functional regions (using probabilistic tractography) based on anatomical connectivity within the cognitive control network, identifying subregions with specialized connectivity. Previous work has shown that this set of regions is active across a wide variety of task demands and forms a highly integrated functional network (Cole & Schneider, 2007). Here we anatomically segmented the network’s (functionally defined) regions, which include dorsolateral prefrontal cortex (DLPFC), posterior medial frontal cortex (PMFC), inferior frontal junction (IFJ), dorsal pre-motor cortex (DPMC), anterior insula cortex (AIC), and posterior parietal cortex (PPC). We found that all these regions are segmented based on their differing anatomical connections within the network. For instance, functionally defined PMFC is segmented into three sub-regions based on its anatomical connectivity with DLPFC, AIC, and PPC. We hypothesize that anatomically coupled areas will exhibit higher functional connectivity with their respective sub-regions than with functionally-defined regions (based on resting state correlations between fMRI signals). These findings would support our prediction that functional regions can be segmented into functional sub-regions, showing tight coupling of functions within the cognitive control network.

B101

TO DO THE RIGHT THING: TEMPORAL DIFFERENCE LEARNING AS TOOL TO DISSECT THE ROLE OF FEEDBACK IN THE STRIATUM. *Erik Peterson[1], Carol Seger[1]; [1]Colorado State University, Fort Collins, CO* – Always do the right thing! That's the ideal policy; however, determining what action is optimal in a given situation is difficult. The basal ganglia are thought to be crucial in forming associations between stimuli and actions. Studies of Parkinson's Disease and other basal ganglia disorders suggest that dopaminergic activity is crucial for feedback mediated learning in the basal ganglia. Multiple lines of evidence also suggest that one of dopamine's roles is as an error signal, representing the difference between expectation and result. One theoretical framework for understanding this signal is temporal difference (TD) learning, which utilizes a similar error signal. We are using the TDf ramework and event-related fMRI to identify the particular learning functions subserved by different corticostriatal loops. As a first step we used a classification of arbitrary visual stimuli task, with simple (but probablistic) feedback: "correct" or "incorrect". Previous work indicated that TD regression predicts BOLD responses in, among others, the ventral striatum, and the dopaminergic substantia nigra (SNc). Our preliminary results are consistent with these findings. However the paradigms used to test the TD framework may be biased in favor of TD-consistent results. We plan to test the TD framework under more challenging conditions.

B102

FEATURE-DRIVEN DECOMPOSITION OF MEG SIGNALS TO CLARIFY VISUAL INFORMATION PROCESSING IN THE BRAIN *Marie Smith[1,2], Philippe Schyns[1,2]; [1]University of Glasgow, [2]Centre for Cognitive NeuroImaging, University of Glasgow* – In this study, we present an analysis methodology that merges our Bubbles techniques of assigning specific information processing content to brain signals with spatially and temporally resolved MEG signals to clarify the dynamics of visual information processing in the brain. We illustrate this by applying it to the analysis of two biologically relevant face categorization tasks: judgments of facial gender and expressiveness in four observers. On the sensor level, we initially observe MEG sensitivity to contra-lateral eye information bi-laterally over occipito-temporal regions irrespective of task, which then extends to ipsi-lateral regions in the gender task and diminishes to be replaced by sensitivity to the mouth in the expressiveness task. Selecting three key sensors, we map out with a 1ms temporal resolution the visual information underlying the M170 and P300 brain responses, and observe complementary information processing from the horizontal and vertical orientation recordings. In the source space, (5000 voxels, 1cm resolution), we track the processing of three key visual features, (left eye, right eye and mouth), as it flows within the cortex from initial task independent sensitivity in lateral occipito-temporal regions to medial parietal sensitivity to task specific information. Crucially, while standard approaches may find activity in a particular brain region during one task vs’ another (or baseline), our approach establishes which information in the visual stimulus the brain signal is responding to and how this response varies with time, cortical location and task demands to establish a more precise tracking of information processing mechanisms.

B103

IDENTIFICATION OF LANGUAGE AREAS FROM EVENT-RELATED FMRI PARADIGMS USING DATA-DRIVEN METHOD *Yanmei Tie[1], Ralph Suarez[1], Stephen Whalen[1], Alexandra Golby[1]; [1]Brigham and Women's Hospital, Harvard Medical School, Boston, MA* – Vocalized event-related language fMRI paradigms for studying language function offer an advantage of more closely simulating natural language performance. However, the motion artifact resulting from verbalizing the responses and co-activations in the sensory-motor areas may lead to contamination in the statistical maps generated using a conventional general linear model (GLM) method. To address this problem, we investigated the capability of a data-driven method, probabilistic ICA (PICA), in separating the language area activations from such complex language paradigms. We analyzed event-related fMRI data from 13 normal healthy controls performing two language tasks (antonym generation, and noun categorization) with two different stimulus modes (visual and auditory presentations). The PICA results consistently revealed two functional networks for each subject’s data, one in the putative language areas and the ipsilateral pre-motor area (PMA), the other in the motor and/or sensory (visual or auditory) areas. The time course of the language-related components showed relatively poor correlation ($r = 0.34 \pm 0.19$) with the reference hemodynamic response (HR) function based on the design matrix, indicating deviation from the HR model used in the GLM method. Combining the results for the same language task across different stimulus modes revealed the essential language areas. In conclusion, this type of data-driven method maybe more appropriate for analyzing language fMRI data with complex paradigms, so as to capture the language-related neural activity that deviates from the putative time course. This may be particularly helpful for patient studies for pre-operative language mapping.

B104

VARIATIONS AMONG MEDITATIVE AND CONCENTRATIVE STATES: A CASE STUDY *Emanuela Tura[1], Jessica Turner[2], Matthew Turner[2], Tugan Muftuler[2]; [1]University of Victoria, [2]University of California, Irvine* – Meditation is a state of consciousness that varies according to technique, person, and session, as well as state achieved. The complexity of the meditation task may imply the use of different brain circuitries and partially explains the different results of past neuroimaging studies. Variability in the results may also be due to the limited number of neuroimaging studies conducted on meditation. The purpose of our study was to assess the level of variability within different sessions of the same individual and to characterize the circuitry of different levels of meditative absorption. We selected an advanced meditator from the Maya school in Rome. He underwent five functional Magnetic Resonance Imaging (fMRI) sessions. Each session was characterized by three conditions: concentration on the breath, meditation on a verse displayed on a screen, and meditation on a verse played by audio and spoken by his teacher. The sequence of the conditions reflected the deepening of the absorption level (as understood by the Maya school). We used Partial Least Squares, a data-driven multivariate approach, to determine the primary covariance patterns generated by the comparison of the three conditions. We found that brain patterns were the same across each session. Primary patterns differentiated the two types of meditations while patterns related to concentration did not covary with the meditation patterns at all. It appeared that neural structures used for concentration and meditation were different, and that the deeper stages of meditation were characterized by the use of different prefrontal and temporal areas.

B105

PROBING INTRINSIC CONNECTIVITY NETWORKS WITH TASK-FREE FMRI: EYES OPEN, OR CLOSED? *Weiming Zeng[1,2], Daniel Simmonds[2], Stewart Mostofsky[1,2], James Pekar[1,2]; [1]Johns Hopkins University, Baltimore MD, [2]Kennedy Krieger Institute, Baltimore MD* – The distributed modular organization of brain function appears to be maintained absent external stimuli or directed behavior, as "intrinsic connectivity networks" (ICNs) [Seeley et al., J. Neurosci. 27:2349, 2007] are revealed by exploratory analyses of fMRI data acquired during "rest." While task-free acquisitions reduce demands on participant compliance, vs. typical neuroimaging paradigms, simply maintaining visual fixation or eye closure can be a challenge for children and some clinically diagnosed populations. Hence, we assessed ICNs using data from alternating four-minute scans of two "task-free" conditions: eyes-open rest and eyes-closed rest. Data were acquired at 3.0 Tesla, and analyzed using Independent Component Analysis (ICA). ICA of individual scans, group ICA of all eyes-open data, and group ICA of all eyes-closed data, all yielded very similar ICNs. Overall, results were similar to the findings of De Luca et al. [NeuroImage 29:1359, 2006] for eyes-closed rest. Group ICA of all scans from all participants yielded ICNs for which loading factors for eyes open and eyes closed can be compared. Median component loading factors across the two conditions were similar, although larger inter-scan variance – dominated by inter-individual variance – was noted in occipital ("visual") ICNs in the eyes closed condition. Further study of differences in inter-individual variance is called for, as different degrees of inter-individual variance are favorable in different contexts: less variance within a population may lead to more robust between-group comparisons, whereas more variance may be advantageous when the goal is to exploit inter-individual differences for examining brain-behavior correlations.

Methodological Issues: Other

B106

SUCCESSFUL TMS DISRUPTION OF LEFT POSTERIOR FUSIFORM DURING READING *Keith J Duncan[1,2], Philip Kelly[1,2], Joseph T Devlin[1,2]; [1]University College London, UK, [2]Institute of Cognitive Neuroscience, University College London, UK* – There is considerable debate regarding the role of the left posterior fusiform gyrus in skilled reading that is based primarily on functional neuroimaging data. If it were possible to selectively perturb neural activity in this region using transcranial magnetic stimulation (TMS), this would offer a powerful complementary tool for investigating the nature of neural information processing in the region. It is commonly assumed, however, that its position on the ventral surface of the brain makes it inaccessible to TMS. We tested this assumption in a set of 10 healthy, native English speakers performing a visual lexical decision task. Using a frameless stereotaxy system, we targeted the lateral posterior fusiform gyrus and/or posterior occipito-temporal sulcus using a trajectory immediately superior to the cerebellum and inferior to the inferior temporal gyrus. In 50% of the trials, repetitive TMS (10Hz for 500msec at 120% active motor threshold) was delivered during the presentation of a letter string, resulting in a significant increase in reaction times for TMS versus non-TMS trials. In contrast, when TMS was delivered to a control site it had no significant effect on RTs. These findings demonstrate the feasibility of using TMS to temporarily disrupt processing in the posterior fusiform region and offers the potential to investigate the question of reading-specific representations in a novel fashion.

Motor control

B107

BEHAVIOURAL CONSEQUENCES OF PREFERRED DIRECTION CODING IN HUMAN MOTOR CORTEX *Christopher Cowper-Smith[1], David Westwood[2]; [1]Dalhousie University, Life Sciences Centre, Halifax, Nova Scotia, Canada, [2]School of Health and Human Performance, Dalhousie University, Halifax, Nova Scotia, Canada* – Here we examine the behavioural consequences of Georgopoulos' (1986) model of movement direction coding in human primary motor cortex (M1). Based on evidence that motor neurons in M1 exhibit preferred direction tuning curves where neural activity is strongest in the preferred direction and weakest at a 180 degree offset, we analyzed reaction times of consecutive, endogenously cued arm and eye movements in separate experiments. Each trial consisted of a prime and probe movement made in rapid succession. Participants sat at a computer workstation and fixated a central target that was surrounded by 8 equidistant peripheral targets. When the 'prime' cue was displayed (a centrally presented arrow pointing to one of the peripheral targets), participants responded as quickly as possible with a corresponding reaching or eye movement. The probe movement was cued by a second arrow 1.5 seconds after prime onset and required a movement response that was offset from the prime movement by 0, ±45, ±90, or 180 degrees. Successive trials were separated by a 4 second delay. Based on the hypothetical tuning curves for neurons in M1, we predicted a sinusoidal relationship between the reaction time for the probe movement and its directional offset from the prime movement. Our results suggest that reaching and eye movements are modulated differently by the degree of offset between prime and probe movements, indicating that directional tuning curves for arm and eye movements may have distinct shapes that can be defined by different functions.

B108

PREPARATION OF FAMILIAR AND UNFAMILIAR MOVEMENT SEQUENCES REFLECTED IN EEG. *Elian de Kleine[1], Rob H.J. van der Lubbe[1]; [1]University of Twente, The Netherlands* – Learning movement sequences, like playing the piano, develops through various phases, from an initial attentive to a more automatic phase. With practice execution of familiar motor sequences becomes faster, which is suggested to occur at an abstract rather than a peripheral processing level. We examined whether these effects were already present during the preparation of familiar sequences by focusing on several measures derived from the electroencephalogram. The contingent negative variation (CNV) was used as a general index of motor preparation, whereas the lateralized readiness potential (LRP) was employed to index effector-specific motor preparation. Furthermore, the posterior contralateral negativity (PCN) was used to index differences in spatial attention. Fixed series of eight keypresses, which were familiar or unfamiliar, had to be prepared, and executed in case of a go-signal. Familiar sequences were executed faster and more accurately than unfamiliar sequences. During the 200 ms before the go-nogo signal the central CNV was enlarged for unfamiliar sequences and the PCN was enlarged for familiar sequences. No differences were found on the LRP. These findings confirm that preparation of familiar sequences requires less attention and involves an abstract rather than a peripheral motor level.

B109

EVIDENCE FOR CEREBELLAR-CORTICAL LOOPS FOR INTRINSICALLY COORDINATED AND EXTRINSICALLY GUIDED ACTIONS. *Madeleine Grealy[1]; [1]University of Strathclyde, Glasgow, Scotland* – Traditionally the cerebellum has been associated with motor control, however, Gao et al. (1996) discovered that the dentate nuclei were more strongly activated during a perceptuo-motor discrimination task than a movement only task. They concluded that the cerebellum 'coordinates the sensory information on which the motor systems depend'. Middleton and Strick (2000) reported projections from the cerebellum to PMv and M1 with a specific role for actions guided by external rather than internal cues, and it is now known that there are distinct loops between the cerebellum and cortical areas, each possibly having a specific behavioural function. Presented here is a case study of a 27 year old (AM) who, eight years previously, had an operation to remove a cystic cerebellar tumour which lay mainly to the left of the midline, including the dentate nucleus, with a solid component on the right. His ability to use proprioceptive and exproprioceptive information to guide his movements was tested. Analyses using the tau-model of perceptuomotor control revealed that compared to six controls AM had a distinct pattern of deficits. His ability to make movements requiring intrinsic guidance (horizontal and vertical hand movements) remained intact, but movements requiring intrinsic coordination (clapping and eating) were uncontrolled when performed both with and without vision. Actions requiring extrinsic guidance (grasping and pointing) were also poor. These data revealed that AM's motor problems related to the perceptual information used to guide the action and suggest a further cerebellar-cortical loop relating to intrinsically coordinated actions.

B110

MOTOR PRIMING OF TRAJECTORIES IN OBSTACLE AVOIDANCE, WITHIN AND BETWEEN PERSONS *Debbie Griffiths[1], Steven Tipper[1]; [1]Centre for Clinical and Cognitive Neuroscience, Bangor University* – Previous research has demonstrated motor priming, that previous actions can influence the current one (Jax & Rosenbaum, 2007; Edwards, Humphreys, & Castiello, 2003). Presented here are the results of several experiments. An individual's previous experience avoiding an obstacle to reach a goal affects the trajectory of their subsequent reaches, despite the absence of that obstacle. Reaches following obstacle avoidance are more deviant than those following non-obstacle reaches. Participants made reaches using actual objects in real space. The priming affect was observed in both vertical and horizontal avoidance of obstacles. The effect was also shown to occur between trajectories whose goals (grasp/touch of an object) were quite different. This study also investigated whether this within person priming was also found between persons, that is, the extent to which the observation of another's avoidance action can prime an individuals' own trajectories. Both allocentric and egocentric perspectives were investigated. The data indicate a robust within person effect, however, results from between persons suggested that motor priming between individuals maybe limited to certain circumstances.

B111

THE EFFECT OF VISUAL TRANSFORMATION ON EXPLICITLY AND IMPLICITLY TIMED BIMANUAL DRAWING TASKS *Nadine Guerrette[1], Ramesh Balasubramaniam[1,2]; [1]School of Human Kinetics, University of Ottawa, [2]Centre for Neural Dynamics, University of Ottawa* – In order to produce an accurate hand movement we require knowledge of our current hand position and of the motion of our arm as it moves to an intended location (Miall & Cole, 2007). Mirror drawing is a particularly challenging task because appropriate hand actions must be planned and directed despite receiving visual feedback that is reversed by the mirror (Lajoie et al., 1992; Miall & Cole, 2007). The purpose of the present study was to investigate the effect of mirror-reflection on explicitly and implicitly timed bimanual drawing movements. Healthy participants (n=8) rhythmically and bimanually traced various template shapes (circles, lines, vertical triangles and horizontal triangles) under two different visual conditions (normal and mirror-reflected visual feedback). Tracing movements were paced by an external auditory cue, and all templates were traced in both symmetrical and asymmetrical coordination modes, where the phasing between the hands was 0º and 180º, respectively. Timing errors were computed, and the quality of the drawings was assessed by measuring deviations from desired trajectories. Our results show that the variability of movement trajectories was greater during the mirror condition for all shapes, however no difference was observed between the symmetrical and asymmetrical coordination modes. Furthermore, timing errors were greater in the mirror condition in comparison to the normal vision condition. This effect was most evident during line and vertical triangle drawing tasks. Results are discussed in terms of the task-specific mechanisms involved in trajectory planning and timing of bimanual movements when faced with a visual transformation.

B112

DISRUPTION OF ACTION EXECUTION DURING OBSERVATION OF BIOLOGICAL AND ROBOTIC EFFECTORS *Ada Kritikos[1], Glen Russell[1]; [1]School of Psychology University of Queensland, St Lucia, Australia* – It is clear that humans are sensitive to biological (human) motion differentially to motion produced by non-biological effectors, such as robots. Response latencies for actions primed by biological effectors are faster than those primed by non-biological effectors. Interestingly, our movement parameters are disrupted when watching dissimilar movements of biological but not effectors non-biological effectors. What remains unclear, however, is precisely what features of the movement are coded by the visuomotor system as 'biological'. Here we speculate that it is the pattern of the kinematic parameters of a biological effector that is crucial, such as the time to peak grasp and peak velocity. The implication of this speculation is that if the kinematic parameters of an biological effector are not 'biological', then 'biological motion' effects should not be evident. Conversely, a non-biological effector should produce these effects if its parameters are re-constructed to appear biological. In this series of experiments, we recorded movements with a motion capture system. Participants made reach-to-grasp movements while watching digitised videos of reach-to-grasp actions by biological or non-biological effectors (biological hand or mechanical hand). Execution parameters were disrupted when observed biological (but not robotic) actions were incongruent for grasp width. We then altered the parameters of the effectors by re-digitising the video clips, such that the biological hand reflected the temporal parameters of the mechanical arm, and vice versa. Preliminary data suggest temporal parameters associated with biological effectors disrupt action execution, regardless of the appearance of the effector.

B113

ATTENTION MODULATES ACTIVATION IN THE MIRROR NEURON SYSTEM *Karolina Moutsopoulou[1], Tom Manly[1], Rhodri Cusack[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK* – The mirror neuron (MN) system is activated both during action execution and action observation. Although studies to date have investigated many properties of the system (e.g., its role in action intention understanding, and relation to language processing), it has not been established which parts of the MN response are automatic and which are modulated by attention. There may be benefits in preventing irrelevant stimuli from influencing the processing of attended actions. This fMRI study aimed to investigate the modulatory effects of attention on MN function. Videos of biological action (arm/leg) and non-biological equivalents (spatially and temporally matched) were used. Trials consisted of two overlaid clips (either both biological, both non-biological, or one of each), and subjects attended to one clip while performing a target detection task (observation). Execution trials of hand/foot movements were included for localization of the MN system. Relative to control stimuli, observation of arm actions activated the STS (commonly implicated in processing biological motion) and MN regions in motor & parietal cortex, which were also active during execution. Leg stimuli yielded less reliable activity. Crucially, the response was modulated by attention in MN regions in motor cortex and left parietal lobe, and in bilateral STS. However, the right STS and a right superior parietal region remained activated even in the unattended condition. The results therefore indicate differential effects of attention in different areas of the MN network. The findings will be discussed in relation to MN models and connectivity between the regions involved.

B114

PLACING ACTIONS IN CONTEXT: MOTOR FACILITATION FOLLOWING OBSERVATION OF IDENTICAL AND NON-IDENTICAL ACTS *Brenda Ocampo[1], Ada Kritikos[1]; [1]School of Psychology, The University of Queensland, [2]The University of Queensland* – The probable function of the human mirror system is to enable imitation through 'direct motor mapping' between observed and executed actions (Iacoboni et al., 1999). Goal-directed actions can be facilitated by observation of identical acts (Edwards et al., 2003). Recent evidence suggests, however, that the mirror system is active during the preparation of non-identical, complementary actions, and that performance (in response time) to objects can also be facilitated (Newman-Norlund et al., 2007). Using motion-capture analysis (ProReflex) we demonstrate that action observation modulated movement parameters to identical objects, whether action observation and execution occurred simultaneously or consecutively. In Experiment 1, participants observed reach-to-grasp actions and then performed these in imitative and complementary contexts. On 40% of trials, cues appeared requiring participants to violate context rules and perform both identical and non identical acts. Findings suggest that in imitative contexts, prior observation of identical acts facilitated movements towards objects relative to prior observation of non-identical acts. Crucially, during complementary contexts, this effect was reversed such that prior observation of non-identical acts facilitated movements compared with identical acts. Preliminary evidence from a further experiment suggests that facilitation occurred only when cues came following the observation of hand actions rather than alone as action words, indicating the possible involvement of the mirror system in mapping observed actions to both identical and non-identical (but goal-related) motor acts. Results are consistent with those of Newman-Norlund et al. (2007), and extend this evidence from basic RT to accuracy in movement trajectories through space.

B115

CEREBELLUM UNDERLIES TRANSFER TO UNTRAINED TASK FOLLOWING A COMBINATION OF MENTAL AND PHYSICAL TRAINING *CJ Olsson[1], Bert Jonsson[1], Lars Nyberg[1,2]; [1]Umeå University, Sweden, [2]Umeå center for Functional Brain Imaging (UFBI), Umeå University, Sweden* – It is well known that mental imagery training can be used to enhance performance on motor tasks. However, the underlying mechanisms of such training effects are not yet completely understood. The current study investigated behavioral and neural effects of mental, physical and combined mental + physical training on a finger tapping task. The mental or physical only groups trained on a finger-sequence for a total of 60 min over six weeks. The combined group trained 60 min physically and in addition 60 min mentally. The results showed that all groups had significantly increased tapping performance for the trained sequence. In addition, for the combined training group there was significant transfer to an untrained sequence. To test whether the transfer effect was as a result of training magnitude, a control group received 120 min of physical practice over six weeks, but this group did not show significant transfer. FMRI scanning indicated that transfer was mediated by the cerebellum, which was activated by the combined group during performance of the untrained sequence. Thus, the combination of mental and physical practice results in transfer to tasks with similar requirements. This implies that adding mental training to existing physical training will improve motor ability and that it promotes flexibility to more easily adapt to untrained tasks. The findings have implications for the use of imagery as a performance enhancer.

B116

TIMING VARIABILITY AND TRACKING BEHAVIOR IN SERIES OF REPETITIVE SACCADIC AND SMOOTH-PURSUIT EYE MOVEMENTS *Brian Richardson[1], Ramesh Balasubramaniam[2]; [1]University of Ottawa, [2]University of Ottawa, Center for Neural Dynamics* – When performing series of saccadic or smooth-pursuit eye movements with monotonic changes in pacing frequency, the points at which phase transitions occur between reactive and predictive behaviors exhibit a similar hysteresis. These findings suggest a common decision process shared by multiple downstream neural pathways. The present study was designed to further characterize the global nature of this temporal organization. In the first experiment, we established intra-subject behavioral transition points with a saccadic target (square wave, position vs. time trajectory) that either increased or decreased its pacing monotonically (0.165Hz and 1Hz). We recorded the characteristics of the behavioral transition to optimally structure subsequent stimuli. Subjects were then shown a smooth-pursuit target (trapezoidal waveform) at identical pacing intervals. During smooth-pursuit trials, once the pacing rate was reached where persistence of a behavior was established, the visual target was switched to a saccadic target. The distribution of saccade latencies was compared between saccade-only, and smooth-pursuit switched to saccade trials. The second experiment involved a synchronization-continuation design. The synchronization phase was presented with either saccade or smooth-pursuit (triangle waveform) targets, while the continuation was performed with saccades. The decomposition of variability during the continuation phase was compared between the two synchronization conditions. Results indicate that a time interval established through tracking with one type of eye movement is not identically transferred to the other. This is indicative of an internal representation of timing which can facilitate timing for multiple effector pathways, but is dependent on the mode of synchronization for optimal accuracy.

B117

OBSERVING JOINT ACTIONS: THE BRAIN KEEPS TABS ON EACH ACTOR'S MOVEMENTS IN SEGREGATED PROCESSING STREAMS *Jeremy Skipper[1], Ekaterina Dobryakova[2], Natalie Sebanz[3]; [1]Sackler Institute for Developmental Psychobiology, Weill-Cornell Medical College, NY, [2]Rutgers University, Newark, New Jersey, [3]University of Birmingham, Birmingham, UK* – Areas of cortex involved in producing movements are active when we observe an individual performing an action as if we were going to perform the action ourselves. Activity in these "motor" areas during action observation has been hypothesized to underlie aspects of action understanding. However, this begs the question of how brain areas involved in the production of movements process joint action, where two or more people are seen acting together . During fMRI, participants watched videos of two actors passing a cup to each other. We varied whether the two actors used the same grip or a different grip. Using a novel repetition suppression method we were able to isolate activity associated with each of the actor's movements. When the actors were both performing the same grips, the distal and proximal actor's movements were more associated with activity in ventral and dorsal aspects of the parietal lobules, precental sulcus and gyrus, and central sulcus, respectively. When actors were performing different grips, the activity for each actor's movements in these areas was more interdispersed, i.e., less divisible along a dorsal/ventral axis, especially in the ventral aspects of the precentral sulcus and gyrus. These results suggest that the brain "keeps tabs" on each individual's movements through spatial segregation of activity patterns, perhaps in accord with known properties of dorsal and ventral aspects of premotor cortex. Interference effects observed in behavioural studies where actors perform "incongruent" movements may result from a breakdown of this segregation.

B118

EYE-HAND COORDINATION DURING A TARGET SELECTION TASK IN MONKEYS *Joo-Hyun Song[1], Robert M. McPeek[1]; [1]The Smith-Kettlewell Eye Research Institute* – We examined how saccades and reaches are coordinated for target selection in monkeys by training them to perform a visual search task in which they reached to an odd-colored target presented with three distractors. The colors of the target and distractors were randomly switched in each trial between red and green. We compared trials in which an initial saccade was misdirected to a distractor, followed by a corrective saccade, and those in which a single saccade was directly executed to the target. We found that an initial saccade directed to the target always preceded a reach. However, when multiple saccades were coordinated with reaches, reaches were sometimes initiated before saccades were executed to the target, demonstrating a flexible temporal eye-hand coordination. When multiple saccades were executed, the precision of reach endpoints was not reduced, but the distance between saccade and reach endpoints increased. Furthermore, we found that a common target was selected for saccades and reaches so that when reach errors were made, saccades were also accompanied to the same site. In addition, we demonstrated that a distractor located within the same hemifield with the target interfered with the target selection process more than any other distractors. This might be explained by the fact that within-hemisphere integration is faster than cross-hemispheric integration due to lateral connections within-hemisphere. Taken together, we suggest that the eye and hand share target selection processes and yet, their coupling is flexible and strategic to maximize the efficiency.

B119

IMITATION IS THE ECHO OF OBSERVATION: MU RHYTHM IN EEG REFLECTS MOTOR RESONANCE WHILE LEARNING OBSERVED MOVEMENTS *Jurjen van der Helden[1], Hein T. van Schie[2], Christiaan Rombouts[1]; [1]University of Twente, Enschede, the Netherlands, [2]Radboud University, Nijmegen, the Netherlands* – Many skills are learned by imitation of a teacher, a model, a sportsman, etc. Mu-activation (~8-13 Hz) in the EEG is thought to reflect motor cortex activation and has repeatedly been shown to be modulated during observation of actions such as reaching and grasping, or finger movement observation. The current study investigated the role of Mu-activation in observational learning of sequences. Fifteen participants (6 male, 9 female, mean age 20.5 y) observed a sequence of six button presses of two index fingers pressing two target buttons in a fixed order, followed by a pause. After 4 repetitions of the same sequence, participants had to repeat the same series of finger movement in the Imitation Condition (IC) or had to indicate whether a deviant movement had been made in the Detection Condition (DC, i.e. in some cases the thumb rather than an index finger moved). Both Alpha and Mu power were suppressed during the IC as compared to the DC. Interestingly, suppression of Mu rhythm was found maximal during the pauses between sequence repetitions. No such effect was found for the DC, which instead showed a rebound of Alpha power during pauses. These data suggest a functional contribution of the Mu rhythm to observational learning related to the maintenance of observed movements within the motor system.

B120

FUNCTIONAL REORGANIZATION IN THE SACCADIC SYSTEM: COMPARING VIRTUAL AND REAL LESIONS *Martijn G van Koningsbruggen[1], Paul E Downing[1], Robert D. Rafal[1]; [1]School of Psychology, Bangor University* – Damage to the Frontal Eye Fields (FEF) impairs the ability to initiate voluntary, but not reflexive eye movements in the direction opposite to their lesion. This implicates involvement of the FEF in the generation of voluntary eye movements, and suggests that there are separate networks controlling reflexive and voluntary eye movements. On the other hand, fMRI studies have found similar involvement of the FEF in both voluntary and reflexive eye movements, and concluded that the FEF is equally important for both. Another interesting but often neglected finding is the fact that although patients' eye movements are slower, the patients can still make voluntary eye movements, suggesting that another area can partly take over from the damaged FEF. We have developed a new approach to investigate this controversy between neuropsychological and fMRI studies. First, we measured the BOLD response in the FEF for both reflexive and voluntary eye movements, and a voluntary key press task. We found that the FEF were activated to the same degree for both voluntary and reflexive eye movements. Next, we applied functionally guided theta burst TMS over the FEF or the vertex just before the start of the fMRI experiment. We discovered that voluntary saccades were slower in the contralateral direction. Preliminary fMRI results suggest that other areas become more activate following theta burst TMS to the FEF, relative to baseline. This will be compared to the fMRI activation found in FEF patients doing the same task, allowing us to investigate functional reorganization.

B121

THE EFFECT OF UPPER LIMB RHYTHMIC ACTIVITY ON STANDING BALANCE IN PATIENTS WITH CEREBELLAR DAMAGE *David White[1], Ramesh Balasubramaniam[2]; [1]University of Ottawa, [2]Centre for Neural Dynamics, University of Ottawa* – Coordinating muscles and joints to accomplish a task is a seemingly automatic process. However, without proper functioning of the cerebellum, performance of simple movements in an organized manner is challenged. Some of the most distinctive signs of cerebellar damage are disturbance to balance and gait, including increased postural sway and irregular responses to perturbations (Earhart & Bastian, 2001). Previous studies on self-perturbation tasks involving arm movements have examined postural patterns (Abe & Yamada, 2001) and the relationship between arm movement and the body's center of pressure (CoP) (Forner-Cordero et al., 2005; Ustinova et al., 2004). Here we examine the cases of two unilateral cerebellar patients with left-hemisphere damage by looking at the coupling in lower limb joints in response to a voluntary and repetitive upper limb perturbation. The two patients and ten healthy controls swung their arms inphase and antiphase in the sagittal plane to a metronome at frequencies of 0.67 and 0.75 Hz. Movement kinematics and CoP data were collected concurrently. Relative phase between the lower limb joints, and between the arm and CoP was computed as well as the amplitude of the excursion of each of the joints. Our results revealed asymmetries in amplitude and relative phase of the lower limb joints between affected and non-affected sides. Differences in CoP amplitude were also observed between affected and non-affected sides and between inphase and antiphase conditions. Our results provide insight into the control mechanisms in multi-segmental coordination tasks and the role of the cerebellum in supporting such movements.

Neuroanatomy

B122

ASSOCIATIONS OF BRAIN SIZE AND VERBAL PERFORMANCE DEPEND ON HANDEDNESS *Christine Chiarello[1], Suzanne Welcome[1], Stephen Towler[2], Ronald Otto[3], Christiana Leonard[2]; [1]University of California, Riverside, [2]University of Florida, Gainesville, [3]Computerized Diagnostic Imaging Center, Riverside* – Brain volume is known to correlate with some measures of cognitive performance. We report data from the Biological Substrates for Language project which included IQ and reading measures, and RT and accuracy scores for a variety of lateralized visual lexical tasks in 200 young adults. Composite scores across the 7 lexical tasks were used to explore relationships with brain volume. Measurements of overall brain volume were made from structural MRIs. Across the entire sample, brain volume positively correlated with IQ, word identification and passage comprehension subtests, and lexical task accuracy and asymmetry. However, handedness (with sex partialled out) modified some of these relationships. Consistent-handers (exclusive preference for one hand, N = 103) and mixed-handers (N = 97) demonstrated different relationships between brain volume and verbal performance. For consistent-handers only, brain volume correlated with RT VF asymmetry–larger leftward asymmetries were observed in those with larger brains. In contrast, for mixed handers, brain volume was associated with overall (nonlateralized) accuracy in the lexical tasks, and reading subtests. These findings suggest that the relationship between brain size and verbal performance is moderated by handedness. A strong phenotypic expression of handedness is associated with stronger verbal lateralization only in those with larger brains. In contrast, in those with a weaker expression of handedness there is a positive association between brain volume and verbal performance that is independent of lateralization.

B123

CEREBELLAR INVOLVEMENT IN COGNITION? A DIFFUSION-WEIGHTED TRACTOGRAPHY STUDY OF FRONTAL LOBE CONNECTIVITY WITH THE CEREBRAL PEDUNCLE *Karl Doron[1], Chadd Funk[1], Mitch Glickstein[2], [1]University of California, Santa Barbara, CA, [2]University College London, London, UK, [3]Sage Center for the Study of the Mind, University of California, Santa Barbara, CA* – Fiber connections within the brain have been studied extensively in non-human primates using tract-tracing techniques and in humans through post-mortem analysis. Studies using diffusion-weighted imaging (DWI) have begun to examine the connections within the normal human brain in vivo. Such studies have suggested that the cerebellum may participate in human cognition based on the input it receives input from the frontal lobe. These studies have not been sufficiently fine-grained to establish which areas within the frontal cortex project to the pontine nuclei, hence to the cerebellum. Here we report the results of a probabilistic tractography study in 20 human datasets in which the frontal lobe was divided into six subregions in order to determine the connectivity of each subregion with the cerebral peduncle. Projections to the cerebral peduncle originate in dorsal and medial regions of the superior frontal gyrus and precental gyrus, with sparse projections from dorsal regions of the middle frontal gyrus. Notably reduced or absent are connections with the middle and inferior frontal gyri, cortical areas associated with activations in cognitive tasks. Importantly, areas showing connectivity with the cerebral peduncle connect to the anterior third of the structure, an area known to carry fibers to the pontine nuclei. Consistent with the monkey literature, areas showing connectivity are associated with motor cortex and the frontal and supplementary eye fields. Based on these connectivity patterns we suggest that the apparent involvement of the cerebellum in cognitive tasks relates to the control of eye movements.

B124

RIGHTWARD HEMISPHERIC ASYMMETRIES IN PLANUM TEMPORALE IN CHILDREN WITH AUTISTIC DISORDER: AN ANATOMICAL MRI INVESTIGATION *Nicole Gage[1], Jenifer Juranek[2], Pauline Filipek[1], Kathryn Osann[1], A. Lisette Isenberg[1], M. Anne Spence[1]; [1]University of California, Irvine, [2]University of Texas Houston Medical Center* – A central goal of cognitive neuroscience is to understand the relationship between brain structures and behavior. Here we assessed hemispheric asymmetries in auditory language regions in children with autistic disorder (AD) and language impairment. We conducted quantitative morphometric analyses of perisylvian regions in a sample (n=50) of children with AD to determine if functional language deficits corresponded to structural anomalies in cortical language areas. A key region of interest was the planum temporale (PT), which is larger in the left hemisphere in most healthy individuals. We report two key findings: (i) Heschl's gyrus, planum polare, and posterior Superior Temporal Gyrus showed hemisphere asymmetry patterns similar to previous findings for children with AD and for typically developing controls; (ii) PT showed a trend for rightward asymmetry that was significant when the sample was constrained to right-handed boys (n=30). This result was due to smaller left rather than larger right PT. Findings of reduced neural territory in left PT are in sharp contrast to the observed pattern (left PT > right PT) for most (70-80%) typical and many language disordered children and adults. PT asymmetry was age dependent, with greater rightward asymmetry as a function of age. We also report lack of concordance in PT asymmetry in a cohort of monozygotic twins, indicating that epigenetic factors are involved in PT development. Results provide evidence for a different maturational path for PT development for children with AD, with both pre- and post-natal experience likely playing a role in PT asymmetries.

B125

BRAIN STRUCTURAL CORRELATES OF PHONETIC EXPERTISE *Narly Golestani[1,2], Sophie Scott[1], Cathy Price[1]; [1]University College London, [2]University of Geneva* – Previous work has shown that, in healthy adults, the ability to learn to hear non-native speech sounds is in part predicted by greater white matter volume of the left Heschl's gyrus (Golestani et al, 2007) and a greater left > right asymmetry in the volumes of the parietal cortices (Golestani et al, 2002, Golestani et al, 2007). In addition, the ability to articulate foreign speech sounds is partly predicted by white matter brain structure in the left insula / pre-frontal cortex as well as in the inferior parietal cortices bilaterally (Golestani & Pallier, 2007). Here, we were interested in understanding brain structural characteristics underlying phonetic expertise. High-resolution structural magnetic resonance imaging was used to compare brain structure in 17 phoneticians to that of 17 age, sex and education-matched healthy controls. Phoneticians were highly trained to listen to and transcribe speech sounds and prosody, and also to articulate foreign and accented speech sounds. Results revealed larger Heschl's gyri bilaterally, as well as a gross morphological shape difference of left Heschl's gyrus between groups. We also found that phoneticians have a larger left pars opercularis and larger temporal poles compared to non-experts. Results demonstrate that brain structure in important parts of language network, including ones underlying auditory perception, language production (Broca's area), and speech intelligibility (temporal poles) characterize phonetic expertise.

B126

DETERMINING NETWORK CONNECTIVITY OF THE SUPERIOR COLLICULUS, FRONTAL *Orion Keifer[1], Paul Corballis[1]; [1]School of Psychology, Georgia Institute of Technology, Alanta, GA* – The majority of assumptions about human neuroanatomy and neurophysiology are based on analogy with non-human primates. While there is a great deal of commonality across primate species, it is always necessary to validate conclusions that are extrapolated from one species to other species. The combination of two magnetic resonance imaging (MRI) techniques, functional MRI (fMRI) and diffusion tensor imaging (DTI) provides a potential for interspecies neuroanatomical comparison. Here we employed the combination of these techniques to explore the proposed network of connections involving the superior colliculus (SC), the parietal eye field (PEF), the frontal eye field (FEF), and the supplementary eye field (SEF), shown in the macaque model. Several studies, using both PET and fMRI, have revealed areas in humans that are proposed homologues of the macaque eye fields. Such activation patterns associated with each of the eye fields provides an opportunity to determine whether DTI-based probabilistic tractography reveals the postulated visual network. We functionally defined the regions of interest for tractography using an fMRI paradigm previously shown to activate the PEF, FEF, SEF, and superior colliculus. Probabilistic DTI tractography revealed a complex network of distributions, including SC to PEF and FEF, PEF to SEF, and FEF to SEF. These results corroborate the connections seen in the macaque species, which helps to substantiate both the use of the macaque as a model of the human saccade system and also to validate the combination of fMRI and DTI as a method for exploring human functional neuroanatomy.

B127

PHONOLOGICAL AND SEMANTIC PARAPHASIAS IN CORTICAL STIMULATION MAPPING *Brandon Loudermilk[1], Todd Detwiler[2], George Ojemann[2], James Brinkley[2], David Corina[1,3]; [1]University of California,* *Davis, [2]University of Washington, [3]Center for Mind and Brain, University of California, Davis* – The present study examines the nature and distribution of naming errors of patients undergoing electrical cortical stimulation mapping (CSM). CSM is an intraoperative procedure used to identify the language, memory, sensory, and motor cortices of patients undergoing awake neurosurgery. During the procedure, a small current is applied to neural tissues in order to induce temporary functional lesions and locate important areas for preservation. Under cortical stimulation, patients are shown slides of common objects and asked to name them. Depending upon which regions are stimulated, this process can result in paraphasias or language errors that fall into three broad categories: phonemic, semantic, and neologistic. This paper reports on a study that examined the naming responses of n=110 patients undergoing cortical stimulation mapping. Specifically, it addresses the characteristics and neuroanatomical distribution of phonological paraphasias, semantic paraphasias, and apraxic errors. Aiding in this endeavor, we relied heavily on a suite of web-based querying and imaging tools which enable the aggregate mapping of stimulation sites to an "averaged" three-dimensional brain. Recorded paraphasias were then visualized and analyzed by type and location using software developed by the Structural Informatics Group at the University of Washington. Regarding neuranatomical distribution, we found wide-spread temporal and parietal regions associated with semantic paraphasias; phonological paraphasias were predominantly confined to the middle and posterior portions of the superior and middle temporal gyrus; and apraxic errors converged on the supramarginal gyrus. Findings suggest a distributed semantic network and implicate the supramarginal gyrus as part of a dorsal extension to frontal regions.

B128

MAPPING THE FUNCTIONAL CONNECTIVITY OF PRECUNEUS *Daniel S. Margulies[1,2,3], A. M. Clare Kelly[1], Lucina Q. Uddin[1], Zarrar Shehzad[1], F. Xavier Castellanos[1], Michael P. Milham[1], Michael Petrides[4]; [1]NYU Child Study Center, [2]Berlin School of Mind and Brain, [3]Berstein Center for Computational Neuroscience Berlin, [4]Montreal Neurological Institute* – The involvement of precuneus in the default mode network has brought it into central focus in recent years. Despite this increased attention, current human imaging literature has yet to appreciate the broad-reaching role for precuneus in associative integration of information across processing domains (sensory, motor, and affective), as suggested by non-human primate studies. Similarly, despite a vast non-human primate literature highlighting functional and structural heterogeneity in the precuneus, human imaging studies tend to lack such specificity, commonly treating it as a unitary structure. This is unfortunate given the diverse patterns of connectivity both within and between prefrontal and posterior parietal sub-regions previously appreciated in animal studies. A recent study of the anterior cingulate cortex has demonstrated the promise of mapping functional connectivity for subdivisions in structurally and functionally complex regions such as this during rest. Here, guided by anatomical connectivity previously examined in the monkey, we simultaneously examine the functional connectivity of 20 precuneus/PCC subregions using 6.5 minutes of resting-state fMRI data collected from 40 healthy adult subjects. We observed similarities between differential patterns of functional connectivity across precuneus subregions, and those previously reported in monkey tracing studies. We also found that precuneus is parcellated into three main connectivity-based subdivisions: somatosensory/motor, visual, and limbic. As the study of networks becomes increasingly integrated into cognitive neuroscience, the recognition of functional parcellation, as defined by differentiated connectivity patterns, will become central to defining cortical function and addressing cortex with more accurate specificity.

B129

IMPROVING THE SPATIAL RESOLUTION OF TRACTOGRAPHY BY COMBINING DIFFUSION WITH STRUCTURAL MRI *Dirk Neumann[1], Matthew Thill[1], Josef Parvizi[2], Ralph Adolphs[1]; [1]California Institute of Technology, [2]Stanford School of Medicine* – While functions of different brain structures has been intensely investigated, little is known about how such structures communicate with one another. Past research has used the anisotropy of water diffusion as a signal in diffusion-weighted MR imaging (DWI) to study fiber bundles composed of axons that connect disparate regions. In these studies, the restriction of diffusion of water is measured in multiple spatial directions and at multiple locations in the brain. Deterministic and probabilistic fiber-tracking algorithms can then be used to identify pathways of fibers. While effective, this method is limited by its low spatial resolution, making it difficult to resolve small fibers as well as crossing fibers. Our study aimed to improve the spatial resolution by combining DWI data with high spatial resolution anatomical data from MRI scans into a fiber-tracking algorithm. The algorithm uses a global probabilistic search to identify potential fiber pathways between selected cortical regions, and a hierarchical Bayes model of fiber geometry and the MR measurements to estimate the certainty of the different fiber paths. The algorithm was tested on a macaque brain, which was scanned post-mortem in a high field 9.4T MR system. We found that the structural data itself is in many cases sufficient to estimate the location of fiber pathways. We are currently working to quantify the increase in spatial precision when the diffusion and structural information are optimally combined.

B130

ARCUATE FASCICULUS VOLUME IS INFLUENCED BY HANDEDNESS AND IS CORRELATED WITH FUNCTIONAL LANGUAGE LATERALIZATION *Ruth Propper[1], Lauren O'Donnell[1], Stephen Whalen[1], Isaiah Norton[1], Ralph Suarez[1], Lilla Zollei[2], Alexandra Golby[1]; [1]Brigham and Women's Hospital, Harvard Medical School, [2]A. A. Martinos Center, Massachusetts General Hospital* – Previous DTI/fMRI research (Vernooij et al., 2007) found increased relative fiber density (RFD) in arcuate fasciculus (AF) in left versus right hemisphere regardless of direction of participant handedness (left-versus right-handers). There was no relationship between AF RFD and functional language lateralization in inferior frontal gyrus (IFG). Other work has found both direction (left versus right) and degree (consistent versus inconsistent) of hand preference influence brain organization; using a novel DTI AF segmentation method we examined AF volume (AFV) and fMRI functional language lateralization in IFG in consistent-left (CLH), consistent-right (CRH), and inconsistent-handed (ICH) individuals. Methods: fMRI and DTI (N=26; CRH=8; CLH=7; ICH=11) were acquired. IFG language activation laterality was calculated using threshold-independent methodology (Branco et al., 2006). Group spectral fiber clustering (O'Donnell et al., 2007) of whole-brain tractography (2mm grid, start: cL>=0.3, stop: cL<0.15, RK2 integration) was used to simultaneously segment AF in all subjects. AFV was defined per hemisphere as number of 1mm cubed voxels intersected by AF fibers. Results: AFV was larger in left versus right hemisphere in CRH only (paired t-test, $p<.05$). Positive correlation between left hemisphere AFV and IFG functional language lateralization ($r=.40$, $p=.05$) was not affected by handedness group, but was eliminated with inclusion of two right hemisphere language lateralized individuals. Conclusion: Differences in AFV between CRH versus CLH and ICH suggest degree and direction of hand preference are important to consider in studies of brain structure-function relationships. Additionally, structural asymmetries in language networks may be related to functional lateralization of language.

B131

INTERHEMISPHERIC COORDINATION IN THE ABSENCE OF CORTICAL COMMISSURES: AN FMRI STUDY OF THE SPLIT-BRAIN AT REST *Lucina Q. Uddin[1], Eric Mooshagian[2], Eran Zaidel[2], Anouk Scheres[3], Daniel S. Margulies[1], A. M. Clare Kelly[1], Zarrar Shehzad[1], Jonathan S. Adelstein[1], F. Xavier Castellanos[1], Bharat B. Biswal[4], Michael P. Milham[1]; [1]Owen Institute for Pediatric Neuroscience, New York University Child Study Center, NY, [2]University of California Los Angeles, CA, [3]University of Arizona, Tucson, AZ, [4]University of Medicine and Dentistry of New Jersey, Newark, NJ* – Split-brain patients present a unique opportunity to address controversies regarding subcortical contributions to interhemispheric coordination. We characterized residual interhemispheric coordination in a complete commissurotomy patient confirmed by structural MRI and diffusion tensor imaging (DTI). By examining patterns of low-frequency BOLD fMRI signal (<0.1 Hz), we assessed the extent to which subcortical structures can support bilateral connectivity of resting state networks. Resting-state (task-free) fMRI data and DTI data was collected from a 74-year-old commissurotomy patient (N.G.). A previously collected sample of 42 healthy adult controls was used for comparison. Using independent components analysis (ICA) and region-of-interest (ROI) based functional connectivity analyses, we demonstrate bilateral resting state networks in a patient lacking all major cerebral commissures. Compared to the control group, patient N.G.'s interhemispheric correlations scores fall within the normal range for two out of three regions examined. This study reports findings from an fMRI examination of functional connectivity between the cerebral hemispheres in a patient with a complete commissurotomy. We provide evidence for bilateral resting state networks in this patient, reflecting continued interhemispheric interaction and suggesting that, at least in part, cortical networks in the brain can be coordinated by subcortical mechanisms.

Poster Session C

Emotion

C1

INDIVIDUAL DIFFERENCES IN DISTRACTIBILITY TO EMOTIONAL STIMULI *Juliette Hesselbrock[1], Reiko Graham[1]; [1]Biobehavioral Undergraduate Research Project, Texas State University* – Many studies have noted the salience of emotional stimuli and their effects on cognitive processes such as attention and memory. Negative emotional stimuli, in particular, tend to grab and hold attention. The objective of this study was to examine individual differences in distractibility to emotional stimuli. A target identification task (the Emotional Interrupt Task, Mitchell et al., 2006) where participants are required to identify targets flanked by emotional pictures was adapted to examine interactions between emotion and attention. Skin conductance response (SCR) was used as an index of autonomic arousal, while the Wisconsin Card Sort Test (WCST) and the Behavioral Rating Inventory of Executive Function- Self Report (BRIEF-SR) were used to evaluate executive function. Analysis of the reaction time data revealed that participants were significantly more distracted by negative pictures than neutral or positive pictures. In addition, SCR responses were significantly larger to negative pictures than neutral or positive pictures. Furthermore, a subsequent regression analysis revealed that the magnitude of attentional distraction by negative pictures could be predicted by performance on the WCST and the BRIEF-SR. Our results suggest that individuals who have poor organizational skills, who struggle with making transitions, or are inflexible in the face of changes are more easily distracted by negative stimuli. Together, these findings suggest that attentional capture by emotional pictures is modulated by both rapid, automatic processes and slower, more controlled, cognitive processes.

C2

MAPPING THE TIME COURSE OF INVOLVEMENT OF RIGHT ANTERIOR STG AND RIGHT FPO IN VOCAL EMOTION PROCESSING *Marjolijn Hoekert[1], Leonie Bais[1], René S. Kahn[2], André Aleman[1]; [1]BCN Neuroimaging Center, University of Groningen, University Medical Center Groningen, The Netherlands, [2]University Medical Center Utrecht, The Netherlands* – The right hemisphere is involved in processing paralinguistic properties of speech that contain information about the emotional state of the speaker, also known as emotional prosody. More specifically, studies revealed that right frontal and right temporal regions play a role in emotional prosody perception. In this study we used triple-pulse rTMS to shed light on the precise time course of involvement of right anterior STG and right FPO. Healthy subjects performed an affective prosody task, in which they were required to focus on prosody and decide which emotion was expressed. During listening a triplet TMS pulses was applied to one of the areas at various time points. Mean reaction time was 2277 ms. Results showed a significant main effect of time for right STG and right FPO. A triplet of pulses given at 1300 ms from stimulus onset resulted in the largest interference with task performance. This effect was stronger for withdrawal emotions than for approach emotions. A further experiment with the inclusion of the POz EEG location as an active control condition, revealed a significant main effect of location with stronger effects at FPO and STG relative to the POz location. Acoustic side effects might however also have interfered with task performance. Results suggest that both right FPO and right STG are critical for the perception of emotional prosody around 1300 ms after sentence onset. This is the first TMS study on the temporal involvement of right FPO and right STG in the processing of emotional prosody.

C3

OPTIMISTIC BIAS IN GENERALIZED ANXIETY DISORDER (GAD) AND GENERALIZED SOCIAL PHOBIA (GSP) *Nick Garber Hollon[1], Jeffrey DeVido[1], Matthew Jones[1], Marilla Geraci[1], James Blair[1], Karina S. Blair[1]; [1]Unit on Affective Cognitive Neuroscience, Mood and Anxiety Disorders Program, National Institute of Mental Health* – Optimistic bias (OB) involves the tendency to underestimate the likelihood of experiencing negative life events and to overestimate the likelihood of experiencing positive life events. There have been suggestions that OB represents a cognitive defense mechanism against increased anxiety levels (Weinstein, 1980). Potentially alternatively, OB has been associated with increased reward related activity within the amygdala and ventromedial prefrontal cortex (vmPFC) in recent neuroimaging work (Sharot et al., 2007). The current study investigated OB in 20 unmedicated individuals with Generalized Anxiety Disorder (GAD), 20 unmedicated individuals with Generalized Social Phobia (GSP), and 20 healthy controls. Both GAD and GSP are associated with increased levels of anxiety. However, whereas GSP is associated with increased amygdala responses to social threat, GAD appears to be associated with reduced amygdala responding and indications of ruminative prefrontal-based "worry" (Blair et al., under revision). If OB reflects a cognitive defense against anxiety, both patient groups might be expected to show increased OB. In contrast, if OB relates to amygdala-vmPFC coding of reinforcement information, patients with GAD might be expected to show reduced OB. The patients with GAD showed significantly less OB than the patients with GSP and the healthy controls. These results suggest that OB cannot be perceived purely in terms of a defense mechanism to cope with increased levels of anxiety. Instead they are consistent with suggestions of inappropriate amygdala-vmPFC interactions in GAD and suggest that these may mediate the reduced OB and potentially increase risk for depression that is seen in this disorder.

C4

AFFECT, STRESS, AND VISUOMOTOR BINDING: EVIDENCE FOR A ROLE OF DOPAMINE IN INTEGRATING PERCEPTION AND ACTION *Bernhard Hommel[1,2], Lorenza Colzato[1,2], Nelleke van Wouwe[1,2], Wouter Kool[1]; [1]Leiden University, Institute for Psychological Research, [2]Leiden Institute for Brain & Cognition* – The primate cortex represents perceived and produced events in a distributed way, which calls for a mechanism that integrates their features and integrates them into coherent structures. Animal, drug and patient studies suggest that the local binding of visual features is under muscarinic-cholinergic control, whereas visuomotor integration seems to be driven by dopaminergic pathways. Consistent with this picture, we present evidence that the binding of visual features and actions is modulated by affect (induced by pictures of positive and negative valence), which induces phasic increases of the dopamine level, and stress (induced by the cold pressure test), which causes an excessive dopamine turnover in prefrontal cortex. Both manipulations selectively affected visuomotor binding but not visual binding, supporting claims that dopamine impacts long-distance integration; and only the task-relevant stimulus features were integrated, which is consistent with a connection between dopamine and working memory. The outcome pattern, including the impact of the personality trait extraversion and measures of the spontaneous eye-blink rate, suggests that the relation between dopamine level and visuomotor performance follows an inverted U-shaped function, with strongest binding being associated with average dopamine levels.

C5

FACIAL EXPRESSION PROCESSING DEPENDS ON STIMULUS VISIBILITY: BEHAVIORAL AND ELECTROPHYSIOLOGICAL EVIDENCE OF PRIMING EFFECTS *Shen-Mou Hsu[1], William Hetrick[1], Luiz Pessoa[1]; [1]Indiana University, Bloomington* – The extent of facial expression processing remains a matter of debate. Instead of focusing on whether or not processing can take place without awareness, the emphasis of the present study was on investigating how facial expression processing differs as a function of stimulus visibility. We used a combination of behavioral and electrophysiological measures to assess the depth of processing while participants performed a priming task, during which emotional faces served as prime stimuli and emotional words served as targets. The prime-target pairs could be congruent (both were "fearful" or "happy") or incongruent. Two levels of prime visibility ("low" vs. "high") were obtained by varying the durations of backward-masked faces. To probe a neural signature of the impact of the masked primes, lateralized readiness potentials (LRPs) were recorded over motor cortex. The results showed that during the high-visibility condition, responses to word targets were faster when the prime-target pairs were congruent than when they were incongruent, providing evidence of priming effects. In line with the behavioral results, the electrophysiological data showed that high-visibility face primes resulted in LRP differences between congruent and incongruent trials, suggesting that prime stimuli initiated motor preparation during the high-visibility condition. Contrary to the above pattern, no evidence for reaction time or LRP differences was observed during the low-visibility condition. Overall, the present study reveals that the depth of facial expression processing is modulated by stimulus visibility.

C6

FEAR CONDITIONING IN A FULLY IMMERSIVE VIRTUAL REALITY ENVIRONMENT *Nicole Huff[1], Jose Alba Hernandez[1], David Dzielinski[2], Holton Thompson[2], Rachael Brady[2], Kevin LaBar[1]; [1]Center for Cognitive Neuroscience, Duke University, [2]Pratt School of Engineering, Duke University* – For nearly a century, Pavlovian fear conditioning has been used extensively to study the behavioral and neural basis of emotional memory formation in nonhuman animals. Much cognitive neuroscience research over the past decade has adapted conditioning paradigms to study analogous mechanisms in humans. Emerging virtual reality (VR) computational techniques provide a new opportunity to simulate fearful experiences in virtual 3-D worlds that more closely approximate real-life situations of fear acquisition in humans. Because VR technology is currently being employed during exposure therapy for the treatment of anxiety disorders, it is important to develop an experimental model of virtual fear acquisition, extinction and recovery to provide a translational bridge with basic neuroscience work. Here we describe a method for conducting fear conditioning experiments in the Duke Immersive Virtual Environment (DiVE). This fully immersive, 6-sided, Digital Light Processing-projected facility is outfitted for concurrent psychophysiological recording. Adjustments to standard VR presentation must be made to accommodate the need for experimental control over presentation and timing of the conditioned and unconditioned stimuli while participants navigate through the virtual worlds. A pilot study of healthy adults was conducted in which they were conditioned to fear dynamic snakes and spiders paired with wristshocks while being guided through indoor and outdoor contexts. Analysis of skin conductance responses indicated the feasibility of acquiring, extinguishing, and recovering fear in the DiVE with this technology. Our findings support the development and use of fully immersive VR as a novel methodology for investigating emotional learning and memory in humans.

C7

EVIDENCE OF A FUNCTIONAL LINK BETWEEN THE ANTERIOR INSULA AND INFERIOR FRONTAL PREMOTOR CORTEX DURING THE OBSERVATION OF EMOTIONAL FACIAL EXPRESSIONS: DOES SUCH A SYSTEM MEDIATE EMOTIONAL CONTAGION? *Mbemba Jabbi[1], Christian Keysers[2]; [1]National Institutes of Mental Health, Bethesda, MD, [2]Social Brain Lab, BCN Neuroimaging Center, University Medical Center Groningen, Antonius Deusinglaan 2, The Netherlands* – A growing body of evidence in social affective neuroscience suggests that a mechanism according to which action representation modulates emotional activity may provide an essential functional architecture for empathy and emotion understanding1, 2. A role for the anterior insula and premotor cortex in mediating such a mechanism has been proposed1, 3. Here, we show anterior insula activation during both the observation of facial expressions and the experience of gustatory disgust, suggesting a role for this structure in emotional contagion. Parallel activation in the face fields of the inferior frontal premotor cortex were shown during the observation of the observed emotional expressions, implicating this region in mediating facial mimicry. Further, the anterior insula and inferior frontal premotor cortex (among other regions), where also shown to be predictive of individuals emotional arousability (a measure of interpersonal empathy)4 during the observation of facial expression of disgust5. Applying effective connectivity with the anterior insula as a seed region6, we showed that only the face fields of the inferior frontal premotor cortex (active both during observation and execution of disgusted facial expressions) is effectively connected with the anterior insula during the observation of disgusted as opposed to neutral facial expressions. These results provide empirical evidence for the idea that the foremost input to emotional contagion in the anterior insula is the motor simulation of the observed facial expression in the inferior frontal gyrus. References 1. Carr L, Iacoboni M, et al. PNAS. (2003) 100(9):5497-502. 2. Keysers C, Gazzola V. Prog Brain Res. (2006) 156:379-401. 3. Dapretto M, Davies MS, et al. Nat Neurosci. (2006) 9(1):28-30. 4. Davis, MH. Catal. Sel. Doc. Psychol. 10 (1980), p. 85 (MS. 2124). 5. Jabbi M, Swart M, Keysers C. Neuroimage. (2007) 34(4):1744-53. 6. Friston KJ, Buechel C, et al. Neuroimage. (1997) 6(3):218-29.

C8

ELEVATED CORTISOL LEVELS FACILITATE MEMORY FOR NEGATIVE INFORMATION ONLY IN INDIVIDUALS SHOWING AMYGDALA ACTIVATION *Allison Jahn[1,2], Simone Kern[2,3], Richard Davidson[1,2], Jerry Halverson[1], Clemens Kirschbaum[3], Heather Abercrombie[1]; [1]University of Wisconsin, [2]Waisman Laboratory for Brain Imaging and Behavior, [3]Technical University of Dresden* – The beneficial effects of cortisol on memory depend on the emotional state of the individual (Okuda et al., 2004; Abercrombie et al., 2006). Thus, emotional arousal plays a permissive role in the effects of cortisol on memory. Animal data show that amygdala activation is necessary for the facilitatory effects of corticosteriods on memory. Further, activation in the amygdala predicts memory for emotionally intense but not neutral information (Canli et al., 2000). We thus hypothesize that in humans cortisol facilitates memory only in individuals showing amygdala activation. We predicted that higher cortisol levels (related to a moderate dose of cortisol given in the late afternoon) would facilitate memory for negative words only in individuals who showed greater amygdala signal change to negative compared to neutral and positive words. Participants completed two placebo/cortisol counterbalanced fMRI sessions and a follow-up memory session. An ROI analysis was used to examine amygdala activation while participants viewed emotional words. Salivary cortisol samples were collected across the scanning sessions. Using a linear regression (controlling for the day of the scan), percent signal change while viewing negative words (negative – neutral + positive words) in the left amygdala and cortisol level across the scanning session (area under the curve) predicted free recall memory for negative words. The interaction between amygdala activation and cortisol levels ($R2 = .25$, $p < 0.05$) predicted memory for negative words such that the individuals with both greater amygdala activation and higher cortisol elevations showed the best memory performance for negative words.

C9

THE COGNITIVE STROOP IN PARTICIPANTS WITH SYMPTOMS OF DEPRESSION USING HIGH-DENSITY ERPS AND S-LORETA
Fern Jaspers-Fayer[1], Isabel Taake[1], Lisa Buchy[2], Mario Liotti[1]; [1]Simon Fraser University, [2]Neurological Sciences, McGill University – Finding neural markers of low mood may help to develop better treatments for depression (Mayberg, 2003). In the present study, 64-channel EEG was recorded in 17 participants who scored high on the Beck Depression Inventory (BDI-II), and 17 comparison participants who scored low, during a classic Stroop Task. Reaction time (RT) interference occurred to incongruent words ("red" written in blue), $F(1,42)=174.71$, $p<.0001$, but there was no difference in RT or error rate between the groups. To localize the Stroop interference effect in these groups, standardized Low-Resolution Electromagnetic Tomography (s-LORETA) was performed on the grandaverage waveforms. Incongruent-Congruent paired sample t-tests were run for both the low and high groups. Within the 200-400ms time-window, we found participants with a low BDI score showed significantly greater current density activation ($t>4.0$) of the right dorsolateral prefrontal cortex, visual and premotor areas (compared to the congruent condition), while the high BDI group showed significantly greater current density activations ($t>4.0$) of the right parietal cortex, the posterior cingulate (BA31) and visual areas (as compared to the congruent condition). In addition to these activations, the high group showed a number of deactivations. Specifically, dorsal Anterior Cingulate Cortex (dACC-BA24) and then the right medial prefrontal cortex (BA9/32) showed a significant decrease in the 200-400ms time window. This result is similar to the blunted anterior cingulate and increased visual activity found in depressed subjects during fMRI studies (George, et al., 1997), and lends further support for the theory that limbic and paralimbic activation is abnormal in depression.

C10

AUDITORY EMOTIONAL SIGNALS TRIGGER EXECUTIVE CONTROL OF ATTENTION
Philipp Kanske[1,2], Sonja A. Kotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, [2]Graduate Program: Function of Attention in Cognition, University of Leipzig, Germany – Auditory emotional signals can signal salience in a specific stituation. We asked the question which role attentional control plays in such situations. To this end we presented angry and neutrally spoken words (female and male speaker) in a version of the Simon spatial incompatibility task. Participants performed a voice decision task. An example of an incompatible trial is a female voice in the left speaker that required a right side button press. The same stimulus in the right speaker rendered a compatible trial. RT results revealed a reduced conflict effect (incompatible – compatible) for auditory emotional stimuli indicating more efficient attentional control. ERP data corroborate this finding. The conflict N200 indexing attentional control was enlarged for auditory emotional stimuli. Interestingly, attentional control in anxiety and depression prone participants did not adapt as efficiently as in low anxiety and depression participants. Effortful control in contrast, the skilled control of voluntary attention, increased the benefit. These data are in line with our results from visual emotional word presentation, suggesting an adaptation benefit of executive control of attention for emotional stimuli.

C11

THE IMPACT OF BASAL HPA-AXIS ACTIVITY ON AGGRESSION AND INFORMATION PROCESSING
Robina Khan[1], Katja Bertsch[1], Ewald Naumann[1], Menno Kruk[2], Patrick Britz[1], Michael Hermes[1]; [1]University of Trier, [2]Leiden University – In animal studies, a negative relationship was found between basal Hypothalamus-Pituitary-Adrenal (HPA)-axis activity and aggressive behavior. Results from clinical samples are ambiguous and experimental evidence is scarce. Furthermore, little is known about the information processing in aggressive individuals and its relationship to HPA-axis activity. We therefore induced aggressive behavior in a healthy sample and analysed the relation to basal HPA-axis activity and the processing of emotional faces. The cortisol awakening response was measured as an index for basal HPA-axis activity prior to the experimental session. Aggressive behavior was induced and measured with the Taylor Aggression Paradigm and the processing of angry, fearful, happy and neutral faces was measured in an emotional Stroop task. We found a significant negative correlation between the area under the curve of the cortisol awakening response and aggressive behavior in the experimental group. In the emotional Stroop task, the experimental group and a non-provoked control group didn't differ with respect to the reaction times. But within the experimental group, more aggressive subjects tended to react faster as well as those with lower basal cortisol levels. This study shows that healthy subjects with lower basal HPA-axis activity can be provoked more easily. Also, the processing of stimuli when provoked differs in subjects with lower basal cortisol levels from those with higher levels. Information processing could therefore be an important variable when studying aggression and the HPA-axis in clinical samples.

C12

FUNCTIONAL NETWORKS AND CORTICAL-SUBCORTICAL INTERACTIONS IN EMOTION: A META-ANALYSIS OF NEUROIMAGING STUDIES
Hedy Kober[1], Lisa Feldman Barrett[2,3], Josh Joseph[1], Eliza Bliss-Moreau[2], Kristen Lindquist[2], Tor Wager[1]; [1]Columbia University, [2]Boston College, [3]Psychiatric Neuroimaging Research Program, Massachusetts General Hospital, Harvard Medical School – We performed an quantitative meta-analysis of 162 neuroimaging studies of emotion using a novel multi-level kernel-based approach, focusing on locating brain regions consistently activated in emotional tasks and on their functional organization into distributed networks, independent of semantically defined emotion category labels (e.g., “anger,” “fear”). Such brain-based analyses are critical if our ways of labeling emotions are to be evaluated and revised based on consistency with brain data. Consistent activations were limited to specific cortical sub-regions, including multiple functional areas within medial, orbital, and inferior lateral frontal cortices. Consistent with a wealth of animal literature, multiple consistent subcortical activations were identified, including amygdala, ventral striatum, thalamus, hypothalamus, and periaqueductal gray. We used multivariate parcellation and clustering techniques to identify networks co-activated across studies. These analyses identified six large-scale distributed networks, including medial and lateral frontal networks, two posterior cortical networks, and paralimbic and core limbic/brainstem networks. Specific follow-up analyses focused on periaqueductal gray (PAG) and hypothalamic (Hy) activations, and identified frontal cortical areas co-activated with these core limbic structures. A specific region of dorsomedial frontal cortex (dmPFC, Brodmann’s Area 9/32) was the only area co-activated with both PAG and Hy. Mediation analyses were consistent with a pathway from dmPFC through PAG to Hy. These results suggest that medial frontal areas are more closely associated with core limbic activation than their lateral counterparts, and that dmPFC may play a particularly important role in the cognitive generation of emotional states.

C13

IMPLICIT PROCESSING OF EMOTIONAL AND MORAL INFORMATION: AUDITORY FMRI EVIDENCE
Sonja A. Kotz[1], Ulrike Altmann[1], Tim Raettig[1], Silke Paulmann[1]; [1]MPI for Human Cognitive and Brain Sciences – While previous studies on social competence and evaluation of social interactions have primarily focussed on social rules and rule compliance (e.g., Singer et al., 2004), there is paucity of research investigating dimensions of emotions (i.e., emotional or moral) in context (but see Moll et al., 2005). In the current experiment we investigated the neural correlates of emotional semantic and emotional prosodic dimensions in auditory language contexts. Of particular interest were brain areas that have previously been reported in response to explicit evaluation such as the orbito-frontal gyrus (OFG), the medial prefrontal cortex

(mPFC), the anterior temporal cortex, the superior temporal sulcus (STS), and the striatum. Here, participants listened to little stories that varied in content (moral, emotional) and prosodic intonation (positive, negative, neutral). Rather than evaluating the stories, participants engaged in a voice detection task rending the task implicit. Results show that emotional content activates the right anterior temporal lobe (BA 38), the right striatum, and the left mPFC. At a lowered threshold there is also activation for moral content in the right BA 38 and the middle temporal gyrus (BA 21). The data suggest that a common denominator of emotional and moral content is the right temporal pole region. Areas that seem to be primarily driven by explicit evaluation of moral/emotional content such as the OFG are not activated under implicit processing conditions.

C14

"WORKING THROUGH" NEGATIVE LIFE EXPERIENCES: AN FMRI STUDY OF THE NEURAL BASIS OF REGULATING AFFECT ASSOCIATED WITH AUTOBIOGRAPHICAL NEGATIVE EMOTIONAL EXPERIENCES *Ethan Kross[1], Matthew Davidson[1], Nick Weiler[1,2], Kevin Ochsner[1]; [1]Columbia University, [2]Stanford University* – Recent years have seen an explosion of research examining the neural bases of emotion regulation. For the most part, this research has used standardized experimental stimuli (e.g., emotionally arousing images and movies) to elicit emotional reactions. Although these findings have helped elucidate the neural bases of people's ability to cognitively regulate affective responses, it remains unclear how they generalize to a variety of "real world" situations requiring emotion regulation. In this vein, the present research used functional magnetic resonance imaging to examine the neural bases of people's ability to regulate emotional responses generated by thinking about negative autobiographical emotional experiences. Sixteen participants were scanned as they recalled a series of highly arousing negative autobiographical emotional memories and thought about them using strategies designed to either maintain or decrease negative affect. Findings indicated that participants displayed significantly lower levels of self-report negative affect when thinking about their experiences using the decrease vs maintain strategies. Contrasts comparing neural activity on trials when participants were instructed to maintain vs. decrease their negative emotional responses revealed elevated levels of activity in ventromedial prefrontal cortex (VMPFC) and subgenual ACC. In addition, activity in VMPFC correlated negatively with drops in self-report negative affect on decrease rather than maintain trials. In contrast, a significant positive correlation was observed between activity in left dorsomedial PFC and drops in negative affect. These findings extend prior findings on the neural bases of emotion-regulation to memory research. The basic science and clinical implications of these findings will be discussed.

C15

HOW DO WE EMPATHIZE WITH SOMEONE UNLIKE US? AN EVENT-RELATED AND EFFECTIVE CONNECTIVITY FMRI STUDY ON PERSPECTIVE-TAKING AND EMPATHY FOR PAIN *Claus Lamm[1,2], Jean Decety[1,2]; [1]The University of Chicago, [2]Center for Social and Cognitive Neuroscience, The University of Chicago* – Empathy enables us to share and understand the affective states of others. Recent fMRI evidence suggests that we rely on our own sensory and affective experiences in order to empathize with someone (Decety & Lamm 2006). But how do we empathize with someone with whom we do not share the same bodily experiences? We investigated this question in an fMRI experiment combining analyses of functional segregation ('localization') and integration (effective connectivity). Participants were required to evaluate the pain inflicted by surgical procedures performed on two groups of patients: 1) patients with a neurological disease who reacted, unlike the observers, with pain during normal touch and with no pain when undergoing needle injections; and 2) patients who reacted to these procedures in the same way as the observers would react to them. Participants were clearly able to evaluate the affective states of both patient groups. However, behavioral and fMRI results revealed that evaluating needle injections in patients who were unlike the observers represented the biggest challenge. A network consisting of dorso-medial prefrontal cortex, bilateral ventral premotor and inferior posterior parietal cortices, and right anterior insula was predominantly associated with this type of evaluation. Connectivity analyses indicated a distinct pattern of connectivity within the pain matrix and the prefrontal cortex for this condition. Our results suggest that empathy is a highly flexible mental function allowing us to suppress our own prepotent responses in order to correctly infer and share the actual affective states of others. Decety & Lamm, ScientificWorldJournal, 20, 1446-1163.

C16

ALTERATION OF MOOD USING AFTER PRESENTATION OF MULTIMEDIA CONTENT DURING COGNITIVE TASK: AN EEG STUDY *Charles-Francois Latchoumane[1], Eunyoung Lee[2], Hyoseop Lee[2], Dong-Il Chung[1], Sungmin Park[2], Soyun Song[2], Jiyun Shin[4], Jeaseung Jeong[1,2]; [1]KAIST/Bio and Brain Engineering Department, [2]KAIST/Culture and Technology Department* – Emotion and mood are major players in our daily lives and clearly influence our decision as well as our cognitive performance. In that perspective, several therapies based on color, music and other medias are being developed to provide a basis for better self-being, but also as a soft resolution of emotion/mood related disorders. In this study, we developed multi-media contents designed to elicit three specific moods (i.e. Relaxation, Happiness and Confidence), and based on the knowledge of mood therapy. We investigated the response of 12 subjects (6 males and 6 females, mean age 22 year old) on their cognitive performance during a visual congruent continuous performance task (cCPT, attentional task). We obtained that the subject perceived a mood change quite clearly for the contents related to relaxation and happiness (i.e. self-evaluation questionnaire), and exhibited changes in their CPT behavioral response as well as in their EEG power ration (i.e. alpha/beta, alpha/gamma, and beta/gamma power ratio). We concluded that emotional/mood induction using multi-modal (audio/video), and complex (e.g. complex visual patterns and movements) contents could elicit changes in attention, visible from a behavioral study, however milder in the electrophysiological response. Moreover, the correlation study between the contents climax and the EEG power showed that there was an electrophysiological change in all subject showing positive valence of emotion elicitation.

C17

COMMON AND DISTINCT BRAIN NETWORKS ASSOCIATED WITH EXPLICIT EMOTIONAL EVALUATION: A META-ANALYTIC STUDY *Kyung Hwa Lee[1,2], Greg Siegle[1,2]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition, University of Pittsburgh* – Brain mechanisms underlying explicit evaluation of emotion have been explored using different tasks including stimulus-focused evaluation ("What is the emotionality of a stimulus/situation?"), evaluation of one's own emotion ("How do you feel?"), and evaluation of others' emotions ("How do other people feel?"). Yet, the extent to which similar brain mechanisms underlie different evaluation tasks is unclear. A meta-analysis of published neuroimaging studies of explicit emotional evaluation was conducted to examine common and distinct brain mechanisms underlying these different explicit evaluation tasks. Activation Likelihood Estimation (ALE), implemented in BrainMap (Laird et al., 2005) was applied to 38 studies (58 contrasts). Results revealed that common regions including the amygdala, lateral prefrontal cortex (LPFC), and dorsomedial PFC were involved in all three evaluation tasks, which may reflect engagement in similar mechanisms such as emotion-cognition interactions and evaluative processing. Distinct brain regions associated with each task were also identified: 1) the sensory cortex and ventrolateral PFC were specifically associated with stimulus-focused evaluation, possibly involved in perceptual and higher-order conceptual processing, 2) the insula and rostral anterior cingulate cortex were specifically associated with evaluation of one's own emotion, potentially associated with interoceptive and experiential processing, and 3) the superior temporal sulcus and temporoparietal-junction were specifically associated with evaluation of others' emotions, potentially reflecting their roles in Theory of Mind and empathy. These findings suggest that different types of explicit evaluation may involve common and distinct brain networks. We therefore suggest caution in generalizing from the results of any one explicit emotion evaluation task.

C18

WHEN PESSIMISM IS REWARDING: INCREASED PLEASANT RELIEF AFTER THREAT OF PAIN *Siri Leknes[1], Irene Tracey[1]; [1]Functional Magnetic Imaging of the Brain (FMRIB) Centre, University of Oxford, UK* – When a negative outcome is expected, a cue signalling its absence (relief) may act as a reward. The level of surprise at a rewarding (or aversive) counterfactual outcome is thought to increase its pleasantness (or unpleasantness). While optimism is associated with increased well-being and life expectancy, the pessimist's negative expectations may lead to increased rewarding relief when these expectations are violated. To test this hypothesis, 15 healthy volunteers participated in an fMRI study where a visual cue predicted 5-second intense heat pain stimulation with 50% probability. A safety cue signalled the relief condition where no heat was applied. The life orientation test (LOT-R) was used to measure trait optimism/pessimism. During the scan, subjects were also asked to imagine rewarding or neutral scenarios (e.g. your favourite meal or an airplane meal). Both the safety cue and the pleasant scenarios were rated as highly pleasant. Subjects also reported feeling dread during anticipation of pain/relief. As predicted, pessimism correlated positively with both dread and relief. When used as a regressor in the fMRI analysis, pessimism was associated with increased activation in the bilateral amygdala and insular cortices during the anticipation period. Pessimists also activated the ventral striatum more during relief, consistent with an increased prediction error when the pain was omitted. BOLD signal in the ventral striatum also correlated with the pleasantness ratings during both relief and imagined reward scenarios. Overall, our findings support a link between pessimism and pleasant relief, suggesting that optimism is not the only route to positive affect.

C19

NEURAL CORRELATES OF REACTIONS TO INFLUENCE ATTEMPTS FROM PARENTS AND FRIENDS *Jared Lessard[1], Chunhui Chen[2], Chuansheng Chen[1]; [1]University of California, Irvine, [2]Beijing Normal University* – Both parents and peers engage in explicit attempts to influence the behaviors of adolescents and young adults. However, the neural bases of reactions to influence attempts are not well understood. In this study, 19 Chinese undergraduate students completed a measure of positive and negative influence attempts by social network members (e.g. parents, peers) and also completed an fMRI scanning session. In this session, participants heard a series of statements about specific positive (e.g. encouraging) and negative (e.g. using guilt induction) influence attempts, and were asked to judge whether their parents, best friends, or classmates had influenced them in that way. The questionnaire measures indicated that parents used more influence attempts than did peers, and that social network members used more positive influence attempts than negative attempts. The fMRI results indicated more bilateral superior temporal (BST) and left calcarine activation in the parent influence condition relative to the friend influence condition. In contrast, there was more left inferior parental activation in the friend influence condition. Collapsing across the parent and friend conditions, more BST, middle cingulated cortex, and left cerebellum activation was found in response to statements regarding positive influence relative to those regarding negative influence. In contrast, more left inferior frontal, bilateral medial superior frontal, and bilateral precuneus activation was found in response to negative influence statements. The activation of the BST in response to positive influence statements was correlated with the behavioral results. The implications of these results will be discussed.

C20

EMOTIONAL VALENCE INDEPENDENCE: THE AVERSIVE SIDE OF THE NUCLEUS ACCUMBENS CIRCUIT *Liat Levita[1], Todd Hare[1,2], Henning Voss[1,3], BJ Casey[1]; [1]The Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University, [2]California Institute of Technology, [3]Citigroup Biomedical Imaging Center, Weill Medical College of Cornell University* – An increasing body of evidence supports an expanded view of nucleus accumbens (NAcc) function that is valence-independent, whereby the NAcc is engaged in both incentive/reward processes and in adaptive responses to conditioned and unconditioned aversive stimuli. Yet, it has been argued that NAcc activation to aversive stimuli may be a consequence to the rewarding effect of termination of aversive events, i.e., relief. To address this question an fMRI study was designed to delineate brain activation to the initiation and termination of auditory aversive and pleasant stimuli. The goal of this work was to test the effect of differentially valenced emotional stimuli on activation of the NAcc in the absence of learning. We found that NAcc activation in adults did not solely occur to pleasant events, and that the degree of NAcc activation to the aversive sounds correlated with the degree of amygdala activation to the same stimuli. Evidence of activation of the NAcc upon termination of the aversive stimuli was not found. To further investigate the functional significance of our findings we examined how self ratings of anxiety and the likelihood to engage in risky behaviors correlated with NAcc and amygdala responses over time. We found that sensitization of amygdala activation to aversive stimuli correlated with greater trait anxiety in females, whereas NAcc activity to positive sounds was correlated with subjects' likelihood to engage in risky behavior in both males and females. Our findings support the expanded view of NAcc function in valence-independent behavioral modulation.

C21

SEEING EMOTION WITH YOUR FEELINGS: A META-ANALYTIC REVIEW OF THE NEURAL REFERENCE SPACE FOR EMOTION EXPERIENCE VS. PERCEPTION *Kristen Lindquist[1], Tor Wager[2], Eliza Bliss-Moreau[1], Hedy Kober[2], Josh Joseph[2], Matthew Davidson[2], Lisa Barrett[1,3]; [1]Boston College, [2]Columbia University, [3]Massachusetts General Hospital, Harvard Medical School* – Must you feel sad to see sadness on another person's face? An embodied account of emotion would suggest so. It is hypothesized that conceptual knowledge recruited during emotion perception is grounded by partial re-enactments of the affective and sensorimotor states that actually instantiate the online experience of emotion. As a result, seeing emotion involves some degree of feeling. In the present meta-analytic review, we summarize 163 neuroimaging studies of emotion (1990 to 2005) to compare the brain regions implicated in experience and perception of emotion. Findings demonstrate partially overlapping circuitry for experience and perception of emotion, with more subcortical (e.g., hypothalamic and brainstem) activation supporting experience, and more amygdala, inferior frontal gyrus, and posterior cortical activation in perception. The observed neural reference spaces for emotion experience and perception are discussed.

C22

MOTIVATION-BASED MODULATION OF BEHAVIOR AND BRAIN ACTIVITY DURING WORKING MEMORY: EFFECTS OF INCENTIVE VALENCE AND CATEGORY *Hannah Locke[1], Todd Braver[1]; [1]Washington University in St. Louis* – What are the psychological and neural mechanisms by which an increase in motivation leads to performance gains? The current study addressed this question by examining behavior and brain activity (sustained and transient) during performance of a Sternberg-type working memory task. Thirty-one participants (ages 19-34, 14 male) were offered performance-dependent, matched reward and penalty incentives (cash or liquids), in high, low, or zero magnitudes, while engaging in the task. Incentive trials were associated with a large improvement in performance (i.e., 200 msec faster reaction times with no change in error rate), and these effects were further modulated by individual differences in personality (promotion vs. prevention focus).

Robust performance improvements were even observed on no-incentive trials within incentive blocks, suggesting that a component of incentive effect on performance might be contextual or tonic, rather than adjustable on a trial-by-trial basis. There were no differences in the effect of incentive valence (reward vs. penalty) or category (cash vs. liquid) on the magnitude of performance improvement. Neuroimaging analyses isolate whether effects of valence and category primarily impact sustained activation, or rather transient activity occurring at either the time of the cue or the time of incentive delivery. Results are presented that contrast the pattern of incentive-based modulation in brain regions associated with cognitive control (e.g., lateral prefrontal cortex and anterior cingulate) versus reward processing (e.g., orbitofrontal cortex, basal ganglia). Lastly, personality effects on brain activity under incentive conditions will be presented.

C23

AN EMOTIONAL ILLUSION: DYNAMIC EXPRESSIONS BIAS THE EVALUATION OF NEUTRAL FACES *Diane E. Marian[1], Arthur P. Shimamura[1]; [1]University of California, Berkeley* – Visual illusions have been studied for centuries because they are useful tools for investigating top-down influences on perception. Here, we describe a new emotional illusion in which facial expressions are perceived differently depending on their context. We constructed short video clips of dynamic expressions by morphing faces from happy to neutral expressions or from angry to neutral expressions. Participants rated the initial expression of a happy or angry face, watched the face change to a neutral expression, and then rated the ending expression. The ending neutral faces were judged as displaying the emotion opposite that of the initial expression. That is, when an expression changed from happy to neutral, the neutral face was rated more negatively than a baseline neutral face. Moreover, when an angry face changed to neutral, the neutral endpoint was rated more positively. These results demonstrate a context-based emotional illusion in which neutral faces seem to display different emotional expressions depending upon their prior appearance. In many respects, this illusory effect is comparable to visual illusions in which a perceptual feature, such as size, color, or orientation is affected by surrounding context.

C24

NEURAL CORRELATES OF TREATMENT IN ADOLESCENTS WITH GENERALIZED ANXIETY DISORDER *Julie Maslowsky[1], Karin Mogg[2], Brendan Bradley[2], Erin McClure Tone[3], Monique Ernst[4], Daniel Pine[4], Christopher Monk[1]; [1]University of Michigan, [2]School of Psychology, University of Southampton, [3]Georgia State University, [4]National Institute of Mental Health* – Generalized Anxiety Disorder (GAD) is a prevalent and debilitating psychiatric illness. Two forms of effective treatment typically given for this disorder are cognitive behavioral therapy (CBT) and medication. The goals of this study were to: 1) examine neural correlates of treatment in GAD youth, and 2) compare the treatment effects of CBT and medication (fluoxetine). Fourteen youth with GAD and 10 age- and gender-matched controls were included in the study. Of the patients, 7 were treated with CBT and 7 with medication. FMRI scans were performed before (Time 1) and after (Time 2) treatment. During the scan, subjects performed a dot probe task that provided a measure of attention bias toward or away from emotional faces. Based on previous results, ROI analyses were performed in amygdala and right ventrolateral prefrontal cortex (VLPFC). Behavioral results showed greater decrease in attentional bias to angry faces from Time 1 to Time 2 in the medication versus CBT group ($F=5.91$, $p<0.05$). FMRI results showed increased VLPFC activation, relative to controls, in both the medication group ($t=2.84$, $p<0.01$) and CBT group ($t=2.60$, $p<0.01$). Bilateral increases in amygdala activation were observed only in the CBT group (right amygdala: $t=2.74$, $p<0.05$; left amygdala: $t=2.60$, $p<0.05$). These results show significant change in patterns of neural activation in response to angry faces following treatment for GAD, with some evidence for differential change by treatment type.

C25

GENDER DIFFERENCES IN EMOTION REGULATION: AN FMRI STUDY OF COGNITIVE REAPPRAISAL *Kateri McRae[1], Kevin N. Ochsner[2], Iris B. Mauss[3], John J.D. Gabrieli[4], James J. Gross[1]; [1]Stanford University, [2]Columbia University, [3]University of Denver, [4]Massachusetts Institute of Technology* – Despite strong popular conceptions of gender differences in emotionality and striking gender differences in the prevalence of disorders thought to involve emotion dysregulation, the literature on the neural bases of emotion regulation is nearly silent regarding gender differences. The purpose of the present study was to address this gap in the literature. Using functional magnetic resonance imaging (fMRI), we asked 12 male and 12 female participants to use a cognitive emotion regulation strategy (reappraisal) to down-regulate their emotional responses to negatively valenced pictures. Behaviorally, men and women evidenced comparable decreases in negative emotion experience. Neurally, however, gender differences emerged. Compared with women, men showed (a) lesser increases in prefrontal regions that are associated with reappraisal, (b) greater decreases in the amygdala, which is associated with emotional responding, and (c) lesser engagement of ventral striatal regions, that are associated with reward processing. We consider two non-competing explanations for these differences. First, men may expend less effort when using cognitive regulation, perhaps due to greater use of automatic emotion regulation. Second, women may use positive emotions in the service of reappraising negative emotions to a greater degree.

C26

BEAUTY IS IN THE EYE OF THE REMEMBERER: THE EFFECTS OF MEMORY ON FACIAL ATTRACTIVENESS *Dan Meegan[1], Chris Warren[2], Jim Tanaka[2]; [1]University of Guelph, [2]University of Victoria* – As with many objects, faces tend to be judged more favorably following previous exposure. Fluency explanations for this 'mere exposure effect' suggest that it occurs because 'old' (i.e., perceptually-identical or conceptually-similar to previous objects) objects are processed with more fluency, and the experience that accompanies this fluency leads to a positive bias on tasks requiring an affective judgment about the objects. Evidence supporting a causal relationship between fluency and judgment bias is indirect, however. We report an experiment designed to directly test this hypothesis by manipulating the degree to which previously exposed objects could be processed fluently. The high fluency condition presented faces in an upright orientation and the low fluency condition presented faces in an inverted orientation. As predicted by the fluency hypothesis, attractiveness judgments were affected by previous exposure only for the high fluency condition. We also report an experiment that assessed recognition of old faces as a function of fluency condition. Previous research has reported that the mere exposure effect is smaller when objects are recognized, perhaps because the feeling of fluency is more likely to be correctly attributed to previous exposure rather than misattributed to affective judgments. Our results show the opposite pattern – recognition, as with attractiveness, was higher in the high fluency than the low fluency condition. We suggest that faces, unlike the affectively-neutral stimuli typically used, encourage misattribution because people are accustomed to having positive feelings about faces and do not typically question the source of those feelings.

C27

ROLE OF ATTENTION IN THE ESTIMATION OF EMOTIONAL SOUND DURATION: AN ERP STUDY *Nathalie Mella[1], Richard Ragot[1], Viviane Pouthas[1]; [1]Cognitive Neuroscience and Cerebral Imaging_CNRS* – The influence of emotion on time processing has been investigated in previous studies, showing in particular that negative events generate a lengthening of subjective duration. In the present experiment, allocation of attention was manipulated in a duration comparison task. Twelve participants had to estimate the duration and emotional intensity of neutral and negative sounds from the IADS (Bradley & Lang, 1999). Results showed that: (1) highly negative sounds were perceived as longer than neutral ones; (2) this effect was stronger when attending to emotion than when attending to time. This lengthening of subjective duration was associated to a higher level of skin conductance response, and to a greater heart rate decceleration. Evoked related potential (ERP) results showed clear differences between highly negative sounds and neutral ones, whichever the attentional instruction. A greater N1 and a greater late parietal positivity were observed for highly negative sounds compared to neutral ones. Moreover, preliminary analyses revealed an enhanced right prefrontal slow negative (CNV-like) component in the 350-700ms time window, for highly aversive sounds while attending to emotion. Taken together, these results suggest that (1) the early perceptual process and the late cognitive assessment are modulated by emotional content even if attention is diverted away from emotion and (2) that differences in duration judgments are reflected in the amplitude of the slow negative component: the longer the subjective duration, the higher its amplitude.

C28

THE NEURAL BASES OF REGULATING ADDICTIVE IMPULSES *Peter Mende-Siedlecki[1], Hedy Kober[1], Ethan Kross[1], Kevin Ochsner[1]; [1]Columbia University* – Problems of addiction are a serious public health concern. Although much behavioral research suggests that a failure to control appetitive impulses may underlie people's dependence on addicted substances, neuroimaging research has only recently begun to address this issue. This study used fMRI to examine the neural bases of cigarette smokers' ability to regulate impulses generated in response to viewing drug-related and non-drug related appetitive stimuli. Twenty smokers were scanned while viewing images of drug-related appetitive stimuli (e.g., pictures of cigarettes) and non drug-related appetitive stimuli (e.g., pictures of delicious looking, unhealthy foods). While viewing these images, participants were instructed to think about either the (a) immediate sensory experience, or (b) the long-term negative physical health implications associated with consuming each item. Self-report ratings indicated that participants displayed statistically equivalent drops in their desire to consume both drug-related and non-drug related stimuli when focusing on their long-term physical health implications rather than their immediate sensory experience. Contrasts examined neural activity on trials when participants were instructed to focus on the long-term physical health consequences vs. immediate sensory experience associated with consuming each type of stimulus. Results were consistent with the hypothesis that regulating appetitive impulses depends upon the effective recruitment of systems implicated in cognitive control that modulate activity in systems implicated in reward. The basic science and clinical implications of these findings will be discussed. This research was supported by NIDA grant DA022541.

C29

TOP-DOWN AND BOTTOM-UP EMOTIONAL PROCESSING: THE INTERACTION BETWEEN EMOTION GENERATION AND EMOTION REGULATION *Supriya Misra[1], Kateri McRae[1], James J. Gross[1]; [1]Stanford University* – Current theories driving affective neuroscience indicate that emotions may be generated in at least two different ways: bottom-up and top-down. Bottom-up emotion generation relies on the properties of a stimulus itself through the perception of low-level stimulus features, while top-down emotion generation relies on the meaning given to a stimulus through high-level cognitive reappraisals. The present study compares emotions generated in a primarily bottom-up (perceptual) and a primarily top-down (cognitive) fashion. In particular, this study tested the hypothesis that top-down emotions are more easily regulated than bottom-up emotions when using cognitive reappraisal. Cognitive reappraisal is a frequently investigated emotion regulation technique, in this case instructing participants to re-think the emotion experience to reduce negative affect. Bottom-up emotional stimuli were fearful faces and top-down stimuli were negatively valenced statements that imbued neutral faces with negative affect. Instructions were either to respond naturally or to use cognitive reappraisal to decrease experienced negative affect. Results confirmed the hypothesis that emotions generated in a primarily top-down fashion were more successfully regulated than those generated in a primarily bottom-up fashion. This suggests that it may be easier to cognitively regulate emotions generated in a cognitive rather than perceptual fashion. These results have implications for developing more effective emotion regulation techniques depending on the emotion generation processes.

C30

ERP INDICES OF INDIVIDUAL DIFFERENCES IN SELF-REGULATION: DIFFERENT TRAJECTORIES TOWARD PROBLEM BEHAVIOR *Ida Moadab[1], Phan Luu[1,2], Thomas J. Dishion[1], Don M. Tucker[1,2]; [1]University of Oregon, [2]Electrical Geodesic Inc.* – Dysfunctional emotion regulation has been linked to problem behaviors in youth, resulting in the development of internalizing and externalizing disorders. Internalizing symptoms and externalizing problems may actually reflect different forms of pathological self-control. Individuals who respond to negative emotion in an under-controlled manner may be more likely to exhibit externalizing types of behaviors, while those who are more responsive to negative feedback may display internalizing symptoms. We measured two ERP components that have been shown to be sensitive to individual differences in inhibitory control and evaluation of negative feedback, the frontal N2 and the ERN respectively. Negative emotion was introduced into a go/no-go task engaging neural mechanisms involved in response inhibition and the evaluation of negative feedback. We predicted that when emotional responses had to be regulated, greater externalizing problems would correlate with smaller N2 amplitudes, indexing under-controlled self-regulation, and larger ERNs would correlate with increasing internalizing symptoms and anxiety, demonstrating increased vigilance to errors. In a sample of seventy-five 9-14 year old children, EEG was collected during the emotional go/no-go task, and parent-report of temperament (EATQ-R) and behavioral and emotional problems (CBCL) were assessed. As predicted, smaller N2 amplitudes were significantly correlated with greater externalizing problems ($r=-.309$, $p=.010$), indexing poor inhibitory control. Also as hypothesized, larger ERN amplitudes were significantly correlated with greater internalizing symptoms ($r=.366$, $p<.01$), indexing responsiveness to errors. The present study indicates that utilizing ERP methodology in paradigms that elicit cognition-emotion can provide insight into the regulatory deficits that result in internalizing and externalizing problems.

C31

THE PROCESSING OF EMOTIONAL FACIAL EXPRESSIONS IN PARKINSON'S DISEASE – AN EVENT-RELATED BRAIN POTENTIAL STUDY *Andreas Mühlberger[1], Matthias J. Wieser[1], Joseph Classen[1], Elisabeth Klupp[1], Peter Weyers[1], Paul Pauli[1]; [1]University of Würzburg* – In addition to cognitive impairments, recent studies revealed that patients suffering from Parkinson's Disease (PD) show deficits in emotion recognition tasks. Particularly, they were found to have difficulties in recognizing anger and disgust in facial expressions. In the current study, the emotional processing of facial expressions was investigated by means of event-related brain potentials. PD patients and healthy controls matched for sex, age, and educational status were investigated. Participants viewed emotional facial expressions (angry, happy, disgusted, fearful, neutral, sad), which were displayed for 1000 ms in a randomized order. Additionally, participants rated facial expression in terms of valence and arousal. The components P100, N170, the early posterior negativity (EPN), and the late positive potential (LPP) were assessed to investigate group differences in emotional modulation. Overall, emotional expressions elicited larger P100 amplitudes compared to neutral ones. Like in other studies, the N170 was not modulated by emotion. Interestingly, the PD patients did not show an enhanced EPN in response to emotional compared to neutral facial expressions, whereas this was found to be prominent in healthy controls for all emotional compared to neutral faces. No effects of emotion or group were detected in the LPP. Furthermore, PD patients showed less pronounced valence ratings for emotional facial expressions. The results indicate that the early visual perceptual processing of emotional facial expressions is blunted in PD. This might point at a prominent role of dopamine for emotion processing.

C32

DISAMBIGUATING PROPERTIES OF AFFECT IN THE HUMAN BRAIN *Alyson Negreira[1], Mariann Weierich[1], Christopher Wright[1,2], Lisa Feldman Barrett[1,3]; [1]Martinos Biomedical Imaging Center, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, [2]Division of Cognitive and Behavioral Neurology, [3]Boston College, Chestnut Hill, MA* – Affect, the neurophysiologic barometer of an individual's relationship to the environment, depends on three crucial properties: hedonic valence, arousal, and novelty. Previous neuroimaging experiments typically studied one or two properties of affect, however no studies to date have manipulated all three. The current study sought to simultaneously assess the effects of valence, arousal and novelty during affective processing using functional magnetic resonance imaging (fMRI). Sixteen young healthy participants (8 females, 8 males; age M=22.25, SD= 2.32) viewed International Affective Picture System (IAPS) pictures within an event-related fMRI design. Twelve distinct groups of IAPS pictures were created based on the dimensions of hedonic valence, arousal, and novelty (e.g.. Familiar/High Arousal/Negative group, etc). Each group contained 5 pictures (3.5s each, jittered ISI run length= 270s) for a total of 60 pictures for each of the 5 runs. An individual participant anatomic region of interest (ROI) approach identified voxels active to the task and percent signal change measures were extracted from these voxels. Both right and left amygdalae revealed a significant Time X Novelty X Valence X Arousal interaction [Right: ($F(9,135)=3.3$, $p=.001$), Left: ($F(9,135)=3.40$, $p=.001$)], indicating that these affective properties are expressed differentially across the time course of the hemodynamic response. Our results suggest that the affective response in humans can be disambiguated into 3 distinct properties: hedonic valence, arousal and novelty. Furthermore, the relationship among these properties changes over time, indicating that the affective process is dynamic and requires the assessment and integration of time, hedonic valence, arousal and novelty.

C33

LEARNING FROM MISTAKES: SEPARATING CUE AND REINFORCEMENT-BASED RESPONDING IN A REVERSAL LEARNING TASK *Pamela Ng[1,2], R. J. R. Blair[1]; [1]National Institutes of Mental Health, NIH, [2]University of New South Wales* – Reversal learning is the ability to adapt as situations change by learning to suppress a previously rewarded stimulus following altered reinforcement contingencies. Previous work has proposed that ventrolateral frontal cortex is critical for guiding this behavioral flexibility. However in all prior work, there has been no attempt to disentangle BOLD responses that relate to processing the cue as opposed to the reinforcement in response reversal paradigms. In the current study, we sought to determine: First, whether previous reports of increased ventrolateral prefrontal cortex activity to punished reversal errors (e.g., Budhani et al., 2006) are driven by cue, or as we predicted, reinforcement information. Secondly, whether findings of increased ventrolateral prefrontal cortex activity are specific to reversal errors or whether activity is also seen to punished errors in acquisition. Eighteen healthy adults participated in an event-related fMRI study using a unique probabilistic response reversal task. In the reversal learning task, cue- and reinforcement-mediated activity was differentiated using a "jittered" temporal design. In line with predictions, increased activity within ventrolateral prefrontal cortex during response reversal appeared to relate to the recruitment of these structures following punishment to alter future responding. However, both structures showed significantly greater activity not only to punished incorrect reversal trials, but also to punished incorrect acquisition trials. These data suggest that ventrolateral prefrontal cortex is recruited following unexpected punishment information to alter future motor responses and not only to overrule prepotent responses. Understanding the neural correlates governing reversal learning will allow us to pinpoint more precisely the brain areas which may be disrupted in disorders associated with deficits in reversal learning. Impairments in reversal learning have been reported in several disorders associated with irritability and reactive aggression, including psychopathy and intermittent explosive disorder.

C34

NON-ARBITRARY CONNECTION BETWEEN VALENCE AND BRIGHTNESS IN THE LEFT HEMISPHERE *Matia Okubo[1]; [1]Senshu University* – Positive words (e.g. faith) were processed faster and more accurately when they were printed in a bright font than in a dark font while the opposite was true for the negative words (e.g. enemy) (Meier et al., 2005). The present study investigated a neural basis for this relationship between valence and brightness in a visual half-field experiment. Positive and negative words were presented to the left visual field-right hemisphere (LVF-RH) or to the right visual field-left hemisphere (RVF-LH) in a dark or a bright font. Participants evaluated the word as positive or negative. As was found in Meier et al. (2005), there was a cross-over interaction between valence and brightness. However, this interaction was qualified by a higher-order interaction. That is, the cross-over interaction was evident in the RVF-LH trials, but not in the LVF-RH trials, suggesting that the left hemisphere is responsible for the non-arbitrary connection between valence and brightness.

C35

ATTRIBUTIONS ABOUT OTHERS' INTENTIONS AFFECT EMOTIONAL LEARNING FROM THEIR ACTIONS *Andreas Olsson[1], Christian Brodbeck[2], Niall Bolger[1], Kevin Ochsner[1]; [1]Columbia University, [2]University of Zürich* – We learn about others through the aversive consequences of their actions. However, it is unknown how our emotional learning about others is affected by our beliefs about their causing or being responsible for aversive events. To address this question we used a fear conditioning paradigm in which subjects were led to believe that they participated in a multi-subject study, and had been randomly assigned to be the 'student', whereas the others were 'teachers'. The ostensive task of the 'teachers' was to deliver feedback (shocks) to the 'student' in order to improve their performance in an alleged implicit learning task. The teachers, whose faces were presented simultaneously with the shock, were believed to either (a) deliver shocks at will (causally linked and responsible), (b) deliver shocks as being told by the experimenter (causally linked, but not responsible), or (c) being present when shocks where delivered by a computer (neither causally linked, not responsible). The presentation of the fourth 'teacher's face (d) was never paired with a shock. Ratings and autonomic measures were collected during the acquisition, extinction and renewal of teacher-shock associations. Although shock delivery was unrelated to performance on the implicit learning task, and of identical number and intensity across teachers, the teachers elicited differential ratings and autonomic responses, indicating that attributed causation and responsibility increased dislike and prevented extinction of the conditioned fear response. The results suggest that attributions about causation and responsibility can affect our emotional learning about others.

C36

IS EMPATHY A KEY DETERMINANT IN THE ACTIVATION OF EMBODIED SIMULATIONS DURING LANGUAGE PROCESSING? EVIDENCE FROM AN APPROACH-AVOIDANCE PARADIGM *Adele Pacini[1], Philip Barnard[1], Tim Dalgleish[1]; [1]MRC Cognition & Brain Sciences Unit* – A considerable amount of research interest has been generated by the discovery of mirror neurons in the premotor cortex (Rizzolatti, Fadiga, Gallese, & Fogassi, 1996), in particular the potential contribution to social skills like empathy. This discovery fits well with theoretical developments in embodied cognition, which assume that we simulate other's body states at a neural level to empathise with their mental state. One important issue is how simulations used in empathy might scaffold higher level embodied processing like language. We present two experiments that investigate this, using a variation of an approach-avoidance paradigm (Brendl, Markman, & Messner, 2003), which has been cited in support of embodied cognition theories. The basic finding is that the evaluation of a positive word activates an approach simulation towards the self, and an avoidance simulation away from the self for negative words, resulting in a delay of around 200ms in the incongruent task (Markman & Brendl, 2005). The key question was whether empathy would mediate the activation of simulations in relation to other people. In experiment 1 participant's moved positive and negative words either towards or away from an unknown person's name, there was a delay of 150ms in the incongruent task. In experiment 2, participants moved words in relation to a hated person. There were no embodied simulations; participants were equally fast to move positive and negative words towards or away from the name. These data suggest that the extent to which we activate embodied simulations in language processing is dependent on empathy.

C37

UNCONSCIOUS CUE-VALUE LEARNING EVIDENCED IN THE HUMAN BRAIN *Mathias Pessiglione[1,2], Predrag Petrovic[1], Jean Daunizeau[1], Ray Dolan[1], Chris Frith[1]; [1]Wellcome Trust Centre for NeuroImaging, London, UK, [2]INSERM U610, Hôpital Pitié-Salpêtrière, Paris, France* – How the brain uses success and failure to optimise future decisions is a long-standing question in neuroscience. One computational solution involves updating the values of context-action associations in proportion to a reward prediction error. Previous evidence suggests that such computations are expressed in the striatum and, as cognitively impenetrable, represent an unconscious learning mechanism. Here, we formally test this by studying instrumental conditioning in a situation where we masked contextual abstract cues, such that they were not consciously perceived. Behaviourally, we show that subjects nonetheless developed a marked propensity to choose cues associated with winning, compared to cues associated with losing money. Functional magnetic resonance imaging revealed that during conditioning, the monetary cue-values, generated from a computational model, specifically correlated with activity in the ventral striatum. We conclude that even without conscious processing of contextual cues, our brain can learn their reward values, and use them to bias decisions.

C38

MANIPULATION OF ATTRIBUTIONAL STYLE MODIFIES EMOTIONAL RESILIENCE TO STRESS *Kelly D. Peters[1], Joseph I. Constans[1,2]; [1]Tulane University, New Orleans, LA, [2]Southeast Louisiana Veterans Health Care System* – Attributional style refers to a cognitive process whereby individuals attribute specific causes to life events. Cognitive theories of depression hypothesize that a "depressogenic" attributional style, in which individuals attribute internal, stable, and global causes to negative events, may causally affect vulnerability to depression. Previous longitudinal studies have demonstrated a temporal precedence for depressogenic attributional style and future depressive episodes; however a causal role for attributional style in depression vulnerability has yet to be established. The purpose of the current study was to 1) examine whether attributional style in an unselected sample of college students could be modified using a computer-based Cognitive Bias Modification (CBM) task, and 2) determine whether manipulations in attributional style would lead to changes in emotional resilience to stress. We hypothesized that participants exposed to a CBM task promoting a positive attributional style (Resilience condition) would demonstrate a decreased tendency to attribute internal, stable causes to negative events compared to participants exposed to a CBM task promoting a depressogenic attributional style (Vulnerability condition). Additionally, we hypothesized that modifications in attributional style would causally affect emotional resilience following a stressful event. The results from this study indicate that the CBM task was effective in modifying attributional style. Following the CBM task, Resilience participants were less likely to attribute internal, stable causes to a negative event compared to Vulnerability participants. Moreover, Resilience participants demonstrated more emotional resilience following a stressful event compared to Vulnerability participants. These findings offer support for the causal role of attributional style in depression vulnerability.

C39

THE INFERIOR FRONTO-OCCIPITAL FASCICULUS MEDIATES RECOGNITION OF THE FACIAL EXPRESSION OF EMOTIONS *Carissa Philippi[1], Sonya Mehta[1], Thomas Grabowski[1], Ralph Adolphs[2], David Rudrauf[1]; [1]University of Iowa, [2]California Institute of Technology* – Lesion and neuroimaging studies have implicated multiple cortical regions in the recognition of emotion from facial expressions, yet it remains unknown how these regions communicate with one another. We hypothesized that visual representations of the face would need to be conveyed to frontal regions that associate the face with its emotional meaning. To test this idea, we isolated long-range association fiber tracts that might be critical in this network and combined probabilistic fiber tract information with the lesion-method. One hundred and four patients with stable, focal brain lesions were tested on their recognition of six emotions (happiness, sadness, fear, disgust, surprise, anger) from faces. For each hemisphere, five association fiber tracts (uncinate, inferior and superior longitudinal, and inferior fronto-occipital (IFOF) fasciculi, cingulum) from a probabilistic atlas were spatially normalized to a reference brain. Intersections of the lesions with these tracts were used to compute probable disconnection. The general linear model was used to predict emotion recognition impairments based on fiber tract information, covarying out lesion size, implicated cortical regions, and concurrent fiber tract disruption. Disconnection of the right IFOF significantly predicted impaired emotion recognition scores, averaged across emotions and individually for sadness, fear, surprise and anger. Furthermore, among the subjects, one had a white matter lesion virtually restricted to IFOF, and had highly impaired emotion recognition. Our findings strongly implicate the right IFOF as a critical component of the large-scale neural system supporting the recognition of the facial expression of emotion.

C40

ATTENTION TO EMOTION: NEURAL RESPONSES DURING EXPLICIT VERSUS IMPLICIT PROCESSING OF DYNAMIC BODY SIGNALS OF THREAT *Swann Pichon[1], Beatrice de Gelder[2,3], Julie Grezes[1]; [1]CNRS - Collège de France, Paris - France, [2]Tilburg University - The Netherlands, [3]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown* – An important issue in understanding how the brain reacts to emotional signals is whether such signals can be processed in the absence of attention and awareness and to what extent the activation level of the most critical brain areas is influenced by the task requirements. Several investigations of brain responses to static facial expressions have suggested that emotional signals are picked up even when attention is engaged elsewhere, whereas others have argued that attention is a prerequisite for extracting emotional information. So far this issue has been raised about static facial expressions. In contrast, the influence of attention on processing dynamic emotional signals from the body is not known. Recent investigations have mapped the brain regions engaged during the passive perception of dynamic body expressions of fear and anger. The present study addresses the question whether task-related attentional effects modulate the activity of the brain networks sustaining emotional body perception. We designed a 2*2 factorial (Explicit-implicit & Threat-Neutral) fMRI experiment in which participants were shown videos (3secs) of actors expressing fear, anger or neutral attitudes with the face blurred. Depending on the task, they were instructed to report either the emotional expression or the colour of a spot overlaid on the video and appearing for 40ms. The results show significant activations in sulcus temporal superior, anterior hippocampus / posterior amygdala, ventrolateral and medial prefrontal cortex when contrasting explicit to implicit contexts. Moreover, the interaction between explicit processing and emotion reveals additional activity in superior colliculus. Supported by: EC-contract number FP6-NEST-2005-Path-IMP-043403

C41

MARKETING ACTIONS CAN MODULATE NEURAL REPRESENTATIONS OF EXPERIENCED UTILITY *Hilke Plassmann[1], John O'Doherty[1], Baba Shiv[2], Antonio Rangel[1]; [1]California Institute of Technology, [2]Stanford Graduate School of Business, Stanford University* – Despite the importance and pervasiveness of marketing, almost nothing is known about the neural mechanisms through which it affects the decisions made by individuals. We propose that marketing actions, such as changes in the price of a product, can affect the neural computations associated with experienced utility. We tested this hypothesis by scanning 20 human subject brains (9f, 11m) using functional magnetic resonance imaging (fMRI) while they tasted wines which, contrary to reality, they believed to be different and sold at different prices. Our results show that increasing the price of a wine increases subjective reports of flavor pleasantness as well as the neural computations of subjective flavor pleasantness that are made in brain areas such as the medial orbitofrontal cortex (mOFC). Importantly, we did not find evidence for an effect of prices on areas of the primary taste areas such as the insula cortex. A natural interpretation is that the top-down cognitive processes that encode the flavor expectancies are integrated with the bottom-up sensory components of the wine in the mOFC, thus modulating the hedonic experience of flavor, but that the flavor expectancies generated by the change in prices do not impact more basic sensory representations. Interestingly, an analogous mechanism has been proposed for pain placebo effects. The paper provides novel evidence for the ability of marketing actions to modulate neural computations of pleasantness during the consumption experience and for the mechanisms through which the effect operates.

C42

EMOTIONAL AND REWARD PROCESSING DURING GAME PLAYING IN NARCOLEPTIC PATIENTS: A FUNCTIONAL MRI STUDY *Aurelie Ponz[1], Rositsa Poryazova[2], Esther Werth[2], Ramin Khatami[2], Peter Boesiger[3], Claudio Bassetti[2], Sophie Schwartz[1]; [1]Neurosciences, University of Geneva, Geneva, Switzerland, [2]University Hospital Zurich, Zurich, Switzerland, [3]Biomedical Engineering, University of Zurich & Swiss Federal Institute of Technology, Zurich, Switzerland* – Background: Narcolepsy with cataplexy (NC) is characterized by excessive daytime sleepiness, cataplexy episodes, caused by hypocretin/orexin (HCRT) deficiency. This hypothalamic neuropeptide is involved in sleep-wake and feeding regulation and, as recently described, in incentive motivation. Although NC-patients often report cataplexy episodes when playing games, it is unknown whether hypocretin depletion in humans might selectively affect neural activity in reward systems. Methods: We acquired event-related fMRI data on 12 NC-patients and 12-matched controls while they performed an incentive delay task. On each trial, subjects were presented with a cue displaying the amount to be won/lost, followed by a target. Subjects pressed on a key as quickly as possible during target presentation. Immediate feedback notified current gain. FMRI data were acquired on a 3-T Philips INTERA system, preprocessed and analyzed using SPM2. Results: Regions involved in reward processing (ventral striatum, cingulate), motor preparation and visual attention were more activated for larger cues in both groups. However, ventral midbrain, including the VTA, was modulated by the size of the cue presentation in controls but not in NC patients. Prefrontal cortex and nucleus accumbens were more activated during winning compared to losing in the controls only. Importantly, NC patients showed increased amygdala response selectively to large positive reward. Conclusion: HCRT-deficiency is associated with a lack of modulation in ventral midbrain regions for reward preparation, as well as an increase in bilateral amygdala activity in response to successful trials outcome. Our fMRI findings provide evidence for altered limbic-striatal responses in hypocretin-deficient patients during reward processing.

C43

EVENT-RELATED BRAIN POTENTIALS IN RESPONSE TO ANGRY FACIAL STIMULI AT THRESHOLD PERCEPTION *Erin Ramage[1], Joey Essoe[1], Mark Geisler[1]; [1]San Francisco State University* – Increased amplitudes and shortened latencies of event-related potentials (ERP's) in response to emotionally salient faces as compared to faces lacking emotion have been shown; however, the electro-physiological processing of emotional expression at threshold perception and the relationship to behavioral measures has not been examined. This study used a modified single-stimulus paradigm where male and female faces were presented every 30 seconds in block randomization. Each face expressed a different intensity of an angry expression, Neutral (NA), Threshold Anger (TA), and Full Anger (FA); each defined by subjective ratings of intensity prior to recording of the brainwaves. ERP waveforms, reaction time, and subjective intensity ratings, were collected in 22 male and 28 female college students. Results indicate that: (1) the intensity ratings increased as the intensity of the anger in the faces increased, (2) the amplitudes and latencies for early sensory visual information processing measured by the N1 and P2 ERP components were similar for all three faces, (3) the amplitudes for cognitive processing implicated in the discrimination of visual stimuli for the N2 ERP component were similar for the TA and FA conditions, and greater for NA, (4) the amplitudes for the later cognitive visual information processing of the P3 ERP component were similar for the NA and TA conditions, and greater for FA. Results suggest that the greatest differences between the ERP's of NA and FA intensities of angry faces are found during cognitive information processing of the N2 and P3 components.

C44

DOES ENGAGEMENT IN AN EMOTION REGULATION STRATEGY IN RESPONSE TO A PREVIOUSLY CONDITIONED STIMULUS RESULT IN ENDURING FEAR INHIBITION? *Colleen Ray[1], Alfred Kaszniak[1]; [1]University of Arizona* – This study was designed to determine whether engaging in cognitive reappraisal inhibits affective responses 5 days after strategy engagement. On Day 1 eighty participants underwent habituation training to a picture of a snake and a picture of a spider. They were then conditioned using a simple discriminatory conditioning fear paradigm to one of the pictures with a 100db noise blast presented at stimulus offset. On Day 3 participants returned to the laboratory and either i) engaged in a cognitive reappraisal strategy, ii) underwent traditional unpaired conditioned stimulus presentation training, iii) engaged in a cognitive reappraisal strategy during traditional unpaired conditioned stimulus presentation iv) or had an experience unrelated to the conditioned stimulus (control group). On Day 8 participants returned to the lab and were exposed to both pictures paralleling the Day 1 protocol. Psychophysiological measures (skin conductance response, orbicularis and corrugator facial electromyography) and emotion self-report (valence and arousal) ratings were used to compare affective responses across conditions. Psychophysiological data demonstrated that engagement in cognitive reappraisal, traditional unpaired conditioned stimulus presentation, as well as the combination of the two reduced fear responses to unpaired conditioned stimulus presentation 5 days later as compared to the control group. The impact on self-report measures was mixed. Thus, engagement in an emotion regulation strategy to a previously fear conditioned stimulus can result in enduring fear inhibition. Implications of this study for current neurological and cognitive views of fear inhibition as well as the boundary conditions of fear inhibition are discussed.

C45

CORTICAL GLUTAMATE IS LINKED TO REWARD RELATED VENTRAL STRIATE ACTIVITY – A COMBINED FMRI AND 1H-MRS STUDY *Jan Reuter[1], Nicola Klein[1], Martin Voss[1], Theresa Dembler[1], Florian Schubert[2], Rüdiger Brühl[2], Frank Seifert[2], Andreas Heinz[1], Jürgen Gallinat[1]; [1]Klinik für Psychiatrie und Psychotherapie, Charité*

Universitätsmedizin Berlin, Germany, [2]Physikalisch-Technische Bundesanstalt, Berlin, Germany – Processing of rewarding stimuli is associated with increased firing rate of dopamine neurons in the ventral striatum, a core region of the brain reward system. Psychiatric diseases with dysfunctional reward behavior, like schizophrenia, are associated with abnormal dopaminergic neurotransmission and dysfunctional activation of the ventral striatum. A close interaction between dopamine and glutamate has been proposed to play an important role in reward processing and in the pathophysiology of schizophrenia. In humans, aspects of dopamine function may be reflected by the BOLD activity of the ventral striatum during presentation of rewarding stimuli, and glutamatergic function may be represented by absolute glutamate concentrations measured with magnetic resonance spectroscopy. An interaction of dopaminergic and glutamatergic neurotransmission has so far not been imaged in humans. We hypothesize and find a correlation between the activity of the ventral striatum (BOLD contrast during reward processing) and glutamate concentration in the anterior cingulate cortex in healthy subjects in a combined fMRI and MRS study.

C46

PERCEPTION IN EMOTIONAL DEFICIT *Gwladys Rey[1], Ken Knoblauch[2], Marie Prévost[3], Roland Jouvent[1], Stéphanie Dubal[1]; [1]CNRS UMR 7593, Centre Emotion, CHU Pitié-Salpêtrière, Paris, France, [2]INSERM U864, Institut cellule souche et cerveau, Bron, France., [3]McGill University, Montréal, Québec, Canada* – Anhedonia is associated with a reduced experience of positive emotion. This study examined emotion perception in physical and social anhedonia under varying perceptual conditions. We used an affective judgment task of photographs that included either sensory or social content. The luminance contrast of positive pictures was varied from 20, 40, 60, 80 or 100% of the initial contrast. Twenty-six subjects with Physical Anhedonia, 10 with Social Anhedonia and 35 nonanhedonic subjects rated the emotional intensity of the pictures. In all subjects, judgments of emotional intensity decreased with contrast attenuation. Low contrast pictures are thus less arousing than high contrast pictures. Physical anhedonics reported decreased pleasure for sensory photos at all but the lowest contrast level, and for social photos at high contrast levels. Social anhedonics did not differ from controls in their ratings of sensory photos, and reported decreased pleasure for social photos at all but the lowest contrast level. The deficit of pleasure in anhedonia is selective for the emotional modality; physical anhedonia relies more on the sensory dimension of the test and social anhedonia relies more on the social dimension. Despite lower global hedonic capacity, anhedonia is associated with a capacity to modulate emotional responses.

C47

EMOTION REGULATION IS ASSOCIATED WITH IMPROVEMENT IN WORKING MEMORY PERFORMANCE *Anne Richards[1], Richard Maddock[1]; [1]University of California Davis* – The goal of this ongoing study is to gain a greater understanding of the behavioral, physiological, and neural effects of emotion regulation on cognitive processes such as working memory. We hypothesized that giving subjects instructions to regulate their emotions would reduce interference caused by emotional distracters. Undergraduate students performed a facial identity recognition working memory task with unpleasant and neutral photographic distracters. In alternating blocks subjects were instructed to either decrease their reaction to the distracter photographs using detachment or to let themselves respond naturally. Skin conductance responses (SCR) to the distracters and subjective ratings of unpleasantness were recorded. A repeated measures ANOVA showed an interaction between distracter valence and the effect of emotion regulation instructions on accuracy (df= 1,25, F=5.846, p = 0.0232). Working memory performance improved on the trials with unpleasant distracters when the instructions were to regulate. Subjects rated the distracters as less unpleasant on the blocks when the instructions were to regulate. A repeated measures ANOVA of SCR amplitude found a main effect of regulation instructions (F=8.6, df=1,25, p=0.007), a main effect of distracter valence (F=5.3, df=1,25, p=0.03), and a non-significant trend for an interaction (F=1.6, df=1,25, p=0.22). The subjective ratings and SCR evidence suggest that subjects were successful at regulating their emotions. The working memory performance evidence suggests that regulating emotional responses improved memory accuracy even though no emotional interference was present without emotion regulation. Imaging studies are planned to test our hypotheses about the mechanism of this working memory improvement.

C48

ASSESSMENT OF EMOTION-MODULATED ATTENTIONAL NARROWING USING EYE MOVEMENT MONITORING *Lily Riggs[1,2], Doug McQuiggan[1,2], Ella Pan[1], Adam Anderson[2], Jennifer Ryan[1,2]; [1]Rotman Research Institute, [2]University of Toronto* – It is suggested that emotional arousal leads to attentional narrowing such that memory for central emotional items is enhanced at the cost of memory for surrounding peripheral items (Easterbrook, 1959). We assessed this hypothesis using behavioral responses and eye movement monitoring (EMM). Participants viewed central negative and neutral IAPS scenes (CS) surrounded by three peripheral neutral objects (PO) across two study blocks. Then, two test blocks were presented. In the first test block, participants saw previously viewed peripheral, manipulated (one object was replaced with a novel object), and novel objects. In the second test block, participants saw previously viewed and novel IAPS scenes. Participants indicated whether PO were old, manipulated or novel, and whether CS were old or new. In the study block, participants viewed CS more than PO regardless of arousal type, and this difference was enhanced for emotional CS. In the test block, duration of first fixation distinguished previously viewed from novel CS, regardless of arousal type. Participants were more accurate in their recognition of emotional versus neutral CS. There was increased viewing of the manipulated PO in manipulated scenes compared to when it appeared in a repeated or novel scene. These effects did not vary by arousal type. By contrast, participants were more accurate in detecting a change in PO when they were previously paired with a neutral versus an emotional scene. While, EMM results from study block and behavioral data support the attention narrowing hypothesis, this tradeoff was not observed for EMM data from test blocks.

C49

ARE EMOTIONAL SIGNALS UNIVERSAL? A CROSS–CULTURAL INVESTIGATION OF VOCAL EXPRESSIONS OF EMOTIONS *Disa Sauter[1,2,3], Frank Eisner[4], Sophie Scott[4]; [1]University College London, [2]Institute of Psychiatry, King's College London, [3]Centre for Brain and Behaviour, Birkbeck college, [4]Institute of Cognitive Neuroscience, University College London* – The basic emotion account (Ekman, 1992) proposes that some affective states are associated with distinct signals, which are universally recognized. This claim has been empirically verified for emotional facial expressions, but little work has investigated whether vocal signals of emotions can be recognized cross-culturally. We report a set of studies carried out with the preliterate Himba, a semi-nomadic people who live in northern Namibia. This is the first investigation to examine the perception of vocal emotional signals in both Western and non-Western participants. We present data from several tasks, including matching of sounds to emotion vignettes, and same-different judgments, with both Western and non-Western stimuli. Identification of non-verbal emotional vocalizations is better than chance for both tasks with both types of stimuli and for some emotions individually. This work lends support to the universalist account of emotional communication.

C50

EMOTIONAL STATES DIFFERENTIALLY BIAS EXTRASTRIATE CORRELATES OF THE ATTENTIONAL SPOTLIGHT *Taylor Schmitz[1,2], Matt Dixon[1], Eve De Rosa[1], Adam Anderson[1]; [1]University of Toronto, [2]University of Toronto, Collaborative Program in Neuroscience* – Behavioral research suggests that positive and negative emotional states may differentially influence visuospatial attention by broadening or narrowing, respectively, the scope of attended information in one's visual field. This fMRI study examined whether positive and negative emotions differentially modulate the spatial scope of selective attention, as indexed by changes in extra-striate visual processing. This was interrogated with a block design experiment consisting of alternating blocks of affect induction (positive, neutral, negative IAPS images) and a visuospatial task. The visuospatial task employed rapid presentations (300ms) of composite face/place (center/surround) stimuli to distinguish category-selective extrastriate regions. The central face was attended (gender decision task), rendering the peripheral place unattended. The visuospatial task included intra-block repetitions of the unattended place information, affording assessment of repetition suppression effects as a metric of unintentional encoding. A post scan localizer was used to functionally define face (FFA) and place (PPA) extrastriate regions of interest. Fourteen individuals (age=22.03±0.68; education=15.57±0.68) participated.. FMRI parameters were as follows: TE=30 ms; TR=2000 ms; flip angle=270°; matrix=64×64; FOV=200mm. Valence-dependent encoding patterns were examined at the group level using factorial ANOVAs. Consistent with predictions, positive affect increased extrastriate PPA encoding of the unattended place information (i.e. broadened attention) and negative affect decreased place encoding (i.e. narrowed attention). As a function of the temporal separation between affect induction and visuospatial blocks, affect induced changes in neural response during visuospatial blocks were not attributable to exogenous stimulus-driven affective cues. This study thus provides neurofunctional evidence that endogenous emotional states alter the scope of attentional selection.

C51

THE ROLE OF SOMATOMOTOR REPRESENTATIONS IN THE RECOGNITION OF AFFECTIVE PROSODY: AN ERP STUDY *Valery Sramko[1], Mario Liotti[1]; [1]Simon Fraser University* – Recognition of emotions has recently been the object of intense research. The somatic marker hypothesis (Damasio, 2003) postulates that an individual's somatomotor representations not only play a central role in one's own emotional experience and expression, but also in the perception of others' facial expressions. In the present study it was hypothesized that recognition of emotions conveyed through affective prosody would activate speech premotor/motor areas in the listener. High-density brain electrical activity was recorded while twenty healthy females categorized semantically neutral sentences presented in five different emotional prosodies (happy, sad, angry, fearful, and neutral). Accuracy was comparable between emotions, but reaction time was significantly faster for angry and fearful intonations. Event-related activity was selectively averaged for the different emotions, time-locked to sentence onset. Scalp topography and global field power revealed an overall effect of affective prosody with a main component peaking at 1 sec. sLORETA localized this activity within the inferior part of the anterior temporal cortex (right greater than left). Main event-related potential (ERP) differences between emotions included an early effect peaking at 450 ms with increased activity in response to fear and localized in right dorsal premotor cortex. A later effect, peaking at 950 ms, showed sad-specific activity localized to left inferior premotor cortex. These findings lend support to the hypothesis that one's own somatomotor representations may be activated during the processing of emotions in speech in others. These results also suggest that different emotions recruit distinct premotor regions during affective prosody recognition.

Higher level cognition: Numerical processing

C52

ALTERED ACTIVITY OF NEURAL SYSTEMS UNDERLYING CALCULATION IN MATH LEARNING DISABILITY: A CASE STUDY *Paul Eslinger[1,2,3], Melissa Long[1], Clancy Blair[4,9], JianLi Wang[2], Jennifer Realmuto[1], Dave Baker[5,8], Steven Thorne[7], David Gamson[6], Erin Zimmerman[1], Qing Yang[2], Lisa Rohrer[10]; [1]Penn State College of Medicine, Neurology, [2]Penn State College of Medicine, Radiology, [3]Penn State College of Medicine, Pediatrics, [4]Penn State University, Human Development and Family Studies, [5]Penn State University, Sociology, [6]Penn State University, Education Policy Studies, [7]Penn State University, Language Acquisition Center, [8]Penn State University, Social Sciences Research Institute, [9]Penn State University, Population Research Institute, [10]Penn State University, Psychology* – In this case study, we tested the hypothesis that the neurodevelopmental bases of mathematical cognition are altered in mathematical learning disability (Math LD). We suspected these alterations would entail attenuated activity of crucial number neurons in the parietal lobe (intraparietal sulcus region) and compensatory recruitment of additional frontal, cingulate, and occipital regions subserving working memory, pattern recognition, and problem solving. Studies in the 15 year old male participant with Math LD were contrasted to a typically developing control sample (n = 16). Participants completed number calculation (addition and subtraction), coin calculation, and number n-back tasks while being scanned in a Philips 3T magnet using a boxcar design with a non-computation number processing baseline condition. Images were processed with SPM2 software. In comparison to healthy controls, the Math LD participant showed significantly increased recruitment in frontal, occipital, temporal, and cingulate regions to varying extents in number n-back, subtraction, and coin calculations tasks, whereas neural recruitment in the addition task was attenuated. Activity in the region of the intraparietal sulcus was erratic across tasks and in comparison to controls. Findings suggest a pattern of neurodevelopmental pathophysiology in this case of Math LD that prominently compromises parietal and frontal lobe networks for number sense, working memory, and efficient processing operations. Recruitment of multiple cortical regions not usually associated with calculation appears to represent compensatory attempts and strategies to handle working memory load and computational operations efficiently.

C53

PARIETAL ACTIVATION DURING SYMBOLIC NUMBER PROCESSING DEPENDS ON AN EXPLICIT FOCUS ON NUMERICAL MAGNITUDE *Minna M Hannula[1,3], Daniel Ansari[2], Bruce McCandliss[3]; [1]University of Turku, Finland, [2]University of Western Ontario, Canada, [3]Weill Cornell Medical College* – A series of recent findings has suggested that the parietal cortex is involved in the processing and representation of numerical magnitude, even when participants are not told to explicitly focus on number. In contrast, other evidence suggests that the intraparietal sulcus (IPS) is not modulated by numerical stimuli when these are irrelevant to the task. The present paper reports a direct investigation of the extent to which parietal involvement in number processing depends on explicit task requirements for recruiting representations of numerical magnitude. Using functional magnetic resonance imaging (fMRI), we compared two cross-modal number judgment tasks, which varied in the degree to which number magnitude representations needed to be deliberately engaged. An additional cross-modal control task involved matching equally familiar symbols, i.e. visually presented letters, with corresponding auditory letter names. During the number comparison task, bilateral regions of the IPS and right precentral gyrus were modulated to a greater extent than during either the number or letter matching tasks. In contrast, number matching did not modulate any regions to a greater extent than letter matching. These findings suggest that the degree of parietal activation during numerical tasks is dependent on the degree to which participants are required to explicitly focus on numerical magnitude, thereby calling for greater attention to the specific task situations under which parietal activation during number processing is observed.

C54

DEVELOPMENTAL SPECIALIZATION FOR SYMBOLIC NUMBER PROCESSING IN THE LEFT SUPRAMARGINAL GYRUS – AN FMRI STUDY *Ian Holloway[1,2], Gavin Price[3], Daniel Ansari[1,2]; [1]Dartmouth College, [2]University of Western Ontario, [3]University of Jyvaskyla* – Like the ability to access sounds from letters, the ability to access the numerical quantity represented by abstract numerical symbols (e.g. Arabic numerals) is crucial for scholastic and employment success. A growing number of neuroimaging studies have begun to elucidate the neural representations of quantity and their typical and atypical developmental trajectories. However, the brain mechanisms underlying the ontogenetic process of connecting abstract symbols with their quantitative referents have yet to be systematically examined. To address this open question, we conducted a functional Magnetic Resonance Imaging study in which 7-9 year old children and adults compared the relative magnitude of symbolic (Arabic numerals) and nonsymbolic quantities (arrays of squares). By contrasting the neural activation elicited by symbolic comparison with that of non-symbolic comparison, we isolated brain regions which responded differentially as a function of numerical format. Furthermore, in a whole-brain voxelwise analysis of the interaction between numerical format (symbolic-nonsymbolic) and age (adults-children), we delineated brain regions whose response to numerical format differs as a function of age. This analysis revealed two regions that showed greater modulation of numerical format in adults relative to children: the left Supramarginal gyrus (SMG) and an area in the right Insular cortex. Importantly, activity in the left SMG was found to predict participants' performance during numerical comparison. The results suggest that the SMG may be a key brain region involved in the developmental process of mapping numerical symbols onto their quantitative referents.

C55

THE TIME-COURSE OF NUMERICAL-SPATIAL INTERACTIONS *Edward Hubbard[1], Mariagrazia Ranzini[1], Manuela Piazza[2], Stanislas Dehaene[1,3]; [1]INSERM Unit 562 Cognitive Neuroimaging Gif-sur-Yvette, France, [2]Center for Mind Brain Sciences, Rovereto, Italy, [3]Collège de France, Paris, France* – Over the past 15 years, behavioral, neuroimaging and patient studies have suggested that human numerical abilities depend, in part, on an automatically elicited left-to-right oriented mental number line. Using fMRI, we have previously found that posterior parietal cortex (PPC) regions which respond more to contraversive than to ipsiversive saccades also respond more strongly to numbers associated with the corresponding side of space (i.e., small numbers = greater activation in right PPC; large numbers = greater activation in left PPC). The current study used event-related potentials to explore the timecourse of these effects and to further explore the functional similarities between numerical and spatial processing. We collected EEG data using a 256-channel EGI system while subjects performed a standard cued target-detection task. On each trial, a non-informative (50% valid) arrow (leftwards or rightwards) or number (1, 2, 8 or 9) cue was presented at fixation, followed after a variable SOA by a left- or right-sided target, to which subjects responded as quickly as possible. Arrows led to a greater negativity over contraversive parietal and central electrodes at approximately 250 – 400 ms after cue onset (the early directing attention negativity; EDAN), even for non-informative arrow cues. Frontal sites exhibited a similar pattern in the 250 – 450 ms time window, possibly reflecting a mix of the EDAN and the anterior directing attention negativity (ADAN) effect. Numerical cues led to similar, albeit weaker, EDAN and ADAN effects, consistent with the suggestion that numerical and spatial processing share mechanisms of automatic spatial orienting.

C56

NUMBER IMPAIRMENT IN CORTICOBASAL DEGENERATION *Shira Koss[1], Luisa Vesely[1], Murray Grossman[1]; [1]University of Pennsylvania* – We investigated acalculia and impaired number knowledge in corticobasal degeneration (CBD). CBD patients diagnosed according to clinical-pathological criteria (Murray et al, 2007) were compared with matched healthy controls. We investigated number knowledge by administering written Arabic numeral or visual dot-pattern probes in which subjects judged the fit of a target value between two boundary values (e.g. whether target value "3" was between "2" and "5"). We manipulated the small (1, 2, 3), medium (4, 5) or large (6, 7) distance between boundary values. To examine a resource-related component, we administered the boundary values in forward or reverse order. CBD (73.8% correct) are significantly impaired compared to controls (96.6% correct). CBD (6875.2 msec) also take significantly longer than controls (2348.8 msec). CBD are equally impaired with Arabic numerals (74.3% correct) and dot-patterns (73.3% correct). While accuracy improves in controls as distance increases (small: 94.6%; medium: 99.1%; large: 99.6% correct), CBD shows the opposite effect (small: 81.4%; medium: 66.0%; large: 60.2% correct). Reverse presentation order impairs performance in CBD (forward: 83.1%; reverse: 64.0% correct), but not in controls (forward: 98.5%; reverse: 94.6% correct). CBD thus have a modality-independent number knowledge impairment. As the amount of numbers in the gap between two boundary numbers increases, CBD become less able to process the larger segment of the number line. This reflects degradation of number knowledge following parietal disease in CBD. CBD are less accurate while managing a number line in reverse order, consistent with executive difficulty and frontal disease.

C57

NUMERICAL BLINK – DISTANCE MATTERS *Sharon Naparstek[1], Neta Shachar[1], Yoav Kessler[1], Avishai Henik[1]; [1]Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev* – In the attentional blink (AB) paradigm, participants are presented with a stream of stimuli in a rapid serial visual presentation (RSVP) and are asked to report two targets. Typically, when the second target appears 2-4 lags after the first target, accuracy rates for reporting T2 are impaired. A common explanation is that the two targets compete for the same attentional resources. To examine whether AB can be modulated by target meaning, the numerical distance between two number targets was manipulated. Participants were presented with 18 letter distractors and 2 digit targets and were asked to report the targets according to the order of presentation. Three variables were manipulated: the number of lags between the targets (1-6 lags), the numerical distance (D) between the targets (D1: e.g., 1-2; D2: e.g., 1-3; D5: e.g., 1-6) and the order in which the targets were presented (ascending: e.g., 3 then 4; descending: e.g., 4 then 3). The results revealed that numerical distance modulated AB. Namely, accuracy rates for reporting the second target were higher for small distances (distance 1 & 2) than for the large distance (distance 5). Furthermore, it seems that the order of targets also modulated AB. That is, participants were more accurate in responding to ascending than to descending presentations. These results imply that AB is not purely attentional and that semantic processing occurs in a pattern indicative of the existence of the classical mental number line.

C58

COMPREHENSION OF MASS VS. COUNT NOUNS IN PATIENTS WITH CORTICOBASAL DEGENERATION *John Nguyen[1], Vanessa Troiani[1], Jonathan Peelle[1], Peachie Moore[1], Murray Grossman[1]; [1]University of Pennsylvania School of Medicine* – The linguistic difference between mass and count quantifiers is linked to both semantic concepts as well as syntactic constraints. We have previously found the semantics of quantifier knowledge to rely on inferior parietal cortex. In the current study, we investigated mass/count comprehension in patients with corticobasal degeneration (CBD), a neurodegenerative condition affecting the parietal lobe. These patients have impaired numerical and quantifier comprehension, but intact object naming and sentence comprehension. CBD patients (N=8) and healthy age-matched adults (N=9) completed a self-paced computer task during which they viewed 240 quantifier statements paired with a corresponding image. Participants were asked to assess whether the corresponding quantifier statement accurately described the picture. Half of the stimuli contained discrete, countable images and half were composed of uncountable images probing mass concepts. CBD patients were impaired on both mass and count concepts when compared to controls. This is consistent with their limited parietal semantic support. Elderly controls demonstrated a reaction time pattern consistent with previous research, with faster responses to countable items. Patients showed a similar pattern, most likely due to reliance on preserved syntax. These data suggest that the mass/count distinction relies on a parietal semantic network that is additionally supported by rules of syntax that accompany quantifier meaning.

C59

ADAPTATION FROM SYMBOLIC MAGNITUDES IN THE PARIETAL CORTEX: THE NEURAL ORIGIN OF THE QUANTITY PRIMING EFFECT *Karolien Notebaert[1], Mauro Pesenti[2], Bert Reynvoet[1]; [1]University of Leuven, [2]University of Louvain-la-Neuve* – Numerical magnitudes are known to be processed in the intraparietal sulci (IPS) of the brain. We used an fMRI-adaptation paradigm to investigate how they are actually encoded at the neural level. In order to uncover the neural origin of the behavioral quantity priming effect, i.e. faster latencies for smaller numerical distances between prime and target, we manipulated the notation (Arabic and verbal numerals) and the numerical distance between a prime and a target symbolic number in a number identification task. A whole brain group analysis resulted in bilateral activations of the intraparietal sulci. In a region of interest (ROI) analysis, the recovery of activation in both IPS was found to be positively correlated with the numerical distance between the prime and the target. These findings support the idea of a notation-independent magnitude representation with overlapping tuning curves of number sensitive neurons in the left and right IPS and reveal for the first time the neural origin of the quantity priming effect, using a design closely matched to behavioral priming studies.

C60

NUMERICAL MAGNITUDE PROCESSING IMPAIRMENTS IN THE DEVELOPMENTAL DYSCALCULIC BRAIN *Gavin Price[1], Ian Holloway[2], Pekka äsänen[3], Manu Vesterinen[1], Daniel Ansari[2]; [1]Agora Center, University of Jyvaskyla, Finland, [2]University of Western Ontario, [3]Niilo Maki Institute, Jyvaskyla, Finland* – Developmental Dyscalculia (DD) is a specific learning disability affecting the acquisition of school level mathematical abilities in the context of otherwise normal academic achievement, with prevalence estimates in the order of 3–6%. It has been suggested that deficits in higher-level mathematical skills may stem from impaired representation and processing of basic numerical magnitude. We show that, in children with pure DD, the right intraparietal sulcus, a key region for the representation and processing of numerical magnitude, is not modulated in response to numerical processing demands to the same degree as in typically developing children. Eight right-handed children diagnosed with DD were compared to eight right-handed, typically developing, age matched peers. Participants selected which of two sets of squares contained more items. Set pairs were assigned to either close (1–3) or far numerical distance (5–8) conditions. Significant group x distance interactions were observed at cluster corrected threshold of $p < 0.05$ in the right intraparietal sulcus, left fusiform gyrus and left medial prefrontal cortex. The interaction in the IPS was characterized by a stronger distance effect in the control group than in the DD group, suggesting a lack of modulation of parietal numerical processing mechanisms in response to increasing numerical task demands in DD children. These results provide evidence for a link between brain mechanisms underlying basic numerical magnitude processing and the development of higher level mathematical skills and are the first to provide direct evidence of parietal dysfunction in DD.

C61

NUMERICAL COGNITION IN COLOUR: SYNAESTHESIA FOR FINGER COUNTING AND DICE PATTERNS *Noam Sagiv[1], Jamie Ward[2]; [1]Centre for Cognition and Neuroimaging, Brunel University, UK, [2]University of Sussex, UK* – Numbers are common inducers of synaesthetic colour experience. While a number of studies suggested that number meaning elicits the colour, it is usually the graphemic representation that is perceived in colour. We report a rare case of a synaesthete (TD) who perceives colours not only when viewing digits, but also when seeing dice patterns and his own fingers while counting. Importantly, the colours are the same across numerical representations as long as they share the same numerosity (number meaning), and projected externally onto the surface of the stimulus. The authenticity of TD's subjective reports was established using Stroop-like paradigms. The case challenges previous speculations suggesting a systematic relationship between the level at which synaesthesia arises, and the spatial extent of synaesthetic colour imagery. We argue that TD's case is best explained by a model we recently proposed to account for phenomenological and behavioural differences among synaesthetes (Ward, Li, Salih, & Sagiv, in press; Consciousness & Cognition).

C62

NUMBERS IN THE BLIND MIND´S EYE *Elena Salillas[1], Alessia Granà[1], Radouane El-Yagoubi[1], Carlo Semenza[1]; [1]University of Trieste* – Increasing evidence signals a relationship between number representation and space (Hubbard et al., 2005). It has been suggested that a number representation with spatial characteristics is hardwired (Spelke and Dehaene, 1999). Thus, the lack of visual experience should somehow end in a similar space-linked representation. In this study blind and sighted populations were compared in an auditory paradigm based on the work of Fischer et al. (2003), where low numbers (1 and 2) facilitate the detection of left-lateralized targets and high numbers (8 and 9) facilitate the detection of right-lateralized targets (congruent conditions). In two experiments, behavioural (Experiment 1) and electrophysiological measures (Experiment 2) were collected. Specifically, an auditory number preceded a lateralized auditory target through dicothic listening. This target had to be detected right after the target (Experiment 1) or in a delayed detection task (Experiment 2). Both blind and sighted population presented lower RTs for congruent number-target location pairs than for incongruent ones. Nevertheless, the processes underlying this congruency effect were diverse between the two populations as signalled by the ERPs. While the sensory component N100 was modulated by congruency in sighted participants, only the more controlled and amodal component P300 was modulated by congruency in blind population. Therefore, although the left-to-right organization of the mental number line seems similar in both populations, unlike sighted participants, the blind group seems to use an amodal representation which needs higher cognitive control.

C63

DIFFERENT PATHWAYS FOR SYMBOLIC AND NONSYMBOLIC QUANTITY PROCESSING IN THE HUMAN BRAIN *Seppe Santens[1], Wim Fias[1], Tom Verguts[1]; [1]Ghent University* – There is now converging evidence for the intraparietal sulcus (IPS) as the neural substrate for an abstract, supramodal representation of quantity. However, it is still largely unknown what other brain areas contribute to numerical processing and what their specific role is. In this study, we aim to investigate the pathways involved in processing symbolic and nonsymbolic quantities. In a blocked fMRI design, quantities from 1 to 5 are presented either in a symbolic format (Arabic digits) or a nonsymbolic format (sets of dots). Structural equation modelling is used to model the time series of three areas in the left hemisphere: primary visual cortex (V1), posterior parietal cortex (PPC) and middle IPS. Results show that V1 and middle IPS are connected when symbolic quantities are presented, whereas a different pathway (V1 – PPC – middle IPS) is activated for nonsymbolic quantities. The results are discussed in the light of recent neuroimaging findings and existing models of number processing.

C64

LATERALIZATION OF FUNCTION IN NUMEROSITY PERCEPTION? *Mark Schmidt[1], Christopher Brogdon[1], Ladolgy Webster[1]; [1]Columbus State University* – Two proposed mechanisms for numerosity perception are subitizing and preverbal counting. Lateralization studies have produced mixed results. We investigated lateralization of function within and beyond the subitizing range. In Exp 1 (N=33) 1-9 white dots were presented for 200 ms in either the left or right visual field (LVF; RVF). Visual angle was 2.5 degrees. Response times (RT) were recorded via voice key. With 3 and 4 dots (i.e., subitizing range) the right hemisphere (RH) produced faster RTs. The RH also produced greater accuracy at 4 dots. There were no hemispheric differences in reported number, but response compression occurred between 6–8 dots in both hemispheres. In Exp 2 (N=32) presentation time was reduced to 150 ms and visual angle increased to 3.0 degrees. With 3 and 4 dots, the RH again produced faster RTs. The RH also produced greater accuracy at 2 dots, and showed greater response compression at 3, 4, 7, and 8 dots. In Exp 3 (N=12) we tested the possibility that use of verbal responses may have given the LH an advantage, which minimized the hemispheric differences found in Exps 1 and 2. A small white square was presented for 150 ms in the LVF or RVF to test simple verbal RT. No hemispheric differences were found. The differences obtained in Exps 1 and 2 were consistent, suggesting that lateralization of function in numerosity perception exists, with the RH superior to the LH. Results are discussed in terms of theories of hemispheric specialization.

C65

LEFT TEMPORO-PARIETAL WHITE MATTER MICROSTRUCTURE "MATTERS" FOR BOTH READING AND MATHEMATICAL ABILITIES: CORRELATION BETWEEN FRACTIONAL ANISOTROPY VALUES IN THE LEFT SUPERIOR CORONA RADIATA AND CHILDREN'S MATH SCORES *Lucia van Eimeren[1,2], Sumit N. Niogi[3], Bruce D. McCandliss[3], Ian Holloway[1,2], Daniel Ansari[1,2]; [1]Dartmouth College, Hanover, NH, [2]University of Western Ontario, London, ON, Canada, [3]Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University, New York, NY* – Over the past decade, an increasing number of studies have used Diffusion Tensor Imaging (DTI) to understand the relationship between white matter microstructure and cognitive abilities. These studies have revealed that left temporo-parietal white matter regions, in particular the left superior corona radiata (SCR), are associated with reading abilities in children and adults. Whereas DTI has been successful in clarifying the role of connectivity between functional brain regions and reading, it has not yet been used to characterize the white matter organization associated with the typical development of mathematical competence. To address this open question, we collected DTI data from 13 typically developing children (7-9 years old). Fractional anisotropy (FA) values were extracted from regions of interests using the Reproducible Objective Quantification Scheme (ROQS) to investigate the relationship between the strength of white matter tract connectivity and children's math scores (Subtests Numerical Operation and Mathematical Reasoning from WIAT-II). The results revealed that individual differences in children's mathematical abilities are correlated with FA values in the left SCR. These data suggest a relationship between typically developing children's math competence and white matter integrity in the same region that has previously been associated with individual differences in reading ability. Furthermore, we found that the lateralization of this white matter tract microstructure was systematically correlated with mathematical abilities. These findings provide the first direct evidence to suggest that the development of verbal mathematical and reading abilities may share common white matter tracts in the left temporo-parietal cortex.

C66

IMPLICIT PROCESSING OF NON-SYMBOLIC NUMEROSITY IN THE ABSENCE OF AWARENESS *Petra Vetter[1], Eva Spolaore[1], Brian Butterworth[1], Geraint Rees[1,2], Bahador Bahrami[1,2]; [1]Institute of Cognitive Neuroscience, University College London, [2]Wellcome Department of Imaging Neuroscience, Institute of Neurology, University College London* – We investigated the explicit and implicit judgement of small numerosities in the absence of awareness. Numerosity stimuli (1, 2 or 3 gabor patches) were presented to one eye but suppressed from awareness by continuously flashing a mask in the other eye. In the first experiment, subjects were unable to explicitly judge discrete numerosities in a 3-alternative forced choice task when they were unaware of the suppressed stimulus. In the second experiment, the number of suppressed and invisible stimuli (prime) affected the speed of numerosity judgment for visible targets presented subsequent to the invisible primes. Reaction times to the target increased with numerical distance between prime and target. These results suggest that extraction of non-symbolic numerosity information occurs in the absence of awareness. Although this information is not available to explicit judgement, it could be traced by its implicit effect.

C67

THE DEVELOPMENT OF NUMERICAL PROCESSING IN THE FIRST YEARS OF FORMAL SCHOOLING: EVIDENCE FROM EVENT-RELATED POTENTIALS AND CLASSROOM ACTIVITIES *Sonia White[1], Denes Szucs[1,2], Fruzsina Soltesz[1]; [1]University of Cambridge, Faculty of Education, Centre for Neuroscience, [2]Hungarian Academy of Sciences* – The purpose of this study was to establish direct links between cognitive neuroscience and education for the domain of number processing. The aim was examine the transition from informal to more abstract, formal numerical processes, acquired through education. To this end, the study focused on the developmental relationships between magnitude and symbolic representations for children in Years 1, 2 and 3. In order to provide a detailed image and link the two fields the methods first utilised the numerical Stroop paradigm, and evaluated amplitude, temporal and spatial aspects of event-related brain potentials (ERPs). The ERPs were able to reveal key number processing characteristics such as the distance effect and size congruity effect. Extending the analysis and incorporating educational elements, associations were drawn to a behavioural parity judgement task and a classroom based number line activity. These inclusions proved to be very fruitful, with the results demonstrating variations of number processing that were task dependent. The results highlight the importance of context when assessing the relationships between magnitude and symbolic representations in young children. Overall, the study supports the need for a multi-disciplinary approach when applying cognitive neuroscience findings to an educational context. The fine grained understanding that this type of research provides will make vital contributions to the development and support structures of mathematics education.

Higher level cognition: Other

C68

SEEING THE FOREST AND THE TREES: EXPLORING THE NEUROLOGICAL UNDERPINNINGS OF GIST AND DETAIL PROCESSING *Raksha Anand[1], Mandy Maguire[1], Sandra Chapman[1], John Hart[1]; [1]The University of Texas at Dallas* – Efficient information processing entails the ability to rapidly and accurately process both gist (global meaning) and details (specific contents) of an ongoing stream of information. Past research has shown that regardless of the efficiency of processing, over time, there is a tendency to remember the gist of information better than the details. The question that remains largely unexplored is whether there are underlying differences in neurological underpinnings of gist and detail processing. This study examined differences in online processing of gist and details using event-related potentials (ERPs) in 20 cognitively normal young adults (18 - 35 years). Participants were asked to judge (yes/no) whether a given statement corresponded to gist or details conveyed in a picture. A total of 240 statement-picture pairs were used. ERPs and behavioral response in terms of reaction time (RT) and accuracy were recorded during this task. Participants showed no RT and accuracy differences between gist and details. Spatio-temporal Principal Components Analyses done on ERP data revealed anterior-posterior and hemispheric differences in processing of gist and details at 700-1080ms ($p<.001$). These results demonstrate neurobiological differences in online processing with potential implications in evaluating theories of information processing. In addition, these findings serve as a baseline to further examine the effects of normal aging and brain disease on gist and detail processing.

C69

THE N400 AS A MEASURE OF CULTURAL DIFFERENCES IN SCENE PERCEPTION *Yumi Ando[1,2], Alicia Yee[1], Carol Huang[1], Sharon Goto[1,2], Richard Lewis[1,2]; [1]Pomona College, [2]Program for Neuroscience, Pomona College* – Accumulating evidence demonstrated that European Americans allocate relatively more attention to foreground objects, whereas East Asians disperse their attention across foreground and background objects (Chua et al., 2005). East Asians' greater focus on background objects is consistent with their greater context sensitivity found across neural, cognitive, and social domains (Lewis, Goto, & Kong, 2007). Ganis and Kutas (2003) have demonstrated that the processing of a background visual scene influences the subsequent processing of target objects. The morphology and time course of the resulting ERPs suggest that the neural processing of the meaning of visual scenes is similar to the N400 semantic context effect. We presented a modification of the Ganis and Kutas (2003) task to European Americans and East Asian Americans. If the Asian Americans disperse their attention across background and target objects to a greater degree than European Americans, they should show a greater N400 relative to the European Americans. To date 36 European Americans and 20 East Asian Americans have been tested. As is typical in our samples, the East Asian Americans were more collectivistic on the Triandis IND/COL scale than the European Americans ($p < .05$), but equally individualistic. As hypothesized the East Asian Americans showed a greater N400 to incongruent background-object pairings than the European Americans. The morphology and time course of the ERPs are consistent with the N400 sentence context effect. This suggests that East Asian Americans are showing greater semantic context sensitivity to the processing of visual scenes than European Americans.

C70

MENTAL TIME TRAVEL TO PAST AND FUTURE: EVIDENCE FROM BRAIN LESIONS BEFORE AND AFTER TREATMENT AND INTRACRANIAL RECORDING *Shahar Arzy[1,2], Olaf Blanke[1,3]; [1]Brain Mind Institute, Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [2]Hadassah Hebrew University Hospital, Jerusalem, Israel, [3]University Hospital, Geneva, Switzerland* – Introduction: The human mind is continuously involved in processing of past memories and prediction of future occurrences, a cogitation that has been called "mental time travel" (MTT). Recently, we demonstrated that MTT involve egocentric perspective taking to past, present or future time-points (absolute-MTT) and independently, future orientation in each time-point (relative-MTT), activating a network consisting mainly of antero-medial temporal and occipito temporal cortex. Methods: We used a novel cognitive paradigm employing concepts from memory research, mental imagery and self-processing to investigate MTT. This paradigm asks subjects to change their egocentric perspective in time to Past, Now or Future and only then to memorize or predict events. We used behavioural measures in two neurological patients before and after having a lesion in the antero-medial temporal and occipito temporal cortex. We also recorded intacranially local field potentials during task performance. Results: Damage to middle-temporal or occipito-temporal cortex does not impair MTT to past and future (absolute-MTT) but causes moderate memory deficits and disrupts future orientation (relative-MTT). These deficits were detected only with lesion presence. Brain activation related to MTT also differentiated between absolute-MTT (found in electrodes at the right temporoparietal junction) and relative-MTT (found at the right occipitotemporal cortex). Conclusions: MTT is composed from two independent components: absolute-MTT (to different time-points) and relative-MTT orientation (in each time-point). MTT and self-processing in time were found to be disentangled, at least partially, from memory function. MTT is more robustly associated with future forecasting than past recollection, relying on activations of middle-temporal and occipito-temporal cortices.

C71

MESOLIMBIC REGIONS ARE DIFFERENTIALLY SENSITIVE TO MAGNITUDE AND DELAY IN A DELAY-DISCOUNTING TASK *Kacey Ballard[1], Brian Knutson[1]; [1]Stanford University, Stanford, CA* – "Delay discounting" refers to a phenomenon in which individuals discount the value of delayed gains relative to immediate gains. Prior functional magnetic resonance imaging (fMRI) studies have documented greater mesolimbic activation when people consider choices involving immediate gains versus delayed gains (McClure et al, 2004) and have also related mesolimbic activation to individual differences in valuing delayed gains (Kable & Glimcher, 2007). However, researchers have not yet determined how mesolimbic activation represents the magnitude and delay of gains, and whether this activation can be used to predict individuals' preferences for delayed versus immediate outcomes. We scanned 16 subjects (8 female) with FMRI (GE 1.5 T scanner, voxel size = 4 mm cubic, TR = 2000 msec, spiral in/out pulse sequence) as they engaged in a delay-discounting task. A novel temporally distributed task design separated presentation of information related to the immediate gain, magnitude of the delayed gain, delay of the delayed gain, and choice. Findings indicated that magnitude of the delayed gain elicited proportional activation in nucleus accumbens (NAcc), medial prefrontal cortex (MPFC), and anterior and posterior cingulate, while delay of the delayed gain elicited proportional activation only in MPFC and posterior cingulate. Logistic regression analyses further indicated that NAcc activation in response to magnitude and MPFC and cingulate activation in response to delay predicted choice of the delayed gain. These findings suggest that activation in different mesolimbic regions is differentially sensitive to magnitude versus delay information and can be used to predict choice of delayed versus immediate gains.

C72

DECISION MAKING IN APPROACH AVOIDANCE CONFLICTS *Ulrike Basten[1], Guido Biele[2], Christoph Stippich[1], Hauke R. Heekeren[2], Christian J. Fiebach[1]; [1]University of Heidelberg, Germany, [2]Max Planck Institute for Human Development, Berlin, Germany* – In many decision making situations available options are associated with both costs and benefits. To resolve the conflict between the resulting approach and avoidance-related behavioral tendencies, costs and benefits need to be integrated to assess the overall value of an option. Here, we determined the neural processes associated with this integration by identifying brain regions whose activity covaries with the difficulty of the required integration. Twelve subjects were trained to associate characteristics of a stimulus (color, shape) with financial consequences (gain, loss). In a subsequent fMRI study, participants decided to either accept or reject the financial consequences of three types of stimuli offered: pure gain, pure loss, or a combination of different amounts of gain and loss. Comparing pure gain and loss trials with integrative trials showed that decisions about pure outcomes activated the ventromedial and anteromedial prefrontal cortex (PFC) stronger, whereas decisions about combined outcomes activated medial (pre-SMA) and dorsolateral PFC. Decision difficulty, determined by the difference between gain and loss associated with a stimulus, modulated response times and brain activation independent of the absolute gain or loss magnitude and behavioral choice. The more difficult the integrative decision was, the more activation was observed in medial and lateral prefrontal performance monitoring regions. In contrast, the easier an integrative decision was, the stronger were the activations in the anteromedial and ventromedial PFC. Weighing the costs against the benefits of behavioral options, thus, relies on the integrated processing of prefrontal performance monitoring systems and ventromedial PFC representing reward value.

C73

THE CHRONO-ARCHITECTURE OF LOVE REVEALED BY HIGH-DENSITY ELECTRICAL NEUROIMAGING *Francesco Bianchi-Demicheli[1], Stephanie Ortigue[2], Scott Grafton[2]; [1]University Hospital of Geneva, Switzerland, [2]UCSB Brain Imaging Center, Sage Center for the Study of the Mind* – Recent brain imaging of love suggest the recruitment of a distributed subcortico-cortical reward, motivation, emotion system as well as higher-cognitive brain areas, in particular the angular gyrus. However, little is known about the time course by which this cascade of brain activations occurs during love processing. We assessed this question in 20 participants in high (N=10) and low (N=10) passionate love, using high-density event-related potentials while participants were performing a standard lexical decision task embedded in a subliminal affective priming paradigm with a beloved's and a neutral's name as primes, and non-words and positive emotional words as targets (Bianchi-Demicheli et al., 2006). The reaction time (RT) results confirmed an affective priming effect, with faster responses to affectively congruent trials (love prime-target pairs; 623ms +/-12.9) than affectively incongruent trials (neutral prime-target pairs; 698ms +/-29.3) in participants in high passionate love only. A delayed N400 for word prime-target pairs matched the RT results with larger negative amplitudes for affectively incongruent than congruent pairs pattern (p< 0.05). Importantly, distinct scalp topographies were also observed earlier (i.e., over the 80-120ms, and 120-220ms periods) between participants in high versus low passionate love. A distributed linear source estimation (LAURA) of this time progression suggested a recruitment of a distributed neural network over time, notably an activation of the angular gyrus followed by the fusiform gyrus in the early steps of love processing. Thus these data shed some lights on the chrono-architecture of love, as a subliminal prime, at a very early processing stage.

C74

DYNAMICS OF CONDITIONAL INFERENCE AND TOP DOWN EFFECTS : A MEG STUDY *Mathilde Bonnefond[1], Anne Cheylus[1], Claude Delpuech[2], Françoise Leçaignard[2], Olivier Bertrand[3], Ira Noveck[1], Jean-Baptiste Van der Henst[1]; [1]CNRS Université de Lyon, [2]CERMEP, [3]Inserm U 821* – Conditional reasoning occurs when a minor premise (A) is integrated to a major conditional premise (If A then B) to produce a conclusion (B). This magnetoencephalography study aims to investigate the dynamics of premises and conclusion integration in reasoning with a specifically designed paradigm. Each trial consisted of a major premise such as If there is a square then there is a low sound followed by a visual stimulus (minor premise) and an auditory one (conclusion). The minor premise could match (Inferential Condition, IC) or not (Non Inferential Condition, NIC) the antecedent of the major premise. We conducted an Evoked Field analysis and a source estimation on these data. The VIC, as compared to a control condition, shows a M400 component followed by a M450 component and by slow components from 550ms to the presentation of the sound. According to preliminary results on source estimation, the latter component originates from the auditory cortex. The NIC shows a M315 which seems to originate from the anterior cingular cortex, known to be involved in conflict monitoring. Three conclusions can be drawn from these results. First, the conflict effect arising when premises mismatch indicates that the major premise elicits expectations about the subsequent premise. Second, the presentation of second premise, granted that it matches the antecedent of the major premise, generates two components: M400 (integration) and M450 (encoding of the conclusion). Third, the activation of the auditory cortex following the integration of the two premises indicates expectations regarding the conclusion.

C75

THETA BURST STIMULATION OF INFERIOR FRONTAL GYRUS DISRUPTS AUTOMATIC IMITATION OF FINGER MOVEMENTS *Caroline Catmur[1,2], Vincent Walsh[1,2], Cecilia Heyes[1]; [1]University College London, [2]Institute of Cognitive Neuroscience, University College London* – In order to imitate an action, the imitator must solve the "correspondence problem" (Brass and Heyes, 2005) to establish which set of motor commands to their own muscles will produce an outcome that visually matches the imitated action. Both behavioral and neurophysiological evidence (Stürmer et al., 2000; Fadiga et al., 1995) suggest that solving the correspondence problem is a process which occurs without intentional control, and thus that observed movements are imitated automatically. This is thought to be as a result of previous sensorimotor experience (Heyes et al., 2005; Catmur et al., 2007). It has been hypothesized that automatic imitation involves "mirror neurons" located in the inferior frontal gyrus (by homology with monkey area F5; di Pellegrino et al., 1992; Rizzolatti et al., 1996), but it has not yet been shown that this brain area is necessary for automatic imitation (i.e. imitation not under intentional control). We used theta burst transcranial magnetic stimulation (Huang et al., 2005) to disrupt processing in the inferior frontal gyrus during a behavioral automatic imitation task. In baseline and control site conditions, participants showed automatic imitation of task-irrelevant finger movements: reaction times to perform finger movements in response to an imperative stimulus were faster when a compatible finger movement accompanied the imperative stimulus than when an incompatible finger movement accompanied it. Following theta burst stimulation to inferior frontal gyrus, this automatic imitation effect was abolished. This suggests that the inferior frontal gyrus is required for automatic imitation of movements.

C76

CORPUS CALLUSOM CONTRIBUTIONS TO CREATIVITY: A DIFFUSION TENSOR IMAGING STUDY *Robert Chavez[1,2], Arvind Caprihan[1], Rebecca England[2], Shirley Smith[1,2], Judith Segall[1], Ranee Barrow[1], Rex Jung[1,2,3]; [1]The MIND Research Network, [2]University of New Mexico* – A broadly accepted definition of creativity refers to the production of something both novel and useful within a given social context (Flaherty, 2005). Neuroimaging studies of creativity are sparse, and none have specifically looked at the contribution of the corpus callosum (CC), linking the two hemispheres. Indeed, given the "left brain – right brain" dichotomy underlying popular conceptions of creativity, extending to the work of Gazzaniga, inquiries regarding the hemispheric connectivity underlying creativity are warranted. We hypothesized that measures of CC volume and diffusivity (obtained from Diffusion Tensor Imaging) would relate to measures of "divergent" reasoning (i.e., Alternate Uses Test, Free Drawing, Four Line Drawing) central to creativity. MRI and creativity measures were obtained in a cohort of 50 neurologically and psychiatrically normal subjects (24 males, 26 females) ranging in age from 18 to 39. Independent judges ranked the creative products of each subject, with high inter-rater reliability (ICC = .84 - .95), from which a "Composite Creativity Index" (CCI) was compiled. We used the Frahm method (2006) to segment the CC into five discrete regions. We found that a model that included volume and mean diffusivity of the anterior midbody of the CC predicted performance on the CCI (F= 8.16, p= .001, R2= .26). Interestingly, volume was negatively (r= -.41) and MD was positively (r= .11) correlated with CCI. To our knowledge, this is the first report assessing the relationship between CC macro- and micro-structural morphology and creativity in a cohort comprised exclusively of normal, healthy subjects.

C77

NEURAL BASIS OF INDIVIDUALISTIC AND COLLECTIVISTIC VIEWS OF SELF *Joan Chiao[1], Tokiko Harada[1], Hidetsugu Komeda[2], Zhang Li[1], Yoko Mano[2], Daisuke Saito[2], Norihiro Sadato[2], Tetsuya Iidaka[3]; [1]Northwestern University, [2]National Institute for Physiological Sciences, [3]Nagoya University* – Individualism and collectivism refer to a fundamental psychological dimension often used to explain differences in how individuals from Western and Eastern cultures construe themselves and their relation to the world. Individualists perceive themselves as stable entities, autonomous from other people and their environment, while collectivists view themselves as dynamic entities, continually defined by their social context and relationships. Using cross-cultural neuroimaging, we investigated whether neural processing during self judgments varies as a function of individualism and collectivism. Results demonstrate that neural activity within ventromedial prefrontal cortex during self judgments positively predicts how individualistic or collectivistic a person is across cultures.

C78

SELF RESPONSES ALONG CINGULATE CORTEX REVEAL QUANTITATIVE NEURAL PHENOTYPE FOR HIGH FUNCTIONING AUTISM

Pearl Chiu[1,2,3], Amin Kayali[1,2], Ken Kishida[1,2], Damon Tomlin[1,2], Laura Klinger[4], Mark Klinger[4], Read Montague[1,2,3]; [1]Baylor College of Medicine, [2]Department of Neuroscience, [3]Department of Psychiatry, [4]University of Alabama Tuscaloosa – Attributing behavioral outcomes correctly to oneself or to other agents is essential for all productive social exchange. We have approached this issue in high-functioning males with autism spectrum disorder (ASD) using two separate fMRI paradigms. First, using a visual imagery task, we extract a basis set for responses along cingulate cortex of control subjects that reveals an agent-specific eigenvector (self eigenmode) associated with imagining oneself executing a specific motor act. Second, we show that the same self eigenmode arises during one's own decision (the self phase) in an interpersonal exchange game (iterated trust game). Third, using the same exchange game, we show that ASD males exhibit a severely diminished self eigenmode when playing the game with a human partner. This diminished response covaries parametrically with their behaviorally assessed symptom severity suggesting its value as an objective endophenotype. These findings may provide a quantitative assessment tool for high functioning ASD.

C79

ANTICIPATORY SKIN CONDUCTANCE RESPONSES IN CATEGORY LEARNING: DECISIONAL UNCERTAINTY OR SOMATIC MARKERS?

Tyler Davis[1], Bradley Love[1], W. Todd Maddox[1]; [1]University of Texas at Austing – One of the more intriguing findings supporting the Somatic Marker Hypothesis (SMH; Damasio, Tranel & Damasio, 1991) is the presence of anticipatory skin conductance responses (SCR's) in normal subjects prior to their making risky decisions. The favored interpretation of these SCR's by proponents of the SMH is that they play a critical role in drawing subjects toward making advantageous decisions, and reflect the influence of emotion on everyday decision making. We offer another interpretation, motivated by findings demonstrating that these SCR's arise due to variability in outcome. This suggests that these SCR's may be orienting responses that reflect decisional uncertainty, and as such are likely involved in learning difficult stimulus-outcome contingencies. We provide support for this account by using a rule-plus-exception category learning task (Palmeri & Nosofsky, 1995), which contains exceptions that are difficult to learn, and therefore subjects' decisions to treat an item as an exception are made under uncertainty. The results show that anticipatory responding is higher on trials in which subjects decide to treat items as exceptions by reversing the category rule (i.e., correct trials for exception items and incorrect trials for rule-following items) then on trials in which they are treated as rule following items. These results are inconsistent with the SMH, because rather than being implicit processes locked to a particular stimulus (i.e., the exceptions), they reflect cognitive processes related to making a type of decision. In addition, we show that this pattern of orienting toward uncertain decisions is predictive of learning in the task.

C80

NEURAL BASIS OF HYPNOTIZABILITY REVEALED BY RESTING STATE FUNCTIONAL CONNECTIVITY AND DIFFUSION TENSOR FIBER-TRACKING

Emily Dennis[1,2], John Gabrieli[3], Susan Whitfield-Gabrieli[3], Brian Haas[1], David Spiegel[4], Fumiko Hoeft[1]; [1]Center for Interdisciplinary Brain Sciences Research, (CIBSR), Stanford University School of Medicine, [2]Whitman College, [3]Brain and Cognitive Sciences, MIT, [4]Stanford University School of Medicine – Hypnosis is a form of attentive receptive concentration that allows one to meaningfully alter perception and experience of the environment. While hypnotic induction and suggestion modulate activity in brain regions associated with the cognitive processes being manipulated (e.g. pain), the neural mechanism of hypnotizability itself remains unknown. We performed functional magnetic resonance imaging (fMRI) during resting state, diffusion tensor imaging for fiber-tracking and high resolution structural MRI to examine voxel-based morphometry (VBM) of gray and white matter in 12 highly hypnotizable participants (HIGH) and 12 low hypnotizable participants (LOW). The HIGH group showed increased salience network functional connectivity in the dorsal anterior cingulate cortex (dACC) and the left dorsolateral prefrontal cortex (DLPFC) as compared to the LOW group. Whole-brain Cohen's d map showed large effect size in the left DLPFC and dACC when comparing HIGH and LOW groups. While examining the fiber-tracts of the ACC, we found that the HIGH group but not the LOW group showed significant positive correlation with Hypnotic Induction Profile scores and white matter integrity. These findings were not due to morphometric differences in regional gray and white matter volumes between the HIGH and LOW groups. The results suggest that connectivity of these prefrontal regions underlie hypnotizability, consistent with the role of executive attention and dopamine function in hypnotizability. ACKNOWLEDGMENT This study was supported by grants from the Nissan Research Center.

C81

SPACE MATTERS: EVIDENCES FROM MONTH-FORM SYNAESTHESIA

Liana Diesendruck[2], Limor Gertner[1], Liat Goldfarb[3], Lior Botzer[2], Avishai Henik[1]; [1]Zlotowski Center of Neuroscience, Ben Gurion University of the Negev, Israel, [2]Ben Gurion University of the Negev, Israel, [3]Center for the Study of Brain, Mind, and Behavior, Princeton University, Princeton, New Jersey – Month-form synesthetes experience months as unique sequence patterns in spatially defined locations, such as circles or ellipses. Among month-form synesthetes months automatically trigger a shift of attention to specific spatial locations (Smilek et al., 2006). The aim of this study was to test this condition through the generation of a scene that simulates the synesthete experience in the most tangible way. Two month-form synesthetes and 5 controls performed a Stroop-like task using a combined haptics and virtual reality system. In the experiment, a circle and a word were simultaneously presented. The word consisted either of a month name or a direction name (e.g., down, right) and was located at the center of the screen, while the circle was displayed in one of four peripheral positions − right, left, top or bottom. When the synesthetes were asked to ignore the word and reach for the circle, no effects were found. In contrast, when told to ignore the circle and reach for a location indicated by the word, a congruency effect was found for both months and directions. That is, synesthetes were faster when the word was congruent with the location indicated by the circle than when the two dimensions were incongruent. In order to examine actual movement and not only reaction time, the participants' initial hand velocity and path angle deviation were also analyzed. Our findings suggest that month-form synesthesia is a genuinely experienced phenomenon, as months elicit spatial locations in a similar manner as directions do.

C82

INSTRUCTIONAL CONTROL OF PROBABILITY LEARNING: A NEURAL NETWORK ACCOUNT

Bradley Doll[1], Michael J. Frank[1], W. Jake Jacobs[1], Alan G. Sanfey[1]; [1]University of Arizona, Cognition and Neural Systems – Subjects chose probabilistically rewarded stimuli from three pairs. A test phase followed in which they chose from novel pairings of the same stimuli without feedback. Those who were misinformed about the probabilistic contingencies in the task before training tended to choose in accordance with the inaccurate instructions in the training and test phases, despite the repeated negative feedback that resulted from such choices. Evidence suggests the striatum is the neural substrate of accurate learning of the standard version of this task. We augment a neural network model of the striatum (Frank 2004) to provide two alternative accounts of this effect: 1. Inaccurate instruction representations in the prefrontal cortex incorrectly train the striatum 2. The striatum learns the correct contingencies, but output is overridden by the instruction representations in the prefrontal cortex.

C83

EFFECTS OF A POINTING RESPONSE MEASURE ON THE NEURAL SUBSTRATE OF IMAGINED SELF-ROTATIONS *Catherine Flynn[1], Maryjane Wraga[1]; [1]Smith College* – Previous behavioral suggests that pointing response measures serve to "anchor" observers to their physical body during spatial reasoning tasks (Wraga, 2003). The corollary to this hypothesis is that tasks involving pointing response measures may engage motor and spatial areas of the brain more readily than those that do not. In this study we directly compared activation found in two imagined self rotation tasks, using verbal and pointing responses. For the verbal task, participants viewed images of 3D objects situated within a sphere. They then imagined rotating themselves to a cue outside of the sphere, and judged whether a textured portion of the object would be visible from the imagined viewpoint. The button presses in this task indicated "yes" and "no." In the pointing task, participants imagined rotating to the external cue and then "pointed" to the location of the textured cube by pressing button keys depicting "left" and "right" arrows. A direct comparison of neural activation in both task revealed distinct neural signatures. The Verbal - Pointing contrast yielded activation in medial temporal gyrus (BA 21) and medial frontal gyrus (BA 8). We also found activation in the parahippocampus (BA 28), which increased as a function of rotation magnitude. In contrast, the Pointing - Verbal contrast revealed activation in visual areas (BA 18) and Premotor Area (PMA: BA6), and several spatial processing areas (BAs 7, 40) that increased with rotation magnitude. These findings support the hypothesis that pointing responses have an anchoring effect on spatial reasoning tasks.

C84

ROLE OF THE BASAL GANGLIA IN WEIGHTING SPEED VERSUS ACCURACY: EMPIRICAL DATA AND A FORMAL MODEL *Birte U. Forstmann[1], Gilles Dutilh[1], Jane Neumann[2], K. Richard Ridderinkhof[1], Scott Brown[3], Eric-Jan Wagenmakers[1]; [1]University of Amsterdam, [2]Max Planck Institute for Human Cognitive and Brain Sciences, [3]University of Newcastle* – Regardless of whether people are shopping, playing basketball, or participating in an elementary cognitive experiment, they always have to strike a balance between making fast but error-prone decisions versus slow but accurate decisions. In other words, people continuously need to decide when to stop deliberating and execute a response, with the associated risk of committing an error. Here we used functional MRI to determine the neural correlates of this so-called speed-accuracy trade-off. In a cuing version of the moving-dots paradigm, participants were motivated to pay attention mainly to speed, mainly to accuracy, or both. We also used the Ratcliff diffusion model to inform the fMRI data analysis and to confirm that the experimental manipulation selectively affected the setting of response thresholds. The Ratcliff diffusion model is one of the most successful models for two-choice reaction time tasks (Ratcliff & Smith, 2004). The behavioral data and the model analysis showed that the manipulation had the intended effect. The imaging data showed that presentation of a cue for speed was associated with a focused activation of the basal ganglia. This result strongly suggests that the basal ganglia play a key role in the regulation of the speed-accuracy trade-off. This empirical finding is consistent with formal neural models of speeded decision making that have anticipated the basal ganglia to be involved in the setting of response thresholds.

C85

MUSICAL METRIC INTERPRETATION MODULATES THE AUDITORY EVOKED MAGNETIC RESPONSE *Takako Fujioka[1], Benjamin Zendel[1], Bernhard Ross[1]; [1]Rotman Research Institute, Baycrest, University of Toronto* – In music, time can be parsed in two ways, via rhythm and meter; both which are relevant to auditory-motor synchronization. Rhythm describes the temporal pattern of a series of auditory events, while meter is an interpretation of that pattern into a global structure of strong and weak accents. Thus, identical rhythmic patterns (e.g., regular beats) can be interpreted in different meters (e.g., 2-beat or 3-beat). The current study investigated how metrical structure influences brain activity, and related performance on an auditory-motor synchronization task. Magnetic brain activity was recorded via 151-channel MEG from expert musicians while they tapped to a metronome-like auditory click stimuli with their right index finger. In one condition subjects tapped to every second click (2-beat), and in the other, to every third click (3-beat), thereby manipulating meter without altering the stimulus or rhythm. In both conditions tapping periods alternated with resting periods every twelve clicks, forcing subjects to maintain the imposed metric structure without tapping. Behavioral findings indicate smaller asynchrony between tap and click in the 2-beat condition compared to the 3-beat condition. Auditory evoked magnetic-fields were separately averaged for clicks that represented strong and weak accents during resting. Equivalent current dipoles were estimated for the peak around 80ms in bilateral auditory cortices. The peak amplitude was larger, and occurred later in the 3-beat condition. Moreover, the peak was smaller to the clicks for the strong accent regardless of meter. These findings suggest that metric interpretation has a top-down effect on auditory processing.

C86

NEURAL BASIS OF SOCIAL PERCEPTION OF A HUMAN VERSUS VIRTUAL HUMAN *Jessica Gayda[1], Andrea Tartaro[2], Zhang Li[1], Justine Cassell[2], Joan Chiao[1,3]; [1]Northwestern University, [2]Center for Technology and Social Behavior, Northwestern University, [3]Institute for Neuroscience, Northwestern University* – Are virtual humans socially understood as human? To investigate this question, we used functional magnetic resonance imaging (fMRI) to measure the neural correlates of perception and social evaluation of two types of agents: an Embodied Conversational Agent (ECA or virtual human) and a real human. Fourteen participants viewed static images of both the human and ECA, rated each image for emotional valence, and completed a post-scan survey on social impressions of the two agents. No significant differences were found in behavioral measures of rating or reaction time, although the real human was rated as more socially relatable in three dimensions. Viewing either kind of agent relative to rest elicited neural activity in a network of brain regions previously associated with social judgments, including left superior temporal sulcus and right fusiform gyrus. Viewing the ECA relative to human resulted in increased activation in superior temporal sulcus, anterior cingulate gyrus, left precuneus, right angular gyrus, and left inferior frontal gyrus, areas associated with social perception, attention, and cognitive control. The condition of human relative to ECA revealed no areas of significant activation. Interestingly, this finding stands in contrast to previous research which suggests passive viewing of humans but not virtual humans elicits greater neural activation in regions associated with social judgment and mentalizing. Our results suggest that while accurate social judgments can be made of either real humans or virtual humans, it appears the latter might require heightened cognitive processing, perhaps because of the novelty and unfamiliarity of virtual humans.

C87

THE IMPACT OF COGNITIVE RESERVE ON COGNITIVE FUNCTIONING OF RETIRED PERSON *Sophie Germain[1], Thierry Meulemans[1], Fabienne Collette[1]; [1]University of Liège, Neuropsychology Unit* – The cognitive reserve concept postulates that some life experiences (such as leisure activities or occupational experience) permit the constitution of a "reserve" which could delayed the manifestation of the cognitive decline appearing during normal aging (Stern, 2002). For example, some studies (e.g., Hultsch et al., 1999) have shown a correlation between the level of participation in intellectual activities and the cognitive functioning in the elderly. During adulthood, retirement is a critical period (because of deep modifications of daily-living habits) during which some people demonstrate a more important cognitive decline than others. A plausible explanation of this discrepancy is the importance of their cognitive reserve. In this study, we have explored the link between the level of cognitive reserve, measured by the engagement level in occupational activities during adulthood, and the cognitive functioning three years after retirement. Our hypothesis was that elderly people who were engaged in more activities should show a better cognitive functioning than people with a lower activity level. In order to test this hypothesis, we have administered to 40 elderly subjects, retired for 3 years, an activity questionnaire and a neuropsychological test battery, exploring memory, attention and executive functioning. Stepwise regression analyses demonstrated that several activities (such as social, physical, domestic, and leisure activities) are significant explicative variables of cognitive functioning in retired people. These results highlight the importance of being active in order to delay the manifestation of the cognitive decline during aging.

C88

FRIEND OR FOE: ALPRAZOLAM'S EFFECTS ON COOPERATION? *Joshua Gowin[1], Scott Lane[1]; [1]University of Texas Health Science Center* – Social interaction and cooperation can be modified by changes in both social context and the neurobiological state of the individual. One example of neurobiological modulation is the acute effect of drugs, which can alter patterns of social behavior. The benzodiazepine alprazolam is a widely used prescription drug typically taken to relieve anxiety. However, epidemiological data indicate that misuse of alprazolam (and other benzodiazepines) may produce an increase in maladaptive social behavior, e.g., sexual assault and violence. We investigated the acute effects of alprazolam on human social behavior under controlled laboratory conditions using a well-known game theory model of social interaction known as the prisoner's dilemma. Nine healthy adults received doses of placebo, 0.5, 1.0, and 2.0 mg alprazolam in counterbalanced within-subject design. Our data suggest that alprazolam can in fact engender behavior that is self-serving and less cooperative. Our findings indicate that the alprazolam decreases social cooperation in a dose-dependant manner.

C89

NEURAL CORRELATES OF CREATIVITY IN REASONING *Adam Green[1], David Kraemer[2], Jonathan Fugelsang[3], Jeremy Gray[1], Kevin Dunbar[4]; [1]Yale University, [2]University of Pennsylvania, [3]University of Waterloo, [4]University of Toronto* – The best ideas are not only creative; they are also well reasoned. Brain function at the intersection of reasoning and creativity, however, has been understudied. Brain-imaging studies of reasoning have not examined creative demand as a parameter. Likewise, creativity research has focused on generation of creative ideas outside the constraints of formal reasoning tasks. Thus, critical questions remain regarding the generation of ideas that are not only creative in the sense of being divergent, but are also useful in the sense of providing appropriate solutions to problems. Here, during fMRI, we constrained creative generation within the context of an analogical reasoning task in order to test two hypotheses: 1) The parameter of creative demand in reasoning will positively modulate activity in an a priori region of left frontopolar cortex, which we have implicated in previous investigations, and 2) The generative component of analogical reasoning – as compared to evaluation of analogies – will be associated with increased demand for hypothesis generation and selection. Results supported both hypotheses. Analogies rated as more creative elicited parametrically increasing recruitment within the predicted ROI. In addition, the analogy generation task preferentially recruited areas of right prefrontal cortex implicated in previous studies of hypothesis generation and selection. These data support an emerging picture of left frontopolar cortex as a mediator of creativity in reasoning. Additionally, these findings provide a new elucidation of how analogical thinking is used to solve problems because they represent a first account of the neural basis of generation in analogical reasoning.

C90

CULTURE-INVARIANT AND CULTURE-SENSITIVE NEURAL SUBSTRATES OF CAUSAL COGNITION: NEUROIMAGING OF FOUR CULTURES *Shihui Han[1]; [1]Peking University, Beijing* – Humans from different cultures make similar inference of cause-effect relationship when observing object interactions determined by universal physical laws. However, whether identical neural processes are recruited in causality judgment of physical events in brains cultivated in distinct cultures remains unknown. To investigate this, we imaged Chinese, American, German, and Korean subjects, using functional magnetic resonance imaging, who judged causes of object movement changes. We show that causality judgments activated a neural network consisting of culture-invariant components (e.g., the medial prefrontal cortex) and culture-sensitive components (e.g., the left parietal cortex). We further demonstrate that the medial prefrontal activation underpins the process of inference reasoning whereas the left parietal activation mediates the context processing involved in causality judgments. Our findings provide neural basis for understanding cultural uniformity and variation in causal attribution of the physical world.

C91

DISSOCIATING GOAL VALUES, DECISION VALUES, AND PREDICTION ERRORS IN THE HUMAN BRAIN *Todd Hare[1], John O'Doherty[1], Colin Camerer[1], Wolfram Schultz[2], Antonio Rangel[1]; [1]California Institute of Technology, [2]University of Cambridge* – In order to make sound decisions, the brain needs to carry out several value related computations. Among them are the computation of goal values, decision values, and prediction errors. Goal values measure the predicted reward that will be obtained from the outcomes associated with the actions under consideration. Decision values measure the net value of taking the different actions (i.e, the benefits minus costs) and are critical for making decisions. Prediction errors measure the change in the individual's overall reward level and are used to improve future computations of goal values. In this study, we use fMRI and a novel decision-making paradigm to dissociate the neural basis of these three computations. Our results suggest that they are supported by different neural substrates: goal values where correlated with activity in medial orbitofrontal cortex, decision values where reflected by activity in central orbitofrontal cortex, and prediction errors are expressed in ventral striatum. Our results also suggest that the standard view that activity in the ventral striatum encodes for goal values is mistaken – this activity is related to prediction error signals that in most experimental paradigms are confounded with goal values.

C92

NEURAL CORRELATES OF REWARD-RELATED SELF-DELUSION *Trey Hedden[1], Drazen Prelec[1], Danica Mijovic-Prelec[1], John D. E. Gabrieli[1]; [1]Massachusetts Institute of Technology* – Cognitive control and reward processing were hypothesized to interact to determine behavior in an economic context. To investigate this, participants (20 young adults) viewed abstract figures prior to scanning, classifying each as possessing a male or female quality. Participants received a small reward for classifications that matched the majority response of a reference sample. During a subsequent functional MRI scan, participants viewed the abstract figures again. Before each figure was presented, participants predicted the gender of the upcoming figure. If participants were better than average in their predictions, they received a large reward. When the figure was presented, participants made a second gender classification, again receiving a small reward for matching the reference sample response. This dual reward structure led the majority of participants to experience cognitive conflict. Ideally, participants should ignore their prediction and attempt to receive the small classification reward on each trial. However, for stimuli on which their prediction did not match their prior classification, participants may be influenced by a desire for the large prediction-related reward, leading them to change their second classification to be consistent with the prediction. We refer to this alteration to conform to the prediction as "reward-related self-delusion". Large individual differences were observed in the extent of reward-related self-delusion. Functional MRI revealed neural correlates of reward-related self-delusion associated with the extent of self-delusion behavior across participants. These regions were localized to reward areas, including ventral striatum and medial orbitofrontal cortex, and to cognitive control regions, including dorsolateral prefrontal cortex.

C93

DOES THE VENTROMEDIAL PREFRONTAL CORTEX REPRESENT IMPLICIT SOCIAL KNOWLEDGE, STIMULUS VALENCE, OR SOME COMBINATION OF THE TWO? IMPLICIT ASSOCIATION TEST (IAT) EFFECTS AFTER VENTROMEDIAL PREFRONTAL DAMAGE *Alexandre Henri-Bhargava[1], Andrea S. Heberlein[2], Katie Lancaster[2], Mahzarin R. Banaji[2], Lesley K. Fellows[1]; [1]McGill University, Montréal, Canada, [2]Harvard University, Cambridge* – The implicit association test (IAT) is a sensitive measure of implicit cognitive associations, and has been widely used in social psychology to study prejudices and stereotypes. A previous study purported to find a reduction of the IAT effect in patients with damage to the ventromedial prefrontal cortex (VMF) performing an IAT of valenced (or evaluative) gender stereotypes. It was hypothesized that damage to VMF degraded implicit social knowledge representations. Other research argues that VMF plays an important role in flexibly tracking the value of stimuli in non-social contexts, or of responding to breaches of expectation quite generally. This raises the question of whether this region of the cortex is critical in representing valenced social associations in particular, valenced associations in general, social knowledge independent of valence, or implicit cognitive associations of any kind. We addressed this question by administering eleven computer-based IATs to patients with VMF damage and control subjects, probing four categories of implicit associations: social and valenced, non-social and valenced, social and non-valenced, and non-social and non-valenced. Preliminary data from two patients with VMF damage suggest that even extensive bilateral VMF damage does not necessarily result in consistent loss of the IAT effect in any of these categories. The IAT likely captures several underlying processes. This design allows us to characterize these processes, and determine which, if any, rely critically on ventromedial prefrontal cortex.

C94

NEUROTICISM PREDICTS NEURAL RESPONSE TO UNCERTAINTY *Jacob B. Hirsh[1], Michael Inzlicht[1]; [1]University of Toronto* – Individuals differ in the extent to which they respond negatively to uncertainty. While some individuals feel little discomfort when facing the unknown, others find it aversive. The current study examined neurophysiological responses to uncertainty using the event-related potential (ERP) technique. We used electroencephalography recordings to monitor the neural activity of 36 participants while they completed a time-estimation task. Specifically, we looked at the feedback-related negativity (FRN), an ERP component that peaks approximately 250 ms after the receipt of feedback information, and is thought to reflect the negative evaluation of self-relevant information. We examined the FRN at midline electrode locations following positive, negative, and uncertain feedback. The magnitude of these responses was then analyzed in relation to individual differences in the personality trait of Neuroticism. As expected, a larger FRN was observed after negative feedback than after positive feedback for all participants, replicating the standard FRN effect. For individuals who scored highly on trait Neuroticism, however, uncertain feedback produced a larger neural response than did negative feedback. The FRN in response to uncertain feedback was significantly predicted by Neuroticism at both Cz ($B = -.45$, $p < .01$) and Fz ($B = -.55$, $p < .01$) electrode locations. Highly neurotic individuals thus appear to have a stronger aversive reaction to uncertainty than to clearly negative information.

C95

THE EFFECT OF EMOTIONAL CONVERSATION ON VISUAL DETECTION DURING SIMULATED DRIVING: AN ERP STUDY *Li Hsieh[1], Sean Seaman[1], Richard Young[2]; [1]Wayne State University, [2]School of Medicine, Wayne State University* – We used behavioral, event-related potential (ERP) and other measures to assess performance and physiological differences among three conditions of multitasking situations: driving without cellular conversations, driving with cellular conversations spoken in a neutral tone, driving with cellular conversations spoken in an angry tone. We employed a validated event-detection paradigm with lane-tracking to measure driving performance. 20 participants viewed a video recording of a driving scene while using a foot pedal to respond to visual events occurring in the periphery of the display. Lane-tracking, using a steering wheel, was employed to ensure participants were engaged with the video recording. RTs to visual events were recorded, while ERPs of individual brain activations were averaged on these events. Behavioral analyses based on 20 subjects showed that the conversation conditions had slightly longer RTs than the driving only condition. In addition, the emotional tone of the conversation seems to moderate the changes in RTs; events occurring during angry conversations were responded to significantly faster than events occurring during neutral conversations, and were only marginally slower than events occurring in driving only condition. Preliminary ERP analysis confirms this distinction between events occurring during angry and neutral events. N200 and P300 with the amplitude with a minimum of 5 μV were found in the visual detection during angry and neural conversations in the anterior and posterior cortical locations, respectively. Implications for theories of multitasking and emotional modulation of visual processing are discussed.

C96

BIOCHEMICAL CORRELATES OF CREATIVITY *Rex Jung[1,2], Ranee Barrow[1], Robert Chavez[2], Shirley Smith[2], Chuck Gaspoarovic[1]; [1]The MIND Research Network, [2]University of New Mexico* – A broadly accepted definition of creativity refers to the production of something both novel and useful within a given social context (Flaherty, 2005). Neuroimaging studies of the construct of creativity are sparse in the research literature, and largely focus on frontal and temporal lobe contributions, based on studies of patients with neurological and psychiatric disorders. We hypothesized that measures of N-acetylaspartate (NAA) obtained within superventricular white and gray matter regions would relate to measures of "divergent" reasoning (i.e., Alternate Uses Test, Free Drawing, Four Line Drawing) central to creativity. MRI and creativity measures were obtained in a cohort of 64 neurologically and psychiatrically normal subjects (34 males, 30 females) ranging in age from 18 to 39. Independent judges ranked the creative products of each subject, with high inter-rater reliability (ICC = .84 - .95), from which a “Composite Creativity Index" CCI was compiled. Using Gasparovic (2006) convolution of segmented images with the spectroscopic image point spread function, estimates of metabolite concentrations was evaluated in gray and white matter quadrants (left/right; anterior/posterior). We found that a model that included right and left anterior NAA was inversely related to the CCI ($F = 6.42$, $p = .003$, $R2 = .20$), and that this relationship was substantially stronger in males ($R2 = .19$) as compared to females ($R2 = .00$). To our knowledge, this is the first report assessing the relationship between biochemical substrates of neuronal health (i.e., NAA) and creativity in a cohort comprised exclusively of normal, healthy subjects.

C97

THE EMBODIED NATURE OF SPATIAL PERSPECTIVE TAKING *Klaus Kessler[1], Lindsey Anne Thomson[1]; [1]Centre for Cognitive Neuroimaging (CCNi), University of Glasgow, United Kingdom* – Humans are able to mentally adopt the spatial perspective of others and “see the world through their eyes”. We claim that spatial perspective taking (SPT) could have developed from the physical alignment of perspectives. That is, hominids might have realised at some point of evolution that physically adopting the same perspective as a conspecific was essential for detecting danger or food. With increasing brain capacity the actual movement might have evolved into a mental re-alignment that provided more flexibility. In a series of three behavioural experiments we found substantial evidence for the claim that SPT might still be rooted in embodied representations. We further conclude that the embodiment of SPT is action- rather than perception-related, although we found evidence for both. This supports Zacks and Michelon's (2005) conclusion that motor areas are part of the underlying neural substrate of SPT. Finally, our results reveal what the next step after automatic "mirroring" of conspecifics (e.g. di Pellegrino et al., 1992; Gallese, 2007, Kessler et al., 2006) may have been in social understanding: the mental alignment of perspectives and the understanding of the visuo-spatial world from another viewpoint. Such an embodied but conscious and deliberate transformation of the self could have then generalised to more sophisticated alignments of socio-cognitive perspectives encompassed by the notion of theory of mind. This clarifies the recently proposed transition from automatic to conscious understanding of others by means of a shared view of the world (Frith & Frith, 2007).

Linguistic processes: Other

C98

HOW DOES SINGLE WORD READING DIFFER BETWEEN PHONOGRAPHIC AND LOGOGRAPHIC SCRIPTS AT A NEURAL LEVEL? *Maki Koyama[1], John Stein[1], Peter Hansen[1,2]; [1]Anatomy and Genetics, University of Oxford, UK, [2]School of Psychology, University of Birmingham, UK* – Recent imaging studies of single word reading in Japanese have reported that phonographic Kana and logographic Kanji elicit differential levels of brain activation in specific cortical areas. However, the origin of the differences between these two scripts remains unclear. Therefore, we used Kana and Kanji words which differed only visually and were matched on their phonological and semantic representations as well as visual familiarity, and conducted an fMRI experiment to identify neural differences in visual-orthographic representations between the two scripts during a one-back visual task. In native Japanese readers, BOLD activation levels, rather than activation loci, differed between Kana and Kanji; Kanji elicited greater activation than Kana in the mid-posterior part of the fusiform gyrus, precuneus and cerebellum bilaterally, as well as in the right middle/inferior occipital gyrus and superior parietal lobule. Similar activation patterns were observed in a control group of native English readers who could process both scripts only visually. In contrast, no brain area showed greater activation for Kana than Kanji in either group. Additionally, ROI analyses revealed that the majority of the areas that were more responsive to Kanji than to Kana were most strongly activated by a control script that was equally unfamiliar to both groups and thus were processed only visually. These results suggest that there is no distinctive brain network specific only to one type of script, but greater visual processing is required for logographic Kanji that is visually more complex than phonographic Kana, thus leading to the observed differences in BOLD activation.

C99

NO DISSOCIATION IN THE PRODUCTION OF REGULAR AND IRREGULAR PAST-TENSE VERBS IN LEFT FRONTAL PATIENTS *Jary Larsen[1,2], Timothy Justus[3], Paul de Mornay Davies[4], Diane Swick[1,2]; [1]University of California, Davis, [2]VA Northern California Health Care System, [3]California Pacific Medical Center Research Institute, [4]Middlesex University* – The cognitive and neural mechanisms involved in morphological processing are not well understood. Dissociations in generating the past tense of English regular and irregular verbs have been reported in patients with Broca's aphasia, with worse performance on regulars than on irregulars (Tyler et al., 2002; Ullman et al., 1997). Some theorists have taken this as evidence that Broca's area, located in the left posterior inferior frontal gyrus (LIFG), is responsible for applying a rule ("add -ed") in generating regular past-tense verbs. However, not all studies have concurred (Bird et al., 2003), and a recent meta-analysis of 75 aphasic patients determined that no consistent pattern of performance emerged. In sentence completion tasks, 13% of patients were worse on regulars, 33% were worse on irregulars, and 54% showed no difference (Faroqi-Shah, 2007). Here, we report results from 10 new patients with lesions that include LIFG and the insula. The stimulus list contained the items used by Ullman et al. and Bird et al. Participants produced the past tense of each present tense verb, which was spoken aloud and used in an example by the experimenter. No significant differences between regular and irregular verbs were observed. In a limited battery of 48 items (n=10), accuracy rates were 61% for regular and 59% for irregular verbs. In a longer battery of 105 items (n=8), accuracy was 72% for regulars and 65% for irregulars. These results provide additional evidence that LIFG does not make differential contributions to the processing of regular and irregular verbs.

C100

DISRUPTION OF SPELLING-TO-SOUND CORRESPONDENCE MAPPING DURING SINGLE WORD READING IN PATIENTS WITH LEFT TEMPORAL LOBE EPILEPSY: IMPLICATIONS FOR MODELS OF READING *Kerry Ledoux[1,2], Nathan Crone[2], Dana Boatman[2], Barry Gordon[1,2,3]; [1]Cognitive Neurology/Neuropsychology, The Johns Hopkins University, [2]The Johns Hopkins University School of Medicine, [3]The Johns Hopkins University* – The nature of the processes engaged during the oral reading of single words has long been a contentious issue in cognitive neuroscience, in part because it may presage much broader questions about the processing of high-level information. The two major classes of reading models (dual-route and connectionist) differ in their predictions about the processing of spelling-to-sound correspondence. Examining such processing in patients with neural disorders might further discriminate between the two types of reading models, and contribute to our understanding of the neural representation of reading processes. To this end, we tested two groups of patients with epilepsy on a single-word oral naming task using words that varied in the frequency of their spelling-to-sound correspondence. The first group (LTL) consisted of patients with intractable epilepsy in whom video-EEG monitoring had localized the epileptic focus to the dominant (left) temporal lobe; the second group (non-LTL) was composed of patients with epileptic foci outside this region. Patients were asked to name single printed words aloud. Overall, reaction times (RTs) for both patient groups were generally slower than those observed previously for normal participants. For the non-LTL group, RTs showed the same pattern across spelling-to-sound correspondence conditions as those previously reported for normal participants. For the LTL group, however, the pattern of RTs suggested a greater relative influence of orthographic frequency and a lesser relative influence of rime frequency. These results are difficult to reconcile with dual-route models of reading, and supportive of interactive connectionist models.

C101

A MODEL FOR FUNCTIONAL SEGREGATION OF MIDDLE AND POSTERIOR REGIONS OF THE SUPERIOR TEMPORAL SULCUS FOR SPEECH PERCEPTION: A META-ANALYSIS OF THE NEUROIMAGING LITERATURE. *Einat Liebenthal[1], Rutvik Desai[1], Lisa Conant[1], Merav Sabri[1], Colin Humphries[1]; [1]Medical College of Wisconsin, Milwaukee* – A functional segregation along an anterior to posterior axis in the superior temporal sulcus (STS) for speech and auditory perception is supported by neuroimaging findings of differential responses to speech and speech-like sounds in the left STS ventral (mSTS) and posterior (pSTS) to HG. However, the respective role of these regions remains elusive. The left mSTS appears to be more responsive to familiar sounds including human and animal vocalizations and in particular speech, whereas the pSTS is more sensitive to the perception of unfamiliar sounds. In addition, regions in pSTS overlapping those responsive to unfamiliar sounds appear to be involved in phonological processing, whether from visual or auditory input. Here, we propose a model in which the main factor driving the differentiation between middle and posterior STS regions is the affinity of the former to holistic representations and of the latter to chronological representations of sounds. We hypothesize that prelexical, holistic and long-term representations of highly-familiar and over-learned sounds are coded in a ventral pathway originating in HG and projecting to the left mSTS. The left mSTS stores representations that can be accessed and processed for meaning by ventral and anterior temporal regions and the angular gyrus. In contrast, atomistic and transient representations retaining the chronological dimension of sounds are stored in left pSTS. The left pSTS acts as a short-term memory buffer that mediates processes relying on the sequential form of sounds such as categorization of unfamiliar sounds (for which holistic representations have not been formed) and phonological processing.

C102

HESITATIONS AFFECT LANGUAGE COMPREHENSION, BUT THE TYPE OF HESITATION MATTERS. *Lucy MacGregor[1], Martin Corley[1], David Donaldson[2]; [1]Philosophy, Psychology and Language Sciences, University of Edinburgh, [2]University of Stirling* – Disfluencies in speech, including hesitations such as "uh", are known to affect listeners. Here we ask whether disfluent repetitions of words, used to buy time when planning speech (e.g., Blackmer & Mitton, 1991), also affect language comprehension. We focus on the processing of, and memory for, the word immediately following disfluency. Corley et al. (2007) used ERPs to demonstrate that when participants listen to utterances, an N400 effect elicited in response to words which were unpredictable in context relative to predictable controls was attenuated when an "uh" hesitation preceded the target. Targets which had been preceded by disfluency were also better recognised during a subsequent memory test. The present study examines disfluent repetitions using a similar paradigm. Participants (n=16) listened to utterances ending in predictable or unpredictable target words. Half of the materials included a disfluent repetition of the pre-target word, for example "Everyone's got bad habits and mine is biting (my) my NAILS/TONGUE." ERPs relative to target onsets revealed that both fluent and disfluent utterances elicited a standard N400; the presence of a repetition, unlike an "uh", did not attenuate the effect. A surprise recognition memory test showed that target words were better recognised when they had been unpredictable in context. However, unlike an "uh", repetition of a word did not affect memory for the subsequent target word. Considered together with findings from Corley et al. (2007), our data show that hesitations do affect language comprehension, but that different types of hesitation exhibit distinct effects.

C103

PHONOLOGICAL PROCESSING OF WRITTEN WORDS BY DEAF AND HEARING ADULTS: EVIDENCE FROM ELECTROPHYSIOLOGY *Mairead MacSweeney[1], Usha Goswami[2], Helen Neville[3]; [1]University College London, [2]University of Cambridge, [3]University of Oregon* – Using fMRI we have previously shown that deaf adults recruit similar neural systems as hearing adults when deciding whether picture pairs rhyme (MacSweeney et al., submitted). In the current study we used electrophysiology to determine whether the timecourse of this neural activity is similar across groups. Deaf native signers of ASL and hearing non-signers were presented with a sequence of two written words and decided whether the second word rhymed with the first. All rhyming trials were orthographically inconsistent (e.g., might – write). All non-rhyming trials were matched to rhyme trials for orthographic overlap (e.g., skirt – write). Behavioral performance by hearing participants was at ceiling and they demonstrated a robust enhanced negativity (N450) to non-rhyming in contrast to rhyming pairs. As demonstrated in previous studies (e.g., Rugg, 1984), this was greatest over the posterior regions of the right hemisphere. Behavioural performance by the deaf group as a whole was above chance level but was significantly poorer than hearing participants. Nevertheless, analysis of the ERPs, during correct trials only, indicated a greater N450 to non-rhymes than rhymes that was greatest over posterior electrodes. However, unlike the hearing group, this effect did not differ across hemispheres. Group differences were of borderline significance, suggesting that the N450 was larger in hearing than deaf participants. These group and individual differences will be further explored in relation to rhyming and reading ability.

C104

EXPERIENCE-, GENDER- AND PERSONALITY-DEPENDENT PROCESSING OF INFANT-DIRECTED SPEECH IN ADULTS: AN FMRI STUDY *Yoshi-Taka Matsuda[1], Ken'ichi Ueno[2], R. Allen Waggoner[3], Donna Erickson[4], Yoko Shimura[5], Keiji Tanaka[3], Kang Cheng[2,3], Reiko Mazuka[1,6]; [1]RIKEN Brain Sci Inst, Wako, Japan, [2]Support Unit for Functional MRI, RIKEN Brain Sci Inst, Wako, Japan, [3]Lab for Cognitive Brain Mapping, RIKEN Brain Sci Inst, Wako, Japan, [4]Showa Academia Musicae, Kawasaki, Japan, [5]Saitama University, Saitama, Japan, [6]Duke University, Durham* – Adults address infants with typical modification of lexicon and prosody. This infant-directed speech (IDS) can be observed across languages and cultures, however, it is still unclear to what extent the processing of IDS depends on experience of rearing, gender and/or personality. This possibility was tested with Japanese parents (n=35, 20 mothers), who have had their first babies within one year (8±2 months old), and age-matched non-parents (n=30, 15 females) using fMRI (Varian 4T MRI system) in an event-related design. IDS effects were determined by measuring differential activity when the subjects discriminated auditorily presented IDS stimuli from adult-directed speech (ADS) stimuli, selectively attending to either the prosody or lexicon, and followed by the mental rehearsal of the percept. The following three results were revealed in the random-effects analysis of multiple comparisons with GLM. 1) Listening to both prosodic and lexical IDS stimuli compared to ADS stimuli increased the BOLD signal only in mothers' (left hemisphere) language areas (left BA44/45 and area Spt), which corresponds to the articulatory network in auditory dorsal pathway. 2) Mothers' personality scores of extraversion showed strong correlations with activation of the left-lateralized motor-related areas involved in speech production when listening to prosodic IDS. 3) These activations, observed in mothers with pre-verbal infants, disappeared when mothers (n=18) ceased to use IDS to their children, who developed to school ages (7.1±0.4 years old). These results suggest that mothers process IDS in personality- and use-dependent manners.

C105

INVOLVEMENT OF LEFT-LATERALIZED FRONTAL AND MIDDLE TEMPORAL REGIONS IN ABSTRACT MATCHING OF AUDIOVISUAL WORD FORMS *Urs Maurer[1,2], Jason D. Zevin[1], Yuliya N. Yoncheva[1], Henning U. Voss[3], Bruce D. McCandliss[1]; [1]Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University, [2]University of Zurich, [3]Citigroup Biomedical Imaging Center, Weill Medical College of Cornell University* – Combining specific visual-orthographic information with specific phonological information associated with auditory word perception is a critical component of the reading process. Here we explore an experimental approach to probing the functional architecture of reading by manipulating both the modality of presentation and the abstract match between visual and auditory word forms. During functional magnetic resonance imaging, we presented words and pseudowords either unimodally (spoken or printed) or bimodally. The bimodal presentation comprised conditions in which stimuli presented on the screen and over the headphones represented either the same (congruent) or different (conflicting) abstract word forms. Effects of abstract word form matching were defined as a differential response between congruent and conflict conditions ($p<0.001$, uncorrected). Results revealed inferior frontal and middle temporal regions in the left hemisphere that showed increased activation for conflicting compared to congruent presentations, whereas the reverse contrast revealed no significant effects. A region of interest analysis including the corresponding right-hemisphere regions confirmed increased conflict effects in the left compared to the right hemisphere for both regions (p<0.05). The results indicate that frontal and middle temporal regions of the left-lateralized language network respond most to conflicting audiovisual information of word form stimuli, and suggest that these regions may also constitute a system that provides phonological feedback during visual word recognition. This left-lateralized system may be especially involved in processing complex visual and auditory word forms, as previous studies using more elementary letter and phoneme-sound representations reported mainly bilateral effects for the reverse contrast in more posterior brain regions.

C106

FUNCTIONAL CONNECTIVITY IN LANGUAGE PRODUCTION *Kai Miller[1], Felix Darvas[1], Jeffrey Ojemann[1]; [1]University of Washington* – We examined electrocorticographic recordings with simultaneous coverage of left frontal, parietal, and temporal cortex in classical speech regions (Wernicke's, Broca's, and primary motor) in 6 subjects and examined the correlation between them during fixation, noun reading, and verb generation (Binder, 1997, JNeurosci). We examined the time series of the power law in the cortical spectrum (Miller, 2007, NeuroImage), and examined correlational asymmetries to reveal functional directionality in the relationship between speech areas. Broca's and Wernicke's areas are most highly correlated nearly simultaneously, suggesting that they may work in concert, or at least in parallel, rather than one clearly preceeding the other. Wernicke's area activity is most highly correlated with activity in premotor cortex 30-50 ms later, while Broca's area activity is most highly correlated with activity in premotor cortex 20-30ms later. The picture suggested by the analysis is that the two language areas work together, followed by flow to the motor intent regions 20-50ms later. We also found significant phase-power coupling between delta, theta and alpha phase with the power law changes in the cortical spectrum that were significantly less during periods of noun reading than verb generation in Wernicke's and Broca's areas, but not in primary motor cortex. All three areas showed diminished phase-power coupling with speech production than fixation, suggesting that this metric is a robust correlate of local cortical activity.

C107

AN EVENT-RELATED POTENTIAL STUDY OF THE PERCEPTUAL MAGNET EFFECT IN SPEECH PERCEPTION *Sharon Miller[1], Yang Zhang[1,2]; [1]University of Minnesota, Minneapolis, MN, [2]Center for Neurobehavioral Development, University of Minnesota, Minneapolis* – The present study used behavioral and ERP measures to examine the controversial "Perceptual Magnet Effect" (PME) in speech perception. Three issues were investigated: (1) whether listeners could consistently judge the category goodness of individual speech tokens, showing that certain variants are better representatives of one phonetic category, (2) whether category goodness would strongly influence listeners' sensitivities to within-category differences, showing reduced sensitivity near the best instance and increased sensitivity in the vicinity of a poor exemplar, (3) whether PME is unique to speech perception. Twenty adult American English speakers participated in the study. The stimuli were synthesized vowels for /a/ and their nonspeech analogs by systematically varying the first two formants. Behavioral experiments used identification, goodness rating, and discrimination tasks. ERP experiments were conducted in four oddball conditions: (1) prototypical /a/ served as the standard and its four variants served as deviant, (2) nonspeech match of the first condition, (3) nonprototypical /a/ served as the standard and its four variants served as deviant, and (4) nonspeech match of the third condition. Behavioral results showed strong evidence that individual subjects rated vowel category goodness based on the F2/F1 ratio. Mismatch negativity amplitudes in the speech conditions showed an overall pattern consistent with the PME prediction, but a similar trend was observed in the nonspeech conditions. Large individual differences were observed, showing either the presence or absence of PME predictable from behavioral data. The results collectively indicated the perceptual organization of within-category variations based on both phonetic knowledge and acoustic analysis.

C108

SEX DIFFERENCES IN LANGUAGE: EVIDENCE FROM EVENT-RELATED POTENTIALS *Robbin Miranda[1], Michael Ullman[1]; [1]Georgetown University Department of Neuroscience* – We investigated sex differences in event-related potentials (ERP) elicited by subject-verb agreement and semantic violations in naturally spoken sentences. Agreement violations elicited an early left-lateralized negativity (ELAN) with an anterior scalp distribution in men and a broad scalp distribution in women. Semantic violations elicited a negativity (N400) with an anterior-central scalp distribution in men and a more posterior distribution in women. Both types of violations additionally elicited a late posterior positivity (P600) that did not differ in amplitude or scalp distribution between males and females. The observed sex differences may reflect a female advantage in declarative memory, although such a conclusion should be considered tentative.

C109

ARE ABSTRACT LETTER REPRESENTATIONS INDEXED BY THE P260 EVENT-RELATED POTENTIAL? *Priya Mitra[1], Donna Coch[1]; [1]Dartmouth College* – Results of a previous event-related potential study with single letters suggest that the P260 indexes abstract letter representations in the adult brain (Petit, Midgley, Holcomb, & Grainger, 2006). Whether novel stimuli that are visually similar to letters can elicit this effect has not been tested. In a forward- and backward-masked priming paradigm, we presented college students with letter-letter and false font-false font (letter-like stimuli controlled for visual elements) pairs in which the targets did (e.g., a-a) or did not (e.g., a-b) match the masked primes preceding them. Participants responded to each trial by pressing buttons indicating whether each target was or was not a real letter. Preliminary analyses with half (n = 9) the anticipated participants show a significant difference (p < .05) in mean amplitude (220-300 ms) between matching and non-matching targets in the letter condition, replicating the pattern in Petit et al. despite task differences. They also show a trend toward a similar pattern in the false font condition (p = .06) in the same epoch. The suggestion of an analogous effect in the false font condition (comprised of novel stimuli that should not have abstract neural representations) may call into question the hypothesis that the P260 specifically indexes abstract letter representations, and may suggest that it reflects more basic visual processing.

C110

EARLY AUDITORY SENSITIVITY TO FORMANT RATIOS IN VOWEL PERCEPTION: MEG EVIDENCE *Philip Monahan[1], William Idsardi[1,2]; [1]University of Maryland, [2]Neuroscience and Cognitive Science Program, University of Maryland* – We present evidence that formant (F) ratios (Miller 1989) provide a neuropsychologically plausible mechanism for eliminating acoustic variability in speech. Our magnetoencephalographic (MEG) findings indicate that the auditory perceptual system is sensitive to F1/F3. The latency of the M100, an early automatic auditory evoked component, reflects differences in F1 (/a/ elicits faster latencies than /u/; Poeppel, et al. 1997). Reinterpreting those results, M100 could follow the F1/F3 ratio. Larger F1/F3 ratios (/a/) should elicit earlier M100 latencies. We present findings from two MEG studies. In Experiment 1, we synthesized two tokens each of /ɛ/ and /ə/ modulating the F3 values to obtain an 8% difference in mel (F1/F3) space between within category partners. Participants passively listened to randomly presented vowel tokens. A significant effect of M100 latency was found for /ɛ/ with a large F1/F3 ratio (p<0.05,r=.57) but not /ə/ (p=0.17,r=.27). Experiment 2 tested the hypothesis that the asymmetric results could be attributed to a greater sensitivity to ratios in more crowded regions of vowel space. Aiming to replicate the finding of /ɛ/ with /o/ and the null effect for /ə/, we synthesized two tokens of /o/ differing 8% in mel (F1/F3) space and reran the /ə/ tokens. As predicted, we found a significant M100 latency facilitation for

/o/ with a large F1/F3 ratio (p<0.02,r=.75), and not /ə/ (p=0.13,r=.38). These results demonstrate that formant information can be rapidly extracted from the speech signal and that formant ratios have a neuropsychological basis as a viable solution in speaker normalization.

C111

OFF-LINE SENTENCE PROCESSING: WHAT'S INVOLVED IN ANSWERING A COMPREHENSION PROBE? *Sharlene Newman[1], Donghoon Lee[1], Kristen Ratlif[1]; [1]Indiana University, Bloomington, IN* – A distinction has been made between on-line and off-line sentence comprehension processing. On-line processes are involved in extracting the meaning of the sentence while off-line processes are those related to using that extracted meaning for a task (e.g., answering a comprehension question). In addition, there is some debate as to the role of working memory in sentence comprehension. This fMRI study was designed to examine the role of working memory during off-line processing. Here, conjoined active and object-relative sentences were presented, each followed by a comprehension probe. To disassociate the activation related to the sentence from that of the probe, a six second delay was placed between them. There were three different probe types: short distance, long distance and false statements, each varying the load placed on working memory (e.g., The pilot scared the escort and broke the mirror on the closet. short: The pilot scared the escort?; long: The pilot broke the mirror?). The results revealed significant differences as a function of probe type when the probe followed conjoined active sentences. The reaction time was longer for the long distance condition and greater activation of the inferior frontal and parietal areas (regions associated with working memory) was observed. Also, activation of the inferior parietal cortex was shown to be greater during the presentation of the probe compared to the sentence for the conjoined active condition. No differences in probe type were observed for the object-relative condition. These results suggest that working memory plays an essential role in off-line processing.

C112

CAUDATE ACTIVITY DURING VERB INFLECTION IN EARLY VS. LATE BILINGUALS *Tomasina Oh[1], Philina Ng[1], Ing Berne Yeh[2], Steven Graham[1]; [1]National University of Singapore, [2]Diagnostic Imaging, National University Hospital* – It has been suggested that our language system comprises a lexicon plus a grammar/computational component, the latter being subserved by fronto-striatal structures. Second language (L2) grammar is thought to depend less on fronto-striatal structures as L2 age of acquisition (AoA) increases. METHODS: 22 highly proficient Mandarin-English bilinguals who acquired English(L2) either EARLY (mean age 4.6; n=11) or LATE (mean age 10.5; n=11) were scanned while generating (GEN) past tenses of regular (rule-based) and irregular (stored in lexicon) verbs compared to baseline reading (READ) regular/irregular tasks. We also included a second fixation baseline which appeared between words. Functional images were processed using BrainVoyager QX (v1.99) prior to computation of group-level random effects GLMs (thresholded at corrected false discovery rate q<0.05). RESULTS/DISCUSSION: Relatively less right caudate activity for LATE participants when inflecting versus reading regular verbs is consistent with the idea that aspects of L2 computation is less dependent on basal ganglia structures for LATE AoA. However, further analyses revealed that this effect was largely due to increased READ baselines for LATE and decreased READ baselines for EARLY participants. We suggest that decreased baseline activation for READ in the EARLY group might in part reflect task-switch costs similar to "reverse Stroop" effects, which would be stronger in the EARLY group due to their increased L2 automaticity and their greater need to suppress generating in the READ condition. CONCLUSION: It is important to consider both baseline and experimental task activations when interpreting AoA effects in L2 grammar.

C113

DIFFERENCES IN THE MISMATCH NEGATIVITY RESPONSE FOR MONOLINGUAL ENGLISH AND BILINGUAL SPEAKERS USING A MULTIPLE DEVIANT ODDBALL PARADIGM *Silvia Ortiz-Mantilla[1], Naseem Choudhury[1], Barbara Alvarez[1], Nathalie Guthrie[1], April A. Benasich[1]; [1]Center for Molecular & Behavioral Neuroscience, Rutgers, The State University of New Jersey* – Little is known about how monolinguals and bilinguals differ in processing of basic auditory stimuli that have been shown to be associated with language, but are not linguistic. In this study, normal hearing adults ages 20 to 40 years old were placed in three different groups: one monolingual (English) and two bilingual (Spanish-English and Other Language-English). Brain event related potentials from 128 electrodes were recorded while participants received a passive multiple deviant oddball paradigm. The mismatch negativity (MMN) response, which is elicited when an auditory change is detected between standard and deviant stimuli, was used to assess auditory discrimination. Four deviant stimuli were presented interspersed in a sequence of identical standard stimuli (70 ms 800 Hz tones). Deviant conditions were: frequency (1200 Hz, 70ms), duration (800 Hz, 30 ms), gap (20 ms silent gap within a 70 ms 800Hz tone), and sweep (linear modulation from 800 to 1200 Hz). The MMN for all three groups was similar in latency and amplitude for the gap and sweep conditions. However, in the frequency condition, the MMN for the bilinguals peaked later with a more robust peak as compared to the monolinguals. In the duration condition, the morphology of the waveform for the bilinguals also differed as compared to monolinguals; bilinguals had more robust peaks and an additional peak immediately following the MMN. These findings suggest subtle differences in cortical response between monolinguals and bilinguals when processing basic non-linguistic stimuli that may underlie differences in decoding language (i.e., phonemes, words, sentences).

C114

SEPARATING THE EFFECTS OF HAND DOMINANCE AND LANGUAGE LATERALIZATION IN MANUAL ACTION REPRESENTATION *Dafna Palti[1], Zohar Ben-Moshe[2], Yael Schwartzman[2], Uri Hadar[2], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Tel Aviv University* – In right handed humans, the left cerebral hemisphere is specialized for both motor control of the dominant hand and the representation of skilled manual actions, but it is unclear whether these two capacities share a single mechanisms. One line of evidence proposes that manual skill representation resides together with the control of the dominant hand. Other evidence suggests that skilled movements is represented independently of hand dominance and may be more closely associated with laterality of language. To test this, 34 right and left-handed subjects were scanned with fMRI while generating words of either actions (A), tools (T) or non-tools (NT) words, thus creating a gradient of manual-action relatedness. Individual statistical brain maps, containing regions that were activated by the action-related gradient (A>T>NT), were created. A group regression analysis was employed on the individual action gradient maps, while indices of either hand dominance or language lateralization were used as covariates. The results showed that within the action-representation network, hand dominance correlated with inferior parietal and posterior temporal regions, while language dominance was mostly correlated with frontal regions, including the premotor cortex. These results suggest that some of the effects associated with manual action representation are related to motor experience, while others are more linked to conceptual representations associated with the language system. The link between manual skill representation and language representation is particularly intriguing in light of ideas that these two systems share a single mechanism of temporal sequencing, and possibly a common evolutionary origin.

C115

AN FMRI STUDY OF PHONEME PERCEPTION IN YOUNG AND OLD ADULTS *Haeil Park[1], Hae-Jeong Park[2,3], Byung Sik Seo[2], Gregory Iverson[1,4]; [1]University of Wisconsin-Milwaukee, [2]Research Institute of Radiological Science, Yonsei University College of Medicine, [3]Yonsei University College of Medicine, [4]Center for Advanced Study of Language, University of Maryland* – In the current study, we used functional Magnetic Resonance Imaging (fMRI) to examine differences in brain activational patterns between younger and older speakers of Korean in their perception of the unusual three-way laryngeal phoneme contrasts of tense /p' t' k'/ vs. lax /p t k/ vs. aspirated /ph th kh/. 7 younger speakers and 3 older Korean speakers were asked to indicate which among the three laryngeal consonants (or a vowel) they heard by pressing one of four buttons using the left thumb. Subtraction of the fMRI signal for vowel-initial syllable perception from that for laryngeal consonant-initial syllable perception should index processes only involved with the perception of these phonetic categories. Such subtractions for younger Korean speakers were found to be associated with strong activation bilaterally in the cuneus, the right middle frontal gyrus (BA 10), the left SMG (BA 40), and the right precuneus. For older Korean speakers, however, significant activation was seen in the left SMG (BA 40), the DLPFC (BA 9), insula (BA 13), and inferior frontal gyrus (BA 47). The results that the cuneus and the right middle frontal gyrus (BA 10) were uniquely activated in younger speakers' perception of the Korean laryngeal distinctions are consistent with Silva's (2006) claim that only younger speakers, as opposed to older ones, are using pitch differences to distinguish Korean laryngeal contrasts, given that those two areas have been reported to be involved with pitch discrimination (e.g., Zatorre et al., 1992; Wong et al., 2004).

C116

BRAIN RESPONSES TO ORTHOGRAPHIC VIOLATIONS BY SECOND-LANGUAGE LEARNERS OF FINNISH *Ilona Pitkänen[1], Geoffrey Valentine[1], Lee Osterhout[1]; [1]University of Washington* – Sometimes second-language (L2) learners are faced with L2 orthographic/phonological word-formation rules that differ from their native language. For example, English speakers studying Finnish must learn Finnish vowel harmony that prohibits co-occurrence of front and back vowels within a word. We examined when and how native English speakers learning Finnish acquire L2 orthographic restrictions by longitudinally measuring their ERPs and lexical decisions to Finnish words, orthographically legal pseudowords, and words and non-words with vowel harmony violations. In ERP studies with native speakers, orthographically legal pseudowords elicited an N400 effect (Bentin, 1987), misspelled words elicited a P600-like effect (Münte et al., 1998), and orthographic irregularity of pseudowords increased P600 amplitude, possibly reflecting increasing difficulty of structurally processing infrequent, unexpected orthographic combinations (Kim et al., in prep). In the current study, an N400 effect to legal pseudowords is seen in native Finnish controls and in learners after 1-2 months of instruction. In the learners, orthographically illegal stimuli also initially elicit an N400-like effect. However, this effect is later replaced by a P600-like effect. This effect is only seen with graphemes common to Finnish and English. Non-English graphemes (ä, ö) elicit no ERP effect in learners. Native Finns show a P600 effect to all illegal forms. We suggest that learners may initially process orthographically illegal forms as pseudowords that lack meaning but violate no expectations of orthographic structure, but in later stages of learning illegal L2 stimuli are processed as violations of L2 orthographic expectations and thus elicit an enhanced P600.

C117

PROSODIC COMPREHENSION IN PARKINSON'S DISEASE *Lauren L. Richmond[1], Luisa Vesely[1], Murray Grossman[1]; [1]University of Pennsylvania* – Background: Prosody is an integral component of speech that is comprised of both the stress and intonation of one's voice. Deficits in prosody production in patients with Parkinson's disease (PD) have been demonstrated. However, it is unclear whether prosodic comprehension is compromised, or if this is related to impaired emotional perception. To assess prosody comprehension in PD, we examined comprehension of propositional and emotional prosody with a novel measure. Design: We compared 30 non-demented, non-depressed PD patients and 13 age- and education-matched controls. Prosody comprehension was assessed using a 91-item distance comprehension task and a 91-item emotion comprehension task. In both tasks, participants hear either a male or female voice stating multisyllabic numbers or dates along one of two continua: 1) dominant-to-submissive emotion; 2) near-to-far proposition. Participants judge the characteristic of the prosodic stimulus on a 5-point scale. Errors were coded as either small (1 point above and 1 point below the target answer) or large (more than 1 point above and below the target answer). Results: PD patients were significantly impaired in their judgments of emotional prosody compared to controls ($t(41)=3.04$, $p<.01$; PD accuracy: 55%, control accuracy: 73%), but did not differ from controls on propositional judgments. PD also showed significant impairment judging dominance compared to distance ($t(29)=5.914$, $p<.001$). Propositional judgment errors were generally small in PD ($t(29)=4.442$, $p<.001$), but this was not found in emotional judgment errors. Conclusion: PD patients are impaired judging emotional prosody on a dominant-to-submissive scale, but are unimpaired judging propositional prosody.

C118

A COMBINED ERP AND NEAR-INFRARED SPECTROSCOPY STUDY ON PHONOTACTIC SENSITIVITY *Sonja Rossi[1], Ina Jürgenson[1], Adriana Hanulikova[2], Hellmuth Obrig[1], Isabell Wartenburger[3]; [1]Berlin Neuroimaging Center, Charitè University Medicine Berlin, Germany, [2]Humboldt University Berlin, Germany, [3]University of Potsdam, Germany* – Possible combinations of different phonemes within a word of a specific language are characterized by phonotactic rules. These rules play an important role in both phonology as well as in lexical activation. In the present study we simultaneously measured event-related brain potentials (ERPs) and the cortical oxygenation changes by near-infrared spectroscopy while participants listened to pseudowords which were either phonotactically legal or illegal with respect to German. Illegal ones, however, were controlled for legality with respect to another language, namely Slovak. ERP results showed an N400 effect for legal compared to illegal pseudowords. The neurovascular signals show a stronger left-hemispheric lateralization for legal compared to illegal pseudowords whereas illegal ones result in a stronger right-hemispheric response over temporal regions. The results suggest that pseudowords following the rules of participants` native language recruit language-related neuronal networks, both from an electrophysiological and a vascular perspective, as the familiar phonotactic rules were extracted even from words without any meaning. The present evidence is important with respect to the universality or diversity of phonotactic processing mechanisms across different languages. As little is known about the neurocognitive aspects associated with the acquisition of phonotactic knowledge during infancy, we just conduct the same study in infants below the sixth month of age.

C119

ACTION-PERCEPTION NETWORKS AS A BASIS FOR LEFT-LATERALISED LANGUAGE FUNCTION: ELECTROPHYSIOLOGICAL BRAIN RESPONSES TO NEWLY LEARNT SPOKEN PSEUDOWORDS *Yury Shtyrov[1], James Kiff[1], Friedemann Pulvermuller[1]; [1]Medical Research Council, Cognition and Brain Sciences Unit, Cambridge, UK* – Cortical laterality of language may be influenced by the learning of cortical memory networks binding information about word-form-related actions and perceptions. We explored this postulate by applying a learning task which used phonetically legal syllables precisely matched for acoustic and psycholinguistic features and concatenated into pseudowords. Subjects learnt pseudowords (1) in a perceptual learning paradigm to build acoustic representation and (2) by articulating/repeating auditorily presented pseudowords to build perception-action networks. After learning, auditory event-related responses to both types of learnt stimuli and to matched controls were recorded using high-density EEG. Neurophysiological data revealed that learning conditions produced larger early negative ERP amplitude (latency: 200ms) than the control condition. Critically, articulatory learning led to significantly left-lateralised fronto-central ERPs, whereas symmetric brain responses were seen over the hemispheres after perceptual learning. These data demonstrate that binding between acoustic and articulatory representations has an impact on the functional laterality of language processing and therefore challenge theories viewing laterality as a product of physical or phonological properties of acoustic signals only.

C120

COST OF COREFERENTIAL PROCESSING WITH REPEATED NAMES: AN ERP STUDY *Tamara Swaab[1], Natalie Kacinik[1], Peter Gordon[2]; [1]UC Davis, Center for Mind and Brain, [2]UNC Chapel Hill* – In this study we used ERPs to examine the underlying bases of the "repeated name penalty (RNP)", which is the finding of a cost in processing during comprehension when a coreferential name is preceded by a name in discourse focus (e.g., "Suzie went to the pet store because Suzie wanted to by a hamster", where the second Suzie would suffer from the RNP). In our previous work we have shown that these infelicitous repeated names yield an N400 effect. In the present study we were interested in determining under which circumstances processing might be sufficiently altered such that the RNP would be reflected as a grammatical or syntactic difficulty, manifested as a P600. Participants were presented with sentences in which prominence and grammaticality was manipulated as in the following examples: Prominent Name Condition: Suzy went to the pet store to buy Suzy a hamster/ herself a hamster/ himself a hamster. Non-Prominent Name Condition: Suzy's brother went to the pet store to buy Suzy a hamster/ himself a hamster/ herself a hamster. ERPs were recorded to the critical names and reflexives and participants were asked at the end of each sentence to make a judgment about its acceptability (good/bad). Violations of the reflexives yielded the expected P600 effect. But, in contrast to previous work, the repeated name penalty took the form of a P600. This shows that repeated names can yield a P600 under conditions that mirrors violations of Principle A (when there is an ungrammatical reflexive).

C121

A COHERENCE ANALYSIS OF EEG RESPONSE TO SPEECH MODULATED BY M-SEQUENCE *Hiroshige Takeichi[1,2,5], Sachiko Koyama[3,5], Brett Foster[4], David Liley[4]; [1]RIKEN, [2]University of Tokyo, [3]Hokkaido University, [4]Swinburne University of Technology, [5]RISTEX, JST* – We have developed a technique for assessment of natural verbal comprehension, using electroencephalography (EEG) and m-sequence modulation (Takeichi et al., Neuroscience Research, 57, 314-318). The technique is superior to the conventional averaging methods in that it is less susceptible to measurement artifacts, efficient without repeated presentations for signal averaging, and suitable for non-time-locked continuous mental processes. Scalp EEGs were recorded from eight right-handed Japanese speakers while they were listening to 51s-long news, in Japanese and Spanish, with and without modulation in amplitude timed by an m-sequence (a binary pseudorandom sequence). Correlation functions were computed between the m-sequence and the EEG. Then, independent component analysis (ICA, AMUSE, delta=1) was applied to the correlation functions to find critical components to discriminate between comprehensible and incomprehensible stimuli. In the present study, we focused on the EEG coherence between recording electrodes. The original EEGs were convolved with the Fourier transform of the critical ICA component function, in order to maintain only the critical component. Coherence values were computed for each electrode pair and individual frequency bands including theta, alpha, beta, gamma, and were averaged across subjects for each frequency band. The coherence value for the Japanese speech without modulation increased between T7 (left temporal) and the other electrodes in the alpha (4-13Hz) band. For the modulated Japanese coherence increased between T7 (left temporal) and the other electrodes, and F8 (right frontal) with other electrodes in the high-gamma (70-100Hz) band. Such coherence changes were not found for either non-modulated or modulated Spanish speech.

C122

NEAR-INFRARED-SPECTROSCOPY REVEALS HEMISPHERIC ASYMMETRY FOR PROCESSING TEMPORALLY VARYING ACOUSTIC STIMULI IN NEWBORNS *Silke Telkemeyer[1,2], Hellmuth Obrig[1], Sonja Rossi[1], Jens Steinbrink[1], Isabell Wartenburger[1,3]; [1]Berlin NeuroImaging Center, Charité University Medicine, Berlin, Germany, [2]Humboldt-University Berlin, Germany, [3]University of Potsdam, Germany* – The ability to decode different temporal features of the auditory stream is mandatory during language acquisition. Despite its relevance little is know about the underlying pathways and the development of interhemispheric specialization for processing auditory information from birth on. Functional imaging studies suggest a left hemispheric dominance for the processing of normal compared to reversed speech in newborns and 3 month olds (Pena et al., 2003; Dehaene-Lambertz et al., 2002). A right-hemispheric dominance for processing sentence prosody in 3 month olds as well as in four year olds has also been demonstrated (Homae et al., 2006; Wartenburger et al., 2007). The Asymmetric Sampling in Time Model (Poeppel, 2003) suggests that the hemispheric lateralization is based on the acoustic properties of the speech-signal. The speech-signal contains rapid transitions (<25 ms) like the variation between formants but also slower temporal transitions (> 300 ms) like prosodic modulation. We focus on the lateralization of processing temporally different acoustic stimuli in newborns. We used identical stimulus as Boemio et al. (2005) had used in adults and presented these slowly and fast modulated acoustic stimuli to 24 neonates (age 3.58 days, 12 boys). We simultaneously recorded the hemodynamic response using Near-Infrared-Spectroscopy as well as the electrophysiological response using EEG. Our results reveal a significantly stronger hemodynamic response for fast as compared to slowly modulated stimuli in left superior temporal areas. Slowly modulated stimuli lead to a stronger right hemispheric activation. These data suggest an asymmetric sampling of temporal features already to be present in newborns.

C123

DYSLEXIA: A SINGLE OR DOUBLE CORE DEFICIT? MAIN ASSUMPTIONS OF THE DD HYPOTHESIS TESTED IN A NATION-WIDE SCHOOL POPULATION *anniek Vaessen[1,2], Leo Blomert[1,2]; [1]University of Mastricht, Netherlands, [2]Maastricht Brain Imaging Centre, Netherlands* – A large proportion of dyslexic readers show difficulties with speeded naming of well-known visual items. As an explanation, Bowers and Wolf (1993) proposed the double deficit (DD) hypothesis which states that naming speed difficulties reflect a second core deficit in dyslexia, independent of a phonological deficit. However, even after a decade of research on this topic, evidence for the existence of a second core deficit is inconsistent. Therefore, other researchers have suggested that naming problems are a consequence of a phonological deficit (single deficit hypothesis). The present study tested the main assumptions of the double deficit hypothesis within-subject in a nation-wide sample of 2300 schoolchildren, their reading ability ranging from very poor to good. First, we investigated whether naming speed uniquely contributes to literacy performance. Second, we examined whether children with a double deficit have more severe literacy problems, since both deficits are assumed to independently contribute to poor literacy skills. Finally, we investigated the relationship between phonological and naming speed performance, since the DD hypothesis assumes that these two skills are independent and thus not related. Results showed that naming speed only uniquely related to (pseudoword) reading speed and not to other literacy measures. Furthermore, children with a double deficit were only more impaired in reading speed and not in reading accuracy or spelling. Moreover, there was a significant relationship between phonological processing (especially speed of phonological processing) and naming speed. The implications of the results for the double and single deficit hypotheses are discussed.

C124

MONITORING IN LANGUAGE PERCEPTION: MILD AND STRONG CONFLICTS ELICIT DIFFERENT ERP PATTERNS *Nan van de Meerendonk[1], Constance Th.W.M. Vissers[1,2], Dorothee J. Chwilla[1], Herman H.J. Kolk[1]; [1]NICI Radboud University of Nijmegen, [2]UMC St Radboud Nijmegen* – Although error monitoring has been exclusively studied in production, we also make perceptual errors and are able to detect them. So far, no attempt has been made to explain how perceptual errors are monitored for. We propose that a strong conflict between what is expected and what is observed triggers reanalysis to check for possible perceptual errors, a process reflected by the P600. This is at variance with the dominant view that the P600 merely indicates the presence of some syntactic obstacle, a grammatical violation or ambiguity. The hypothesis is able to account for the fact that P600 effects have been found in a wide variety of circumstances: after syntactic anomalies, garden path sentences, semantic reversal anomalies, semantically anomalous sentences which are partially plausible, misspelled words in high cloze-contexts and sentence-picture mismatches. A question is why typical N400 sentences like 'He spread the warm bread with socks' (Kutas & Hillyard, 1980) do not elicit a P600? We hypothesized that when a critical noun is medium implausible in the context, a mild conflict arises between the expected and unexpected event; the language system can still interpret the unexpected event and an N400 effect is elicited. When the noun is highly implausible however, a strong conflict arises; integration fails and a monitoring process is triggered, eliciting a biphasic N400-P600 pattern. An ERP study confirmed this hypothesis, showing that only when the conflict between the expected and unexpected event is strong enough, a monitoring process is triggered.

C125

DO SECOND LANGUAGE LEARNERS ACTIVATE L1 GRAMMATICAL FEATURES DURING L2 READING? AN ERP STUDY OF CODE-SWITCHING *Maartje van der Meij[1,2], Manuel Carreiras[2,3], Fernando Cuetos[1], Horacio A. Barber[2,3]; [1]University of Oviedo, Faculty of Psychology, [2]University of La Laguna, [3]Instituto de Tecnologías Biomédicas (ITB)* – Code switching was used to investigate if beginners and more advanced late second language learners showed qualitative differences of brain activity when reading in their second language. In particular, we investigated if the level of knowledge of the second language influenced the activation of grammatical features of the first language (Spanish) when reading in their second language (English). Event-related potentials were used to compare switches from L2 to L1. English sentences included an adjective that was presented either in English or in Spanish. The Spanish adjective either agreed or disagreed in grammatical gender with the preceding noun phrase (e.g. The lake was frozen/ helado(masc)/ *helada(fem); The Spanish word for lake –lago– is masculine, so the correct adjective would be "helado" to agree in gender). Since English does not contain grammatical gender, a disagreement effect would show the pre-activation of L1 features during L2 reading. The advanced group showed an enhanced negativity in the N400 time window and a late positive complex (LPC) in response to the code switching, while the beginners showed only a sustained positivity starting around 300 ms. In addition, gender disagreement modulated the sustained positivity amplitude in the group of beginners. In contrast, gender disagreement modulated the N400 effect but not the LPC effect in the advanced group. These results suggest that the level of English changes the brain activity related to code switching and the sensitivity to grammatical features of the first language.

C126

THE NEURAL BASIS OF LEFT-LATERALIZED AND BILATERAL LANGUAGE FUNCTIONS IN CHILDREN AND YOUNG ADULTS *Jennifer Vannest[1,3], Jerod Rasmussen[1], Jerzy Szaflarski[2], Katherine Szalewski[3], Vincent Schmithorst[3,1], Scott Holland[3,1]; [1]Cincinnati Children's Hospital Medical Center, [2]University of Cincinnati Academic Health Center, [3]Pediatric Neuroimaging Research Consortium, Cincinnati Children's Hospital Medical Center* – A left-lateralized neural basis has been well-documented for many language skills; e.g. semantic retrieval. However, other language functions such as linguistic prosody perception have been associated with bilateral mechanisms. These networks have not been previously studied in detail in children. Nine children and young adults ages 11-29 completed two block-design fMRI tasks. First, a semantic decision task (active condition: semantic decision regarding auditorially-presented single words; control condition: decision regarding tone sequences). Second, a prosody discrimination task (active condition: judge, via prosody, whether audiovisually presented sentences were statements or questions; control condition: semantic judgment about similar sentences). fMRI data were analyzed using a general linear model to identify active voxels in each task for each participant. After Talairach transformation, random-effects analysis was performed to determine group activations, thresholded at z ≥ 3.1, with clusters > 10 (p<.01 corrected). We also calculated lateralization indices in active regions. For semantic decision, a left-lateralized network emerged, including left inferior frontal (IFG, mean LI=.44) and left superior temporal / supramarginal gyri (STG, mean LI=.33). In contrast, prosody discrimination activated these regions plus their right hemisphere homologues (IFG, mean LI= -.21; STG, mean LI=-.004). The tasks differed significantly in lateralization (t-tests in each region, ps<.05).Our preliminary results demonstrate different lateralization/localization for specific language skills: semantic retrieval engages left hemisphere language mechanisms while prosody discrimination evokes bilateral activation. This pattern was consistent across children and young adults, and overall suggests a complex interaction of brain regions across hemispheres for effective language comprehension.

C127

ERP COMPONENTS THAT REVEAL ATTENTION ALLOCATION TO WORD PARTS *Man-Ying Wang[1], Bo-Chen Kuo[2], Chia-Ying Lee[3], Shih-Kuen Cheng[4], Chia-Wei Hsu[1], I-Chung Han[1]; [1]Soochow University, Taiwan, [2]National Taiwan University, Taiwan, [3]Institute of Linguistics, Academia Sinica, Taiwan, [4]Institute of Cognitive Neuroscience, National Central University, Taiwan* – The effects of attention allocation to word components on event-related potentials (ERP's) were investigated in two experiments. Participants viewed a Chinese character composed of two horizontally aligned components while their attention allocation to the two components was probed by a dot probe task. A lexical decision task followed the dot probe in Experiment 2 (but not in Experiment 1) in order to impose recognition demands. It was hypothesized that attention was directed to components located on the right due to their high information value. A difference wave was thus computed by subtracting ERP's elicited by dots on the left from those on the right. A contralateral, occipito-temporal selection negativity (SN) component with an onset at 150ms after the dot was found. It was sensitive to whether the character is real and regularly structured. The sensitivity of the SN component to word characteristics, however, was restricted to Experiment 2. These findings suggest that attention allocation to word components was modulated by recognition demands.

C128

RELATIONSHIPS BETWEEN PERFORMANCE AND HEMIPSHERIC ASYMMETRY ON LEXICAL TASKS *Suzanne Welcome[1], Chrisine Chiarello[1], Laura Halderman[2], Christiana Leonard[3]; [1]University of California, Riverside, [2]University of Pittsburgh, [3]University of Florida, Gainesville* – Most individuals show a left-hemisphere advantage for processing verbal stimuli. Deviations from this modal pattern of asymmetry have been proposed to characterize disorders such as dyslexia (Shaywitz, et al, 2007) and schizophrenia (Sommer, et al., 2001). However, within the normal population, there is great variability between individuals in the degree of behavioral asymmetry. It is unclear whether these individual differences are associated with variations in cognitive performance on standardized measures of verbal ability. We report data from the Biological Substrates for Language Project which collected standardized measures of reading ability and IQ, and asymmetry data from 7 divided visual field tasks in 200 young adults. In order to explore relationships between individual differences in asymmetry and performance, asymmetries in accuracy and reaction time on individual tasks were used to predict performance on standardized measures. For some of the lexical tasks, asymmetries were correlated with reading ability and IQ. In all cases, greater asymmetry predicted better performance on the standardized measures. Variation in asymmetries accounted for up to 9.5 percent of the variance in the standardized measures. These data suggest that in the normal population, a greater degree of behavioral lateralization may confer an advantage in the processing of verbal information.

C129

TIME-COURSE AND TEMPORAL ASYNCHRONY OF LETTER/ SPEECH-SOUND INTEGRATION IN FLUENT READERS *Gonny Willems[1,2], Hanne Poelmans[1,2], Leo Blomert[1,2]; [1]Maastricht University, The Netherlands, [2]Maastricht Brain Imaging Center, The Netherlands* – Learning and automatizing letter/speech-sounds relations via cross-modal integration is a crucial step in literacy acquisition. Recently, an fMRI-study revealed the network of brain regions for letter/speech-sounds integration in adults (1). Furthermore, a recent ERP-study using a passive paradigm demonstrated early and automatic influence of letters on speech-sound processing, with strong temporal constraints (2). In the present study, we further explored the time-course and temporal constraints of letter/speech-sounds integration using a different ERP-paradigm (N1/P2), which allows employing an active task and further exploring SOA (stimuli-onset-asynchrony). Letters and speech-sounds were presented unimodally (A,V) and bimodally (AV: congruent/incongruent combinations), either simultaneously or with the letter preceding the speech-sound by 200, 300 or 400ms. Cross-modal integration was assessed via the additive model, assuming bimodal responses to differ from the sum of the two unimodal responses (AV≠ A+V). Furthermore, we expected congruent visual information to modify speech-sound processing differently than incongruent visual information (AVcon ≠ AVinc). The results showed a suppressed auditory-evoked N1/P2 in cross-modal as compared to auditory-only conditions at SOA 200, 300, 400ms, but not at 0ms. This suppressed response suggests a modified auditory speech-sound processing by the visually presented letter. The absence of a suppression effect at 0ms might indicate that N1/P2 reflects a mechanism in which predictability of visual information is critical for early letter/speech-sounds integration. Additionally, P2 responses to congruent and incongruent pairs seem to differ, suggesting that integration is driven by learned letter/speech-sound associations. (1) van Atteveldt ea., 2004, Neuron, (43), 271 (2) Froyen ea., in press, Neuroscience Letters

C130

UNDERSTANDING "MISSING" ARGUMENTS: AN ELECTROPHYSIOLOGICAL INVESTIGATION OF SUBJECT DROP IN JAPANESE *Susann Wolff[1], Matthias Schlesewsky[2], Kaoru Horie[3], Ina Bornkessel-Schlesewsky[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Germany, [2]University of Marburg, Germany, [3]Tohoku University, Japan* – Most of our knowledge about how sentential constituents are integrated with one another – and the neurocognitive processes underlying this integration – stems from experimental settings in which the constituents were all present in the input. Many languages of the world, however, allow sentence constituents to be omitted quite freely in natural discourse. To examine how sentential meaning is computed under these circumstances, the present ERP study investigated contextual influences on the processing of sentences with a dropped subject in Japanese. Native speakers of Japanese (n=26) read two types of transitive target sentences (subject-object-verb and object-verb) in four different contexts (both arguments of target sentence introduced, subject introduced, object introduced, neither introduced). At the position of the target sentence verb, we observed a broadly distributed positivity (400-550 ms) for sentences involving a dropped subject. This effect was most pronounced when two referents had already been introduced in the discourse and least pronounced with a context introducing only the (dropped) subject or a context without any referents. The finding of a positivity rather than an N400 is in line with previous results from German, which also reported positivities in connection with reference establishment processes (Burkhardt, 2006, 2007). Altogether, our findings indicate that subject drop is least costly when the referent of the dropped argument is unambiguously identifiable (i.e. either uniquely determined by the context, or inferred as the speaker in the absence of contextual cues), and most costly when the context permits several competing potential subject referents.

C131

PREDICTING GAINS IN READING ABILITIES USING DIFFUSION TENSOR IMAGING (DTI) IN ADOLESCENTS WITH DYSLEXIA *Nahal Zakerani[1,2], McCandliss Bruce[3], Ho Candy[1], Heitzmann Joshua[1], Black Jessica M.[1], Ojo Xavier, R.[1], Gabrieli John DE,[4], Reiss Allan, L.[1], Hoeft Fumiko[1]; [1]Stanford University School of Medicine - Center for Interdisciplinary Brain Studies Research, [2]Pacific Graduate School of Psychology, [3]Sackler Institute for Developmental Psychobiology, [4]Brain and Cognitive Sciences, MIT* – The present study investigated the relationship between white matter integrity and individual differences in reading gains in adolescents with dyslexia. We performed DTI and a battery of behavioral tests in 20 children (age 14.1 + 1.9) with dyslexia and followed them for 2.5 years. Individual differences in baseline fractional anisotropy (FA) measured by Reproducible Objective Quantification Scheme (ROQS) and reading scores (in 67 typical and poor readers) replicated findings from Niogi & McCandliss (Neuropsychologia 2006); single word reading scores correlated positively with left Centrum Semiovale FA values. As a group, children with dyslexia showed significant gains in standard scores of reading over 2.5 years (5 + 7.3, p = 0.007). Greater gains in decoding regressing out baseline age, IQ and decoding scores, were predicted by greater FA values of the bilateral Superior Coronal Radiata (SCR; right (r = 0.64) > left) (r = 0.59), not significantly different between hemispheres), but not FA of other fibers. These findings provide evidence of white matter pathways that may be associated with the development of compensatory mechanisms in dyslexia.

C132

SUPRAMARGINAL AND ANGULAR GYRI RESPOND TO ACOUSTIC CHANGES THAT ARE ALSO PHONETIC BUT NOT BECAUSE OF HABITUATION TO PHONEME IDENTITY *Jason Zevin[1], Jamie Ferri[1], Jeremy Skipper[1], Bruce McCandliss[1]; [1]Sackler Institute for Developmental Psychobiology, Weill-Cornell Medical College* – Many studies of phonetic perception depend on the logic of habituation: Responses to trains of repeated stimuli are compared with responses to trains of stimuli containing a phonetic change in order to isolate regions that respond preferentially to change. Here we test habituation directly by examining temporal properties of passive BOLD responses to long (15s) blocks of stimuli in a "no change" condition -- with all stimuli drawn from the same phonetic category -- and a "change" condition in which stimuli were drawn alternately from two categories. In both conditions, all ten stimuli were recordings of unique productions drawn from sets that varied in fundamental frequency, amplitude, harmonicity and other non-phonetic properties. A t-test comparing the change and no change conditions revealed a change-specific response in a wide region posterior to the planum temporale, encompassing portions of both supramarginal and angular gyri, consistent with previous findings from shorter stimulation paradigms. In contrast to earlier studies, however, the response was strongly bilateral. Furthermore, inspection of the time series for these regions provided no evidence of a response to speech that habituates to successive stimuli from the same category. Instead, a robust response to the change condition was observed to contrast with a null response in the no change condition.

Poster Session D

Higher level cognition: Executive functions

D1

ROLE OF STRATEGIC SELF-REGULATION AND EXECUTIVE ATTENTION IN FIRST EPISODE OF SCHIZOPHRENIA. *Gricel Orellana[1], Andrea Slachevsky[2], Marcela Peña[3]; [1]University of Chile, Chile, [2]Faculty of Medicine, University of Chile, [3]School of Psychology, University Catholic, Chile* – Objective: Contribute to explain the mechanisms of behaviour disorders in schizophrenia, specifically disexecutive behaviour. Two functions have not been completely studied in schizophrenia: executive attention and strategic self-regulation of behavior. The aim of our study is to determine which of the three attentional networks – alert, orientation and executive attention – works abnormally in schizophrenia and if patients present an upheaval the self-regulation. We also study the relation between troubles in these functions and the existence of psycho-social problems. Methods: 20 patients, of both sexes, aged 18 to 30 years, each with only one psychotic episode treated. The following tests were applied: Test of Raven to evaluate IQ; ANT to evaluate attentional networks; Mattis's Dementia Rating Scale, WCST and FAB to evaluate executive functions and Six Element Test to evaluate strategic self-regulation. The disexecutive behaviour was evaluated the DEX and the Grefex's questionnaires. In order to evaluate squizophrenia symptoms, we applied PANSS. A group of 20 healthy controls matched by sex, age and educational level was included in the study. Results: our results revealed that patients presented a disorder of the three attentional networks, especially the executive attention, and poor performances in the Six Elements Tests – they applied non efficient strategies during the execution of the task. Moreover, patients presented statistical differences with controls in Raven, WCST, Mattis' s Dementia Rating Scale, FAB and disexecutive questionnaires. Performances in frontal cognitive tests are not correlated with the disexecutive behaviours. Conclusions: Our results suggest that troubles in executive attention and strategic auto-regulation could explain some patological behaviours in schizophrenia.

D2

THE PERCEPTUAL SIMILARITY OF STIMULI IN THE FLANKER TASK AFFECTS THE ERN/NE. *Joseph Orr[1], Subhratha Muthusamy[1], William Gehring[1]; [1]University of Michigan* – Theories of performance monitoring differ as to whether the ERN/Ne component of the event-related brain potential reflects a performance monitoring process concerned primarily with response conflict, overt errors, violations of predicted reward, or some other event. One difficulty in comparing these theories is that they are not specific about whether a stimulus must be completely evaluated before the reward properties or conflicting response attributes affect the performance monitoring system. In the present study we tested whether the presence of a distinctive visual stimulus feature corresponding to the correct response affects the ERN/Ne. Eighteen subjects performed a variant of the flanker task where, in one condition, the target and flanker stimulus did not differ in any basic visual feature (e.g., FFEFF). In the other condition, a salient visual feature discriminated the target and flanking letter (XXOXX). The ERN/Ne was larger on error trials where the stimulus corresponding to the error response and that corresponding to the correct response were distinguished by a salient visual feature than when there was no such feature present. While this finding might be accommodated by further elaborations of the reinforcement-learning and conflict-monitoring theories, we suggest a variant of the error-detection (mismatch) hypothesis, namely that when producing a response, the brain predicts the elementary perceptual information that stimulus evaluation should have yielded at the moment the response occurs. The more perceptually distinct the predicted information and that present at the moment of response, the larger the error signal.

D3

A COMMON MEDIAL FRONTAL CORTICAL NETWORK FOR THE STROOP AND ANTI-SACCADE TASKS BUT NOT FOR THE SUBCORTICAL AREA IN THE PUTAMEN. *Shima Ovaysikia[1], James Danckert[2], Joseph DeSouza[1,3]; [1]York University, Toronto, Canada, [2]University of Waterloo, Waterloo, ON, Canada, [3]York Center for Vision Research, Toronto, Canada* – A medial frontal cortex structure called the anterior cingulate cortex (ACC) is thought to be involved in monitoring response conflicts and/or directing adjustments needed for control of behavior. Ford et al. (2005) showed increased activation in ACC related to anti-saccade errors and during incongruent Stroop tasks, MacDonald et al. (2000) showed increased activity. Thus, we sought to discover a more precise location of cingulate cortex activation for these two tasks, both of which involve suppression of a natural behavior. One hypothesis states that suppression is a general phenomenon that is not task specific, whereas others have demarcated ACC into distinct areas involved in language and motor behaviors. We averaged across subjects to examine the specific anatomical locations with a focus on the frontal cortex using fMRI. In accordance with the first proposed hypothesis, our analysis shows similar activation of the medial frontal structures (including ACC) for both the Stroop and anti-saccade tasks with the Stroop activation extending more anterior along the medial frontal activation than the anti-saccade activations. Both tasks involved other frontal brain regions; frontal eye fields bilaterally, supplementary eye fields, dorsal and ventral prefrontal cortex and putamen activations. The putamen activation was bilateral for the anti-saccade task but only localized to the left hemisphere for the Stroop task. Although the medial frontal activations were bilateral for both tasks there may be a different subcortical mechanism being used.

D4

SPATIAL ATTENTION IS AFFECTED BY MENTAL ROTATION IN A DUAL TASK *Merel Pannebakker[1], Wessel van Dam[1], Pierre Jolicœur[2], Guido Band[1], Richard Ridderinkhof[3], Bernhard Hommel[1]; [1]Leiden University, [2]University of Montreal, [3]University of Amsterdam* – Within a dual-task, encoding and motor processes are generally considered to take place unimpeded, but central processes such as decision making or mental rotation may be sensitive to capacity limitations. In this experiment, we used a dual task to investigate whether mental rotation (T1) affects the onset and intensity of attention in T2 using event-related potentials like the N2pc. The N2pc is a contralateral visual-spatial measure of attention that reaches its peak on the posterior lateral sides of the head. If a more difficult mental rotation takes up more capacity, would this influence the attention of T2 as measured by the N2pc, or is the capacity of visual-spatial attention without any significant limitation? We manipulated the available capacity in two ways: for S1, we varied the angle from upright position to induce a smaller or a larger mental rotation. Second, we varied SOA to induce different amounts of task overlap. Results show that in case of an increased angle from upright position for S1 as well as for increased task overlap (short SOA), the N2pc at S2 was attenuated. This would argue against views that attention is not modulated because its capacity is hardly limited.

D5

UPDATING SENSORY AND TASK-SET REPRESENTATIONS DURING TASK-SWITCHING: AN ANALYSIS OF BEHAVIORAL COSTS AND COGNITIVE BRAIN POTENTIALS IN HUMANS *Jose Antonio Perianez[1], Francisco Barcelo[1]; [1]Institut Universitari d'Investigacio en Ciencies de la Salut (IUNICS) University of the Balearic Islands, Palma de Mallorca, Spain* – Human cognitive control depends on both bottom-up and top-down influences along a hierarchy of neural representations in the brain. Task-cueing paradigms have suggested that the updating of sensory cues (i.e., bottom-up control) and the updating of task-set representations (i.e., top-down control) both contribute to overall behavioral task-switching costs (i.e., Forstmann et al. 2007). Few studies have explored the fast temporal course of brain activations underlying these bottom-up and top-down modes of cognitive control underlying behavioral switch costs. Here we used a 2:2 cue-to-task mapping in order to dissociate the behavioral and event-related potentials (ERP) indicators associated with the updating of sensory and task-set representations through an orthogonal manipulation of cue- and task-related switches and repetitions. Task switches enhanced the amplitude of centrally distributed early cue-locked P3 activity (180-220 ms), and mirrored behavioral task-switch costs. In turn, cue switches evoked reduced centrally distributed N2 (255-295 ms) amplitudes, and paralleled behavioral cue-switch costs. Importantly, both task- and cue-updating enhanced the amplitude of parietally distributed late cue-locked P3 activity (300-340 ms), suggesting that only this late P3 component was modulated by the updating of both sensory and task-set representations. These results suggested a joint contribution from both sensory and task-set representations to behavioral switch costs, which could not be completely captured by any isolated index of brain activation. In line with recent models, we conclude that cognitive control emerges from mutual interactions between exogenous and endogenous sources of information.

D6

MIRRORING AND SOCIAL COGNITION: ELECTROPHYSIOLOGICAL AND TRANSCRANIAL MAGNETIC STIMULATION EVIDENCE FOR DISSOCIABLE SUBCOMPONENTS OF THEORY OF MIND *Jaime Pineda[1,2], Erin Hecht[2], Brang David[1], Agmon Eran[2], Elfenbein Hanie[2], Davis Jena[2]; [1]UCSD, [2]Emory University* – A distinction is made between social-perceptive components of theory of mind (ToM), involving judgments of mental state based on facial and bodily expressions, and social-cognitive components, which are more representation-based and linked to language. This is similar to the distinction between representing the mental state of another as if it were one's own (simulation theory), requiring involvement of the mirror neuron system (MNS), and explicit reasoning about mental states (theory theory), which does not. The MNS, located in part in the pars opercularis of the inferior frontal gyrus (IFG), is thought to be involved in producing shared neural representations about the self and others, including ToM. Furthermore, evidence that mu rhythms over sensorimotor cortex are suppressed during MNS function allowed testing of this componential view of ToM. In Study 1, participants performed an emotion recognition task, assumed to engage the social-perceptual component, while a cartoons task was assumed to engage the social-cognitive component. In Study 2, a 1 Hz repetitive transcranial magnetic stimulation (rTMS) pulse was applied to the left IFG for 5 minutes prior to task performance. In Study 1, mu suppression was positively correlated with accuracy on the social-perceptual but not the social-cognitive task. In Study 2, rTMS inhibited mu suppression. Furthermore, it had little effect on performance on the social-cognitive task, while significantly decreasing accuracy and increasing response latency on the social-perceptual task. These results are consistent with a componential view of ToM and suggest that other mechanisms are necessary for mental attributions of beliefs and intentions.

D7

THE EFFECT OF PREFRONTAL CORTICAL LESIONS ON CATEGORY SELECTIVITY IN VISUAL ASSOCIATION CORTEX *Suraj Pradhan[1], David Fegen[2,3], Mark D'Esposito[2,3,4]; [1]Northwestern University, [2]Henry H. Wheeler Jr. Brain Imaging Center, University of California, Berkeley, [3]Helen Wills Neuroscience Institute, University of California, Berkeley, [4]University of California, Berkeley* – Although numerous theoretical models implicate the prefrontal cortex (PFC) as a source of top-down control signals, this speculation is largely driven by suggestive findings rather than direct empirical evidence. This is predominantly due to the methodological challenges in detecting causal interactions across cortical regions (Miller & D'Esposito, 2005). Previous studies have shown that subregions of visual association cortex (VAC) exhibit specificity for particular categories of complex visual objects. For example, processing of face and scene stimuli preferentially engage the fusiform face area (FFA) and the parahippocampal place area (PPA), respectively. The aim of the current fMRI study was to examine whether disruption of PFC top-down signals would effect the tuning of these VAC category-specific regions. During scanning, five patients with unilateral lateral PFC lesions performed a 1-back task that included 16 second blocks of either face or scene images. Face-selective (i.e. FFA) and scene-selective (i.e. PPA) regions were defined in each hemisphere. There were two main findings. First, an overlap analysis revealed that category selectivity was reduced in the FFA and PPA on the same side of the PFC lesion as compared to the non-lesioned hemisphere. That is, these regions became less selective to their preferred category. Second, using a neural network backpropagation algorithm, a pattern-classifier was less accurate in predicting category membership in the FFA and PPA on the same side of the PFC lesion as compared to the non-lesioned hemisphere. These findings provide direct evidence for a top-down modulatory effect of the PFC on visual association cortex.

D8

DISSOCIATION BETWEEN LINGUISTIC AND VISUOSPATIAL FMRI ACTIVATIONS DURING CONDITIONAL AND TRANSITIVE REASONING *Jérôme Prado[1], Jean-Baptiste Van der Henst[1], Ira Noveck[1]; [1]Laboratoire sur le Langage, le Cerveau et la Cognition (L2C2), Université de Lyon, France* – A highly debated issue in the literature on deductive reasoning concerns the linguistic or visuospatial nature of the inference-making process. Several neuroimaging studies have attempted to address this question but have found heterogenic results. One of the possible explanations for these discrepancies could lay in the fact that different types of logical arguments could involve different types of cognitive processes. To test this hypothesis, we used fMRI while the same participants were asked to reason on both conditional arguments (e.g. there is a triangle; if there is a triangle then there is a circle) and transitive relations (e.g. the square is to the left of the circle; the circle is to the left of the triangle). We found that largely separate functional networks were activated for each logical argument relative to its respective baseline, at the time of the inference making process. While a bilateral superior parietal system was specifically involved in the transitive reasoning task, the conditional task yielded activation in a restricted network involving Broca's area and the left inferior parietal cortex. This functional dissociation suggests that reasoning on conditional arguments mostly rely on linguistic processes while reasoning on transitive relations mostly relies on visuospatial mechanisms. These results are consistent with the idea that there is not a unified cognitive mechanism at the basis of deductive reasoning and suggest that different kinds of processes are involved depending on the type of logical argument.

D9

AGING EFFECTS ON TEMPORAL CONSTRUAL *Kanchna Ramchandran[1], Irwin Levin[1], Antoine Bechara[3], Daniel Tranel[1], Natalie L. Denburg[1]; [1]University of Iowa, [2]University of Southern California* – According to temporal construal theory, people construe the near-term future at concrete, subordinate levels (Ex: making a list=writing things down) and the long-term future at abstract, supra-ordinate levels (Ex: making a list=getting organized). Healthy, community dwelling, older adults (55-79 years) were measured on behavioral tasks of temporal construal. While time perspective (the length of one's self-defined future) declines with age, our results indicate that abstract thinking is significantly higher in the old-old (72-79) vs. the young-old (55-71). These preliminary results are discussed in the context of the anterior prefrontal cortex that is hypothesized to mediate temporal construal and its supposed functional decline with age. It is perhaps in this region (1) where collective experience is structured as abstract rules/prototypes of behavior and (2) where decision-making declines as people age. Thus, older adults may ignore the long-term consequences of their decisions as being too abstract, while disproportionately focusing on immediate payoffs.

D10

THE EFFECT OF LEVODOPA INFUSION ON TASK RELATED FUNCTIONAL CONNECTIVITY IN PARKINSON DISEASE *Grega Repovs[1], Deanna Barch[1], Meghan Campbell[2], Tamara Hershey[2]; [1]Washington University in Saint Louis, [2]Washington University School of Medicine, Washington University in Saint Louis* – Parkinson disease (PD) is a neurodegenerative disease primarily characterized by a depletion of dopaminergic neurons in substantia nigra. Besides pronounced motor disfunction, PD patients also exhibit impairment of a number of cognitive abilities such as working memory (WM) and inhibition in cognitive control. Given the important role of dopamine in modulating the information flow both within frontal lobes as well as to and from other brain areas, we were interested in exploring to what degree the depletion of dopaminergic neurons in PD affects task-related functional connectivity, as well as assessing the effect of dopaminergic treatment on the same. 24 patients with PD and 21 healthy controls took part in a levodopa challenge study. Each participant performed two block-design fMRI runs of 2-back WM and Go/No-Go tasks off and on levodopa infusion. Preliminary analysis of functional connectivity between task related regions of interest conducted on 10 patients and 13 controls revealed significant task dependent differences in functional connectivity between the two groups. The differences were present both in baseline off-levodopa condition as well as in the effect of levodopa on functional connectivity. For patients performing WM task levodopa infusion enhanced connectivity within dorsolateral prefrontal - posterior parietal network, regarded as crucial for WM executive processes. In Go/No-Go task levodopa infusion enhanced connectivity of cortical and subcortical regions to right inferior frontal cortex, a region strongly implicated in response inhibition. The results reveal significant contribution of dopamine to task related integration of brain function and its impairment in PD.

D11

REINTERPRETING COGNITIVE CONTROL AS BAYESIAN INFERENCE *Jeremy Reynolds[1], Michael Mozer[1]; [1]University of Colorado* – Cognitive control refers to the flexible deployment of memory and attention in response to task demands and current goals. Modern theories of cognitive control are often framed in terms of optimization: control operations are performed so as to maximize reward, produce few errors, achieve goals in minimal time, etc. We present a novel perspective on cognitive control which posits that control operations determined by Bayesian inference. We model tasks in which participants are shown sequences of stimuli, some demanding a response, and others modulating the nature of the responses (e.g., Koechlin, Ody, & Kouneiher, 2003). In these tasks, participants must use working memory to maintain the current control set. Our modeling framework is based on a dynamic Bayes network that is initialized with the information contained in the task instructions. The network includes an internal memory whose control operations (storage, retrieval, and reset) are deduced via probabilistic inference. We show that our model provides a parsimonious account of behavioral and neuroimaging data, and offers a novel view of dynamic control hierarchies operating at different time scales that emerge as a response to task demands. Moreover, our framework provides insight into how task instructions can be directly translated into appropriate behavior and then efficiently refined with subsequent task experience.

D12

FUNCTIONAL ANATOMY OF SUSTAINED ATTENTION FOLLOWING TRAUMATIC BRAIN INJURY *Nadine Richard[1], Charlene O'Connor[1], Marina Mandic[2], Adriana Restagno[2], Brian Levine[1,2]; [1]University of Toronto, [2]Rotman Research Institute* – Sustained attention (SA) refers to the endogenous ("top-down") control of attentional resources to maintain goal-directed behavior. In neurologically healthy individuals, SA involves a right-lateralized fronto-thalamic-parietal network, with dorsolateral prefrontal cortex (DLPFC) as the primary substrate for executive control. Frontal lobe functioning is particularly vulnerable to the effects of traumatic brain injury (TBI), often resulting in enduring SA deficit. Neuroplastic mechanisms and/or the engagement of alternate processes offer possible routes for the recovery of endogenous control, with the additional possibility of attentional re-engagement though exogenous ("bottom-up") stimulation (e.g. via alerting tones). This fMRI study measured activation in seven chronic (minimum one year post-injury) moderate-to-severe TBI patients, whose performance on the Sustained Attention to Response Task (SART; Robertson et al., 1997) was comparable to that of ten neurologically healthy controls. Participants performed the SART and a visuomotor control task, each with and without exogenous alerting tones, yielding four experimental conditions in a blocked fMRI design. Rather than the focal right DLPFC activity observed in controls, TBI patients showed activations across several prefrontal regions during SART performance. By contrast, activations in thalamic and right parietal regions were similar across the patient and control groups, suggesting that functioning in these regions is less directly affected by TBI. Exogenous alerting tones had similar performance but different neurophysiological effects in the two groups. These findings suggest that patients who have sustained and functionally recovered from moderate-to-severe TBI recruit an altered network to support sustained attention.

D13

ACTION AND DESIRE: AN FMRI/EYETRACKER STUDY OF REWARD-ORIENTED ACTION PREPARATION *K. Richard Ridderinkhof[1], Helga Harsay[1], Anna van Duijvenvoorde[2], Nick Oosterhof[3], Birte Forstmann[1], Jasper Wijnen[1], Rogier Mars[1]; [1]Acacia, University of Amsterdam, [2]University of Amsterdam, [3]Princeton University, [4]University of Oxford* – In the interface between motivation and action, expectancy of reward plays a critical role. Potential reward can enhance action readiness in systems concerned with action preparation. Nonhuman primate research suggests that the enhancement of action readiness is achieved by a gating mechanism within subcortical areas that upregulates the throughput of cortical information to executive structures in the presence of potential reward. In a combined eyetracker-fMRI-setup, human subjects engaged in an antisaccade task. Reflexive responses had to be suppressed and voluntary responses had to be generated. Information on reward and spatial preparation was precued. Antisaccadic onset-latency served as a behavioural measure for the level of action preparation. In anticipation of reward the striatum was strongly activated and antisaccadic onset latency was reduced. Specific preparatory information on an upcoming action activated cortical and subcortical structures within the oculomotor circuit and reduced antisaccadic onset latency. Furthermore with both reward- and preparatory information available in the preparatory phase the striatum seemed to serve as an integrative structure to improve cross-talk among reward- and oculomotor circuits by "pushing" the superior colliculus to an "up" state to facilitate afferent cortical input. Thus action preparation and efficiency was successfully maximized in the expectation of an upcoming reward.

D14

DOES COMPENSATORY NEURAL ACTIVITY SURVIVE OLD-OLD AGE? *Jenna L. Riis[1,2], Scott M. McGinnis[1,2], Hyemi Chong[3], David A. Wolk[4], Dorene M. Rentz[1,2], Phillip J. Holcomb[5], Kirk R. Daffner[1,2]; [1]Harvard*

Medical School, [2]Brigham and Women's Hospital, [3]University of Texas Southwestern Medical School, [4]University of Pittsburgh School of Medicine, [5]Tufts University – It has been postulated that one compensatory mechanism employed by high-performing older adults to offset age-related declines in neurophysiological functioning is the appropriation of more processing resources. Consistent with this idea, we have found that cognitively high-performing younger-old adults (60-79 years old) respond behaviorally to novel stimuli comparably to their younger counterparts by allocating additional resources, as measured by the P3 event-related potential. We hypothesized that age-associated reductions in processing capacity would cause this mechanism to break down in old-old adults (≥80 years old). Here, we compared old-old to young-old, middle-aged, and young adults who participated in a subject-controlled variant of the novelty oddball paradigm. Preliminary results revealed: 1) Cognitively high-performing old-old adults continued to be engaged by novelty, spending much more time viewing novel than standard stimuli. 2) Distinctions between cognitively high and average-performers in novelty processing persisted in old-old age, with cognitively high-performers continuing to allocate more attentional resources to novel stimuli (as measured by P3 amplitude and viewing duration) than cognitively average-performers. 3) As predicted, across cognitively high-performers, there was a reduction in P3 amplitude to novel stimuli in old-old compared to young-old adults, suggesting that information processing resources may decline in cognitively high-performing old-old adults, undermining their capacity to compensate by appropriating additional resources. 4) Among cognitively high-performing old-old, the P3 response to novel and standard stimuli became less distinct, consistent with the notion that even in successful cognitive aging there may be an age-related reduction in processors specialized to handle specific stimulus types.

D15

DIFFUSION TENSOR IMAGING CORRELATES OF COGNITIVE CONTROL *R. E. Roberts[1,2], P. Nachev[1], M. Husain[2,1]; [1]Imperial College London, [2]Institute of Cognitive Neuroscience & Institute of Neurology, UCL* – Cognitive control is used to describe the management and allocation of resources in response to situations of increased difficulty, interference or competition. The aim of our study was to investigate whether differences in performance, across healthy individuals, on cognitive control tasks can be related to the structure of white matter within their brains using diffusion tensor imaging (DTI). Our subjects were tested on two different tasks, the Eriksen Flanker and Change of Plan paradigms, which examine performance on two different aspects of cognitive control: interference suppression and rapidly switching response plans respectively. In addition to medial and lateral prefrontal fMRI activations, previous Flanker and Change of Plan studies have demonstrated task-relevant activity in parietal cortex. We used the coordinates of these areas to guide the location of our regions of interest (ROIs) in our DTI analysis. In the Flanker ROI, we found a positive correlation between incongruence cost and Fractional Anisotropy (FA) in the white matter adjacent to the intraparietal sulcus (IPS), most prominently in the left hemisphere. In the Change of Plan ROI, there was a positive correlation between performance and FA in the white matter adjacent to IPS, this time most prominently in the right hemisphere. Our initial findings suggest that the microstructure of white matter adjacent to IPS may be related to behavioural performance on two tests of cognitive control. In conjunction with medial frontal regions, IPS may perform a more prominent role in response selection and interference suppression than previously thought.

D16

UNEXPECTED REWARD AND EXPECTED PUNISHMENT ELICIT NEURAL ACTIVITY IN THE STRIATUM AND DORSAL RAPHÉ NUCLEUS RESPECTIVELY. *Oliver J. Robinson[1], Barbara J. Sahakian[1], Roshan Cools[1]; [1]University of Cambridge, Behavioural and Clinical Neuroscience Institute* – Adequate adaptation to our constantly changing environment requires the anticipation of biologically relevant events by learning signals of their occurrence, i.e. reward and punishment prediction. A putative neuronal mechanism of reward prediction is the fast phasic firing of dopamine cells that project to the striatum and the prefrontal cortex. Conversely, the prediction of future punishment may be subserved by serotonin, released by the dorsal raphé nucleus, thus acting as a motivational opponent to dopamine in prediction learning (Daw et al., 2002). Here we demonstrate, using event-related functional magnetic resonance imaging during observational reversal learning, that the ventral striatum and the ventromedial prefrontal cortex are more active when subjects switch responding following unexpected reward than when they switch responding following unexpected punishment. This difference may underlie previously observed contrasting effects of dopamine on behavioural switching following unexpected reward versus punishment (Cools et al., 2006). By contrast, activation centred on the dorsal raphé nucleus was greater for predicted (and unavoidable) punishment than for predicted reward. These data concur with distinct dopaminergic and serotoninergic mechanisms of outcome-based switching and punishment-prediction respectively (Cools et al., 2006; 2007).

D17

DISSOCIABLE NEURAL NETWORKS FOR ATTENTION AND INTENTION DURING PREPARATION IN TASK SWITCHING *Hannes Ruge[1], Todd Braver[2]; [1]University of Technology Dresden, [2]Washington University in St. Louis* – The picture emerging from previous behavioral and brain imaging studies suggests that preparation for frequently changing future task demands seems to be accomplished by attentional means. Specifically, the term "attentional" is used to emphasize that rather general processing routines required for accomplishing a certain task (e.g. letter judgment or digit judgment) are biased in favor of the currently relevant task. This mechanism ensures that upcoming task-ambiguous stimuli (e.g., a letter and a digit) will be preferentially processed within the previously biased channel. Among the most consistently reported brain areas associated with such attentional preparation processes are the posterior parietal cortex and the posterior lateral prefrontal cortex. The present study demonstrates that task preparation can also include intentional (action-oriented), rather than attentional (input-oriented) processes. We show that such a shift of strategy can be induced, when the effects that are entailed by actions in a given task are made explicit. Under such conditions, preparatory BOLD activation was observed in more anterior regions within lateral prefrontal cortex and the anterior intra-parietal sulcus.

D18

MOTIVATIONALLY-BASED MODULATION OF COGNITIVE CONTROL DURING TASK-SWITCHING *Adam Savine[1], Todd Braver[1]; [1]Washington University in St. Louis* – It is becoming increasingly appreciated that the mechanisms by which humans exert control over thoughts and actions will need to be understood in terms of motivational as well as cognitive processes. Motivation may facilitate adaptive mobilization of cognitive control, such that in tasks with higher motivational priority cognitive resources will be more effectively deployed to regulate behavioral performance. The current study tested this hypothesis within the domain of cued task-switching. Participants performed face and word classification tasks in either single-task or mixed-task blocks. In half of the trials (randomly intermixed) in each block an advance incentive cue signaled the potential for a monetary bonus for good performance (with performance criteria set individually from a baseline task block). On non-incentive trials the classic task-switching behavioral performance signatures of switch cost and mixing cost were observed. However, on trials with incentive cues, these costs were significantly attenuated, demonstrating that motivational priority information conveyed by incentive cues is of greater strength or of a different type than the priority information provided by neutral task cues. Neuroimaging data of this paradigm provide additional information regarding the neural correlates of incentive effects on cognitive control. Results are presented regarding incentive cue effects on preparatory lateral prefrontal cortex (PFC) activation, and on PFC and anterior cingulate cortex (ACC) responses in trials subsequent to ones in which reward was not obtained.

D19

THE NEURAL BASIS OF RAPID INSTRUCTED TASK LEARNING *Walter Schneider[1,2,3], Michael W. Cole[1,2,3], Bruna Martins[1]; [1]University of Pittsburgh, [2]Center for Neuroscience, University of Pittsburgh, [3]Center for the Neural Basis of Cognition, University of Pittsburgh* – Interpreting symbols for rapid instructed task learning (RITL) is one of the most powerful yet poorly understood human behaviors. Accurately learning cognitive tasks usually requires only several trials for humans, which is in sharp contrast to the many trials typically necessary for our primate relatives (e.g., thousands of trials over 3-6 months for macaques to learn a simple match-to-sample task for Fuster and Jervey, 1982). This poorly understood yet extremely important cognitive ability relies on explicit task instruction and allows for rapid sharing of behaviors among individuals, increasing cooperation, survivability, and productivity in everyday life. Functional MRI (fMRI) was used here to investigate RITL, comparing loading of novel task instructions to loading of familiar task instructions. We found that an anterior portion of lateral prefrontal cortex (aPFC) is more active during RITL. We suggest that aPFC is important for rapidly converting task instructions into task sets for subsequent task performance. Sustained activity within dorsolateral prefrontal cortex (DLPFC) suggests these task sets are maintained during task performance within this region. DLPFC and other cognitive control network (Cole & Schneider, 2007) regions likely interact to implement each task set constructed by aPFC.

D20

THE INFLUENCE OF SOCIAL EVALUATION ON PERFORMANCE MONITORING: EVIDENCE FROM EVENT-RELATED POTENTIALS AND SKIN CONDUCTANCE RESPONSES *Beate Schuermann[1], Norbert Kathmann[1], Tanja Endrass[1]; [1]Humboldt-University, Berlin* – The affective and motivational state plays a decisive role in behavioural self-regulation, providing insight into stress-related consequences of cognitive functioning. In situations, where errors become highly significant to oneself, e.g. during social evaluation, activity of the self-monitoring system increases in order to prevent errors. Performance monitoring, as an essential prerequisite for altering behaviour, can be investigated using a response-locked brain potential, the error-negativity (ERN), observed at fronto-central electrodes after the execution of errors. Several studies have already examined the influence of financial incentives on the ERN. These studies lead to an increased interest in investigating motivational influences on the ERN in general. However, little is known about the modulating effects of social motivation on performance monitoring. The present study measured the ERN during a modified Stroop task with two motivational conditions in 20 undergraduates. During an evaluation condition the aim was to induce stress, therefore participants were told that performance was directly assessed by a research assistant. In contrast, during a control condition subjects were told that no evaluation would take place. Skin conductance response was measured during both experimental conditions to validate the stress induction. The results suggest a reliably larger ERN and stronger electrodermal activity during the evaluation condition in comparison to the control condition. No behavioural differences could be observed between conditions. ERN modulations are interpreted as consequences of different error perception and error significance under social evaluation. These results emphasize an evaluative function of the ERN, and support its sensitivity to affective and motivational contexts.

D21

EFFECTS OF STIMULUS-RESPONSE CONGRUENCY ON TEMPORAL FLANKER TASK PERFORMANCE: EVIDENCE FOR MODALITY-SPECIFIC CONTROL MECHANISMS *Hillary Schwarb[1], Eliot Hazeltine[2], Eric H. Schumacher[1]; [1]Georgia Institute of Technology, [2]University of Iowa* – Theorists differ regarding the cognitive architecture of executive control; some propose that a unitary central executive mechanism (e.g., Baddeley, 1986; 1996) while others suggest a collection of independent control mechanisms (e.g., Miller & Cohen, 2001) accomplishes this control. In the present experiments, we look for evidence for independent control mechanisms by examining conflict adaptation within and between stimulus modalities. If multiple control mechanisms mediate human performance, then the modality of the task stimulus may be an important factor for determining how cognitive control is allocated. To test whether control transfers across stimulus modalities, we modified the flanker task (Eriksen & Eriksen, 1974) so that the stimuli were differentiated in time rather than space, making it amenable to both visual and auditory stimuli. A four choice version of the task was used to eliminate the contributions of stimulus feature repetitions. As in the standard flanker task, the congruency effect was larger after compatible trials than after incompatible trials – the hallmark behavioral finding of adaptive control processes. However, this sequential effect was only observed when the consecutive trials used the same stimulus modality. When the stimulus modality switched, no adaptive control was observed – this result was obtained even when the two stimulus modalities used highly related SR mappings. These data suggest that sequential effects are restricted to the relevant input modality; that conflict resolution is modality-specific; and that modalities rather than SR mappings determine the boundaries for conflict resolution. The neural implications of separate modality-specific conflict resolution mechanisms were investigated using fMRI.

D22

PREDICTORS OF COGNITIVE CONTROL PROCESSING INCREMENTS IN PRESCHOOLERS FROM POOR HOMES AFTER COGNITIVE TRAINING INTERVENTIONS *Soledad Segretin[1,2], Sebastian Lipina[1,2], Sol Benaros[1], Julia Hermida[1]; [1]Unidad de Neurobiología Aplicada (UNA), CEMIC-CONICET, [2]Escuela de Humanidades, Universidad Nacional de San Martin (UNSAM)* – Previous studies showed negative impact of poverty on executive performance in healthy preschoolers. Two cognitive training interventions [T1: N= 237; T2 N=382) were applied in two new cohorts (3-5 years). Intervention Groups received individual (T1, T2) or group (T2) weekly sessions of training in tasks demanding inhibitory control, working memory, planning, and flexibility processing. Three schemes were applied: 16, 25 or 32 sessions. Control Groups were involved in tasks with non-executive demands (same schemes). Both groups received iron and acid folic supplementation. Teachers and parents received training and/or counselling, respectively. Ethical international and national procedures were applied. Intervention Groups significantly enhanced performance on trained and new tasks (Colombo and Lipina, 2005; Martelli et al., 2007; Segretin et al., 2007). In order to identify the role of independent variables on performance increments, Multinomial Regression Analyses were applied. Higher baseline ages predicted performance increments in verbal working memory (T1: rr=2.36, p=0.01, IC95%=1.19/4.66); spatial working memory (T2: rr=2.88, p<0.001, IC95%=1.63/5.11); and flexibility (T2: rr=2.29, p=0.02, IC95%=1.14/4.60). Lower baseline scores predicted performance increments in attention (T2: rr=0.87, p<0.001, IC95%=0.83/0.92), spatial working memory (T1: rr=0.71, p=0.005, IC95%=0.56/0.90); and flexibility (T1: rr=0.59, p<0.001, IC95%=0.45/0.77; T2: rr=0.53, p<0.001, IC95%=0.41/0.70). Higher parental education and occupation predicted increments in spatial working memory (T1: rr=1.47, p=0.03, IC95%=1.04/2.08) and flexibility (T2: rr=1.25, p=0.02, IC95%=1.03/1.50). Results suggest that a profile consisting in higher baseline ages, lower baseline performances, and higher parental education/occupation backgrounds, were the best predictors of cognitive control performance increments in healthy preschoolers from poor-homes.

D23

DOPAMINE REPLACEMENT THERAPY MODULATES ATTENTION SHIFTING BUT NOT REVERSAL LEARNING IN MILD-MODERATE PARKINSON'S DISEASE *Alison C. Simioni[1], Lesley K. Fellows[1]; [1]McGill University* – Dopamine plays a modulatory role in human cognition, but the mechanisms underlying this modulation remain unclear. Untreated patients with Parkinson's disease (PD) can have variable cognitive deficits, often in the domain of frontal-executive function. Some work suggests that dopamine replacement therapy (DRT) also affects cognition, either improving or worsening specific executive functions. It has been proposed that this relates to regional differences in dopamine denervation within frontal-striatal systems. Existing evidence for this regionally-specific hypothesis is largely derived from between group comparisons in relatively small samples- a concern in this heterogeneous disease. We tested the effects of DRT on dorsolateral and ventromedial prefrontal-striatal function in a cohort of 19 patients with mild-moderate PD, in a within-subjects design. Task shifting was used as a probe of dorsolateral frontal function, reversal learning a test of ventromedial frontal function. Basic motor abilities were measured with the Purdue Pegboard test. DRT had the expected beneficial effect on motor ability, significantly improving pegboard scores. In contrast to prior reports, no significant effect of DRT was detected on standard measures of reversal learning. Treatment did affect task shifting performance. Patients tended to be slower off medication on both switch and non-switch trials, but switch cost was significantly smaller off compared to on medication, again in contrast to previous work. These findings highlight the complex role of dopamine in prefrontal function, and argue against a regional frontostriatal dopamine deficiency-overdose account of executive dysfunction in PD.

D24

BRAIN RESOURCE ALLOCATION IN THE ATTENTIONAL BLINK *Heleen A. Slagter[1], Tom Johnstone[1], Iseult A.M. Beets[2], Bridget Kelly[1], Richard J. Davidson[1]; [1]University of Wisconsin, Madison, WI, [2]Philips-University, Marburg, Germany* – The brain has difficulty processing two temporally close targets, as is evidenced by the "attentional blink" (AB) deficit: If two targets are presented within 500 ms in a rapid sequence of distracters, correct identification of the first target (T1) hinders identification of the second (T2). This deficit is thought to result from competition between the two targets for limited attentional resources. To gain a better understanding of the neural mechanisms underlying the AB, while in an MRI scanner, participants performed an AB task in which T1 and T2 were visual stimuli (a body and a scene respectively) which both activate dissociable areas of occipitotemporal cortex: the extrastriate body area (EBA) and the parahippocampal place area (PPA). This allowed us to examine attentional resource distribution between the two targets. Greater PPA activity was observed in T2seen compared to T2unseen trials, reflecting conscious T2 perception. No overall difference in EBA activation was observed between T2seen and T2unseen trials, confirming the idea that the AB bottleneck occurs at a later locus of processing. However, poor performance was generally associated with greater EBA activity in T2unseen vs. T2seen trials, indicating that individuals with a relatively big AB spent more processing resources to represent T1 in T2unseen trials. This finding supports the idea that the AB results from an over-allocation of resources to T1. Results from additional analyses on simultaneously collected skin conductance, pupil diameter, and heart rate data provide further insight into the role of arousal and cognitive effort in AB task performance.

D25

NEURAL MECHANISMS OF SOCIAL AND NON-SOCIAL REWARD PROCESSING *David V. Smith[1,2,3], Benjamin Y. Hayden[3,4], Justin R. Meyer[2], Jason A. Chen[2], Truong-Kha Trong[2], Allen Song[2], Micheal L. Platt[1,3,4], Scott A. Huettel[1,2,3]; [1]Center for Cognitive Neuroscience, Duke University, [2]Brain Imaging and Analysis Center, Duke University, [3]Center for Neuroeconomic Studies, Duke University, [4]Duke University* – Viewing an attractive face and obtaining money are both rewarding. Monetary rewards, however, are secondary reinforcers (i.e., they cannot be immediately consumed), while social rewards like viewing an attractive face can be immediately experienced by their recipients. We examined whether the receipt of social (attractive faces) and non-social (money) rewards similarly modulate neural systems implicated in learning and valuation of outcomes. We used event-related functional magnetic resonance imaging (fMRI) to examine the brain responses of heterosexual men to female faces. Attractiveness of the face stimuli was calibrated based on normative data from an independent behavioral study. Subjects passively viewed a succession of faces and financial gains and losses (non-hypothetical) while they performed a simple, unrelated task. Monetary gains, compared to losses, evoked activation in the ventromedial prefrontal cortex that scaled with the value of monetary but not social rewards. Activation in the ventral striatum, in contrast, increased with increasing magnitude of both social and non-social rewards. These results suggest that social rewards might be particularly valuable for studying experienced utility since they are consumed immediately unlike money which can only be utilized after the experiment. Ongoing research extends this paradigm to an active choice task in which subjects trade money for the opportunity to view a more attractive face (cf. Hayden et al. 2007). Preliminary data from this latter paradigm suggest that activation in cognitive control regions is modulated by individual differences in subjects' value functions for social rewards.

D26

USING REAL-TIME FMRI TO ACHIEVE ENHANCED CONTROL OVER MEDIAL PREFRONTAL CORTEX *Rachelle Smith[1], Graeme McCaig[1], Kamyar Keramatian[2], Burkard Maedler[3], Kalina Christoff[1]; [1]University of British Columbia, [2]University of British Columbia/Neuroscience Program, [3]University of British Columbia* – Real-time fMRI (rt-fMRI) allows for improved hypothesis testing of proposed functions of higher order brain regions and for presentation of real-time feedback of activation in target areas. While rt-fMRI has been applied in studies of the anterior cingulate, somatomotor cortex, supplementary motor area, parahippocampal place area, amygdala, primary and secondary auditory areas and most recently, the anterior insula, its application to higher order brain regions such as the anterior prefrontal cortex remains relatively unexplored. The present study aimed to test the hypothesis that subjects can learn improved modulation of activation in the anterior medial prefrontal cortex (MPFC) based on rt-fMRI feedback of the average activation in this region. Previous studies have implicated the anterior MPFC in emotional awareness (e.g. Lane et al., 1997) and self-referential processing (e.g. Fossati et al., 2003). Based on these findings, we employed an up-regulation strategy that aimed at focusing attention upon an emotionally significant personal memory (chosen prior to scanning by the subject), while experiencing in fullness and reflecting upon the associated emotion. The down-regulation strategy, on the other hand, aimed at detaching oneself from the associated emotion, while viewing the same personal memory from a more cognitive perspective. Results demonstrate the suitability of this paradigm for modulation of the anterior MPFC. These findings and the developed paradigm bear implications for the development of alternative treatments for clinical disorders such as depression that are often characterized by a ruminative response style (e.g. Nolen-Hoeksema and Morrow, 1991).

D27

THE ANTERIOR CINGULATE CORTEX AND THE PREFRONTAL CORTEX IN PROACTIVE AND CONCURRENT INTERFERENCES - SWITCHING *Myeong-Ho Sohn[1], Byeong-Taek Lee[2], E. Zita Patai[1], Becky Weldon[1]; [1]George Washington University, [2]Seoul National University* – Cognitive control is required to minimize the interference effect on the performance of the goal-relevant task. In this fMRI study, we examined the effects of proactive and concurrent interferences. The proactive interference occurs when the current task is different from the most recent task. The concurrent interference occurs when the current target is accompanied with a distractor. Participants performed two perceptual classification tasks and two semantic classification tasks in a task-switching paradigm. In general, participants were more fluent with perceptual than semantic tasks. The performance of a semantic task was interfered more by a concurrent distractor associated with another semantic task than by a concurrent distractor associated with a perceptual task. In contrast, the perceptual task performance did not differ by the type of concurrent distractor. In addition, the switch cost of a semantic task was greater when preceded by a perceptual task than by another semantic task, which the switch cost of a perceptual task did not differ by the type of the preceding task. Although the behavioral data seemingly portray a contradicting case (i.e., the greater concurrent interference with a semantic task and the greater proactive interference with a perceptual task), the imaging results revealed greater activations in the anterior cingulate and the prefrontal cortex in relation to the semantic task performance. We interpret these results that the semantic task suffers more from the task-level conflict, which is detected by the anterior cingulate cortex and modulated by the prefrontal cortex.

D28

RESPONSE INHIBITION AND ATTENTIONAL PROCESSING IN 5-7 YEAR-OLD CHILDREN WITH AND WITHOUT ADHD SYMPTOMS; AN ERP STUDY. *Marjolein Spronk[1], Lisa M. Jonkman[1], Chantal Kemner[1,2]; [1]Maastricht University, Maastricht, The Netherlands, [2]University Medical Centre, Utrecht, The Netherlands* — Attention-deficit hyperactivity disorder (ADHD) in children below age 7 is still a relatively neglected area in Event-Related-brain Potential (ERP) research. The aim of the present study was to investigate differences in response inhibition and attentional processing in 5-7 year-old children with and without ADHD symptoms, both derived from a community sample. Thirteen ADHD children and 16 control children performed a CPT-AX task. Behavioral measures (hits, false alarms, inattention and impulsivity scores) and ERP measures of conflict monitoring and inhibition (Nogo-N2 and Nogo-P3), cue-orientation and prestimulus target expectation (Cue-N2 and P3) and response preparation (Contingent Negative Variation (CNV)) were collected. Although no behavioral differences were found between the two groups, ERPs showed a significant Cue-P3 at Cz in the control group, which was absent in the ADHD group. Furthermore, CNV was found to be similar at fronto-central leads but larger in the ADHD group at parietal-occipital leads. No group differences for Nogo-N2 were found and Nogo-P3 appeared absent in both groups. The attenuated Cue-P3 effect in the ADHD group is interpreted as a reduced Go-expectation compared to controls. The functional significance of the enlarged parietal-occipital CNV in ADHD children is still unclear. Whereas intact Nogo-N2's in both groups indicate comparable levels of conflict, the absence of the Nogo-P3 in both groups indicates that inhibition processes are still immature at this age. In conclusion, community sample ADHD children perform similar to healthy children at the CPT-task at age 5-7, ERPs, however, show that attention-related brain activity is already deficient at this age.

D29

NEUROPLASTICITY-BASED COGNITIVE TRAINING IMPROVES WORKING MEMORY AND COGNITIVE CONTROL PROCESSES IN SCHIZOPHRENIA PATIENTS: BEHAVIORAL AND FMRI ASSESSMENTS *Karuna Subramaniam[1,2], Tracy Luks[1], Stephanie Aldebot[1], Paul Hennig[1], Adelaide Hearst[1], Melissa Fisher[1], Dawood Subhani[1], Gregory V. Simpson[1], Sophia Vinogradov[1]; [1]University of California San Francisco, [2]Northwestern University* – Previous research has demonstrated that schizophrenia patients show impairments in attention, working memory (WM) and cognitive control functions, which are associated with relative decreases in DLPFC activity compared to healthy controls (HCs). In the current study, we investigated whether neuroplasticity-based cognitive training would improve these impairments. We used fMRI to measure brain activity in 16 patients and 8 HCs while they performed three N-Back tasks, of increasing levels of WM load (0, 1, and 2-Back tasks), and an AX-CPT task that assessed cognitive control. Eight patients were then randomly assigned to 80 hours of computerized targeted cognitive training exercises (TCTs) that trained auditory and visual processing (Posit-Science), and 8 to the control-condition involving 80 hours of graphic-based computer games (CGs). All subjects repeated the fMRI tasks after this 16-week intervention. BOLD fMRI activity was measured on a 3 T GE scanner (EPI; 14 slices every 1sec for the N-Back task; 24 slices every 2sec for the AX-CPT task) before and after intervention. Preliminary results on the 2-Back task regarding the changes in performance relative to baseline indicate that after training, TCTs made 42% more correct rejections and 84% fewer false positives compared to CGs. On the AX-CPT task, the change scores relative to baseline indicate that after training TCTs made 49% more correct target responses (AX); 40% fewer incorrect non-target responses (AY); and 50% fewer misses compared to CGs. Taken together, these findings suggest that neuroplasticity-based cognitive training improves patients' WM and cognitive control operations.

D30

A HIGH DENSITY EEG STUDY OF THE RIGHT INFERIOR FRONTAL CORTEX DURING STOP SIGNAL RESPONSE INHIBITION *Nicole Swann[1], Julie Onton[2], Scott Makeig[2], Adam Aron[1]; [1]UC San Diego, [2]Institute for Neural Computation, UC San Diego* — Prior research has shown that the inferior frontal cortex of the right hemisphere (rIFC) is critical for voluntarily stopping of an initiated response tendency. We used 256 channel EEG to monitor 8 volunteers during a stop-signal task. For each trial, subjects were prompted to initiate a right hand motor response. However, for a minority of trials, an auditory stop signal instructed the subject to inhibit their already-initiated response. Each stop signal was delivered at a variable time relative to the initiation prompt to produce a roughly equal number of successful and failed 'stop' trials. Using independent component analysis (ICA), we extracted a putative rIFC-localized EEG component in all of the 8 subjects analyzed so far. In these components, preliminary observations suggest a stronger increase in theta power during 'stop' trials relative to 'go' trials. This theta response was similar for the early portions of all 'stop' trials regardless of whether or not stopping was successful – consistent with the notion that the stop process is triggered on all trials regardless of outcome (and what determines success or failure is the speed of going). The increase in theta power occurred roughly 200 ms after the stop signal, consistent with prior reports of an event-related potential near 200ms following stop signal presentation (N200). Future analysis will explore possible phase coherence of the rIFC signal with other putatively connected cortical regions.

D31

ELECTROPHYSIOLOGICAL EVIDENCE FOR A DIFFERENTIAL ACTIVATION OF THE BRAIN NETWORK ASSOCIATED WITH TEMPORAL DISCRIMINATION PROCESSING. *Vincenza Tarantino[1], Christina G. Baehne[2], Ann-Christine Ehlis[2], Michael M. Plichta[2], Christian P. Jacob[2], Patrizia S. Bisiacchi[1], Andreas J. Fallgatter[2]; [1]University of Padua, Italy, [2]University of Wuerzburg, Germany* – The ability to discriminate time durations of stimuli is essential in order to optimally shape behaviour. However the question of how temporal information is processed by the brain is still a matter of debate. In the present study we examined behavioural and brain electrical activity related to a visual time discrimination task. Forty-four subjects were required to compare two sequentially presented time intervals: a fixed standard interval (1000 ms), and an equal to standard, longer (1200 ms), or shorter (800 ms) one. Longer intervals were more accurately and faster identified than shorter intervals. ERP data showed a CNV component at centro-frontal sites, which develops during the encoding of the comparison interval and, only for longer intervals, terminates at the end of a memorized standard duration (negative-to-positive shift). In line with previous studies, the shift of CNV might be assumed to reflect the end of a process in which pulses are accumulated.

Interestingly, the analysis of amplitude and scalp distribution of ERP components after the offset of the comparison intervals differentiated the time processing associated with the three time durations. Specifically, the amplitude of a P150 peak linearly increased with the interval length at central and parietal sites. A P500 component was found to be pronounced and earlier in latency in more parietal scalp locations, for longer than for shorter intervals. Results are discussed in the light of memory processes required by the task, and linked to the timing of activation of specific brain areas of a fronto-parietal circuit.

D32

DIFFERENCES IN ACTIVATION BETWEEN CURRENT AND FORMER COCAINE USERS USING A MONETARY INCENTIVE DELAY TASK *Andre Thomas[1], Jennifer Hylton[1], Shashwath Meda[1], Melissa Andrews[1], Michael Stevens[1,2], Godfrey Pearlson[1,2]; [1]1Olin Neuropsychiatry Research Center, Institute of Living at Hartford Hospital, [2]Yale University School of Medicine* – We assessed fMRI activation differences between current and former cocaine users while anticipating rewards using a monetary incentive delay (MID) task. Subjects/Methods. We studied 10 current cocaine dependent subjects (8 male), 13 former cocaine dependent subjects (11 male), and 33 non-drug using healthy subjects (HC; 12 male) with fMRI at 3T. We compared all 3 groups using one-way ANOVA in SPM2, for MID phases (Prospective reward, anticipation of reward, outcome to wins and losses) and small volume correction in predefined ROI's in a "motivational circuit", comprising nucleus accumbens (NAcc), amygdala, ventral tegmental area (VTA), ventromedial PFC, caudate, putamen, hippocampus, anterior cingulate, insula and OFC. Findings. The cocaine groups activated less in NAcc during anticipation periods than HC (0.055 FWE corrected). Current users activated VTA (0.051 FWE corrected) markedly more than former users; both activated > HC. Also, current users deactivated more in left NAcc and right caudate vs former users, contrasted with HC. Conversely, former users activated more in ventromedial PFC in the anticipation phases (0.004 uncorrected and 0.009 uncorrected). Both groups activated more in both the mesial PFC than controls. Failure to activate NAcc during the reward anticipation phase characterized current & past cocaine abusers. Differences in VTA, mesial PFC, and NAcc activation in anticipation phases distinguished the drug groups from controls. Discussion. Data are consistent with a general deficit in dopaminergic reward circuitry, perhaps both predisposing to and exacerbated by cocaine abuse.

D33

INVESTIGATING THE DISTINCTIONS BETWEEN SWITCHING TASKS AND RESUMING FROM INTERRUPTIONS. *Yi-Fang D. Tsai[1], Matthew S. Peterson[1]; [1]George Mason University* – Differences in switch and interruption costs have not been addressed in task-switching and interruptions literature. Task-switching is commonly presented as switching from one task to another when given an external signal. Switch costs may be due to failure of a preparatory process or may reflect carry-over effects of competing stimulus-response associations. In contrast, an interruption occurs when a secondary task temporarily interrupts the completion of a primary task. Compared to a simple task switch, an additional retrieval step is necessary to reactivate the appropriate representations when resuming the primary task. If resumptions require additional memory retrieval, then they should be sensitive to potential interference effects during the interruption interval. Subjects were trained on three discrimination tasks: even-odd, low-high, and consonant-vowel. Subjects performed one of the three discrimination tasks until they were either cued to switch to another task or instructed to remember the last task they performed when given a state change cue (interruption). The length of the interruptions was held constant and one or three task switches occurred during the interruption interval. After the interruption interval, subjects resumed the task that occurred before the interruption. Reaction times were faster for no switch trials compared to switch trials. There was no significant reaction time difference between switch and resumption trials. However, resumption times were faster when the interruption interval contained one task switch compared to when it contained three. These results suggest that resumptions from an interrupting task may suffer interference effects due to the nature of the interrupting task.

D34

MULTIPLE ROUTES TO COGNITIVE CONTROL? BEHAVIOURAL ADJUSTMENT TRIGGERED BY CHANGES IN RESPONSE CONFLICT DOES NOT DEPEND ON INTACT PREFRONTAL CORTEX *Ami Tsuchida[1,2], Lesley Fellows[1,2]; [1]Montreal Neurological Institution, [2]McGill University* – Functional imaging studies have repeatedly implicated two regions of prefrontal cortex in cognitive control: Both dorsal anterior cingulate cortex (dACC) and dorsolateral prefrontal cortex (DLPFC) are commonly activated when adjustment of behavior is needed in the face of response conflict. Recent theories relate these activations to evaluative and strategic functions of these regions, with dACC said to detect conflict, in turn leading to adjustment of cognitive control implemented by DLPFC. Converging support for this view has been more variable. For example, patients with dACC damage do not necessarily show deficits in adjusting performance in response to changing levels of conflict. Here we asked whether any region of human prefrontal cortex is necessary for such performance adjustment. We administered a computerized Stroop color-naming task to 33 subjects with focal frontal lobe damage, and 29 demographically-matched controls. As in prior imaging and lesion work, the proportion of incongruent trials was manipulated to examine how cognitive control was affected by changes in the degree of response conflict. Subjects were assigned to 4 groups, based on the site of damage: right lateral (N=9), left lateral (N=5), dorsomedial (N=10), and ventromedial (N=9). Although damage to left lateral PFC was associated with an exaggerated Stroop effect compared to controls, all 4 lesion groups showed intact adjustment of the Stroop effect in response to changing conflict level. These results argue against a critical prefrontal contribution to such adjustments, and lead us to question the underlying basis of this putative 'top-down' phenomenon.

D35

LEARNING TO IGNORE THE IRRELEVANT: BEHAVIOURAL AND NEURAL CORRELATES OF TARGETED PRACTICE ON A NOVEL SELECTIVE ATTENTION TASK. *Gary Turner[1], Anthony Chen[1,2], Shawn Song[2], Terrence Nycum[1], Mark D'Esposito[1,3]; [1]Helen Wills Neuroscience Institute, University of California, Berkeley, [2]University of California, San Francisco, [3]University of California, Berkeley* – Poor goal direction is consistently identified as a rehabilitation target, yet neural mechanisms underlying improvements in goal-directed behaviour are not well understood. The capacity to parse information as goal-relevant or -irrelevant, is an essential component of goal-direction. Here we investigated neural mechanisms associated with changes in this capacity through targeted practice. We challenged healthy participants to selectively process goal-relevant information while ignoring interleaved, goal-irrelevant stimuli using a modified N-back task design. Participants were presented with a pseudo-random sequence of face and scene stimuli and asked to selectively maintain face stimuli while learning to ignore goal-irrelevant scene stimuli over a single fMRI session during which category relevance remained constant. The task design allowed us to model brain responses to each stimulus category independently. We were interested in whether top-down, selective attention practice would result in changes in neural selectivity (i.e., relative contribution of face and scene-associated brain activity) in the fusiform face area (FFA) and parahippocampal place area (PPA). In PPA, increased neural selectivity with practice was observed for all participants. Selectivity changes were more variable in FFA regions. Both increases in PPA selectivity and greater face-related activity in FFA were associated with faster responses to goal-relevant face stimuli across the scan session. No similar brain-behaviour patterns were observed for the ignored scene stimuli. These data provide preliminary evidence for rapid, practice-related changes in neural selectivity within visual association cortex that are behaviourally relevant. Such neural changes may serve as biomarkers of enhanced goal-directed selection following rehabilitation.

D36

SEX DIFFERENCES IN THE FUNCTIONAL NEUROANATOMY OF WORKING MEMORY IN ADULTS WITH ATTENTION-DEFICIT/ HYPERACTIVITY DISORDER *Eve Valera[1,2,3], Ariel Brown[4], Joseph Biederman[1,2], Stephen Faraone[5], Nikos Makris[3,6], Michael Monuteaux[1,2], Michael Vitulano[1], Michael Schiller[6], Larry Seidman[1,2,7]; [1]Clinical and Research Program in Pediatric Psychopharmacology, Massachusetts General Hospital, [2]Harvard Medical School, [3]Athinoula A. Martinos Center, Massachusetts Institute of Technology, Massachusetts General Hospital, Harvard Medical School, [4]Boston University School of Medicine, [5]SUNY Genetics Research Program, SUNY Upstate Medical Center, [6]Center for Morphometric Analysis, Massachusetts General Hospital, [7]Massachusetts Mental Health Center Public Psychiatry Division, Beth Israel Deaconess Medical Center, Harvard Medical School* – Attention-deficit/hyperactivity disorder (ADHD) in adults is associated with significant morbidity and dysfunction. The majority of ADHD neuroimaging research, often showing functional abnormalities in ADHD, has been conducted with males, so it is unknown whether these findings also apply to females. Thus, we examined sex differences in neural functioning of ADHD adults during performance on a verbal working memory (WM) task. Forty-four adults with ADHD (21 female) and 49 controls (23 female) were group-matched on age, sex, and estimated IQ. Correct responses and reaction time on an n-back task were measures of behavioral WM performance. The BOLD fMRI response was used as a measure of neural activity during WM performance. Behavioral WM performance on the n-back task did not differ significantly between ADHD adults and controls. Using Statistical Parametric Mapping, a comparison of neural activity for all ADHD adults vs. all controls showed decreased activity in a prefrontal region for the ADHD adults. However, separated by sex, analyses revealed that male ADHD adults showed significantly decreased activity relative to male controls in several brain regions, whereas female ADHD adults showed no differences from female controls. Also, correlational analyses revealed negative associations between WM related neural activity and number of hyperactive symptoms for males and number of inattentive symptoms for females. In sum, male but not female adults with ADHD showed altered patterns of neural activity during performance on a verbal WM task. These findings highlight the importance of obtaining large samples and examining groups separately by sex.

D37

PREFRONTAL NETWORK UNDERLYING INHIBITION OF A PREPOTENT RESPONSE: FMRI EVIDENCE *Antonino Vallesi[1], Anthony R. McIntosh[1,2], Donald T. Stuss[1,2]; [1]Rotman Research Institute - Baycrest Centre, Toronto, Ontario, Canada, [2]University of Toronto, Toronto, Ontario, Canada* – Inhibition is an important cognitive function which may be decomposed into different sub-functions. The neural networks underlying inhibition are, however, not yet well-characterized. We addressed this issue by using fMRI on 12 healthy participants performing a Stroop-like go/nogo task. In that task, a prepotent response should be prevented in the presence of a nogo stimulus ("distractor") which shares features with the go stimulus ("target"). Conflict was controlled by matching the distractor with an equally conflicting target. The absence of a response was controlled by matching the distractor with another nogo stimulus category associated with a weaker tendency to respond ("other"). Focusing on frontal regions, multivariate Partial Least Squares (PLS) analysis identified a network of areas mainly activated in the presence of distractors, including bilateral ventrolateral prefrontal cortex (VLPFC), dorsolateral prefrontal cortex (DLPFC), and anterior cingulate cortex (ACC). Functional connectivity among these areas was assessed by selecting a seed voxel in the right VLPFC, and running a subsequent Multiblock PLS analysis that identifies how distributed patterns of brain activity covary together in relation to the task conditions. This analysis confirmed that these areas were functionally connected with each other especially when inhibition was required. Based on previous neuropsychological work, these findings suggest that different prefrontal areas support inhibitory function in complementary and yet interacting ways, such as retrieving the task-rules (left VLPFC), setting up the schemata necessary to prevent a prepotent but inappropriate response (left DLPFC), energising these schemata (ACC), inhibiting the response (right VLPFC) and monitoring the results (right DLPFC).

D38

DIFFERENTIAL EFFECTS OF DEEP-BRAIN STIMULATION IN THE SUBTHALAMIC NUCLEUS ON SELECTIVE RESPONSE INHIBITION *Wery P. M. van den Wildenberg[1], Scott A. Wylie[2], Nelleke C. van Wouwe[2,3], K. Richard Ridderinkhof[1,3]; [1]University of Amsterdam, the Netherlands, [2]University of Virginia, Charlottesville, [3]Leiden University, the Netherlands* – Recent patient studies and fMRI work have shown that the basal ganglia play a key role in a distributed brain network that controls the non-specific abortion of motor responses. The aim of the present study was to specify the involvement of the basal ganglia in the selective inhibition of responses as a more fine-grained form of cognitive control. We employed two well-established paradigms to tap two specific manifestations of selective response inhibition. First, we administered the Simon conflict task (based on the so-called activation-suppression model) to study response capture and selective inhibition of response activation that is triggered by irrelevant information. Second, we employed the stop-change task (based on a horse-race model) to investigate the ability to interrupt and change an ongoing overt action. Our sample consisted of 12 patients diagnosed with Parkinson's disease (PD) who received deep-brain stimulation (DBS) in the subthalamic nucleus (STN). All patients performed the tasks on and off stimulation to address the question whether stimulation is effective in improving the suppression of task-irrelevant response activation (Simon task) and the stop-signal RT (stop-change task). The results show that DBS of the STN impaired interference control and was associated with significantly enhanced selective stopping, as indicated by shorter stop-signal RTs to the change signal. An additional finding is that DBS of the STN did not lead to significantly shorter response latencies to the change signal, pointing towards the functional independence of the effects of DBS on responding and response inhibition.

D39

FUNCTIONAL LOCALIZATION IN NEUROIMAGING: A MULTI-DOMAIN META-ANALYTIC APPROACH *Jared X. Van Snellenberg[1], Jason Buhle[1], Tor D. Wager[1]; [1]Columbia University* – Meta-analysis is an important approach to understanding which brain regions subserve the cognitive and affective functions studied with neuroimaging. The results of meta-analyses within a given domain (e.g. working memory) can identify the location and extent of brain areas that are activated consistently across studies and laboratories. Comparing activations across different meta-analyses can additionally reveal brain regions involved in domain-general processes and demonstrate the specificity and predictive value of findings across a range of task conditions. In the present study, we compared activations from published meta-analyses of working memory (WM, 60 studies), inhibition (47 studies), task switching (31 studies), and emotion (163 studies), and an unpublished meta-analysis of long-term memory (LTM, 165 studies). These comparisons reveal a number of commonalities across domains. Each of the four cognitive domains showed consistent bilateral activation of the inferior frontal junction (lateral BA 9, superior BA 44 and 46) and a dorsal medial junction region at the interface of medial BA 6 and 8 and dorsal BA 32, often referred to as anterior cingulate cortex in the literature. LTM, WM storage, and task switching additionally all activated bilateral anterior insula, as did studies eliciting emotional experience. Finally, LTM, executive WM, and task switching all activated superior parietal cortex (BA 7). Although activations in these regions are often ascribed to different specific functions in individual studies, they are likely to play more fundamental roles in the organization of motivated behavior across many types of tasks.

D40

BOLD SUPPORT FOR BOTH GOAL-DRIVEN AND STIMULUS-DRIVEN BIAS IN THE CONTINUOUS PERFORMANCE TASK *Nelleke van Wouwe[1,3], Richard Ridderinkhof[2], Guido Band[1,3], Merel Pannebakker[1,3], Leon de Bruin[1,3], Serge Rombouts[1,3], Bernhard Hommel[1,3]; [1]Leiden University, [2]University of Amsterdam, [3]Leiden Institute for Brain and Cognition* – Working memory maintenance of the current task context, like rules and intentions, is crucial in acting adaptively. When these rules are insufficiently maintained, current decisions are increasingly biased by recent experiences such as learned associations between features of an event. By means of an event-related fMRI we aimed to distinguish the contribution of rule based control processes and automatically learned cue-probe associations in an adapted AX-continuous performance task, using words (cues) and pictures of faces and houses (probes). The subjects' task was to respond on a target probe given that it was preceded by a specific cue. Behavioral results indicate that top down control and cue-probe associations both explain part of the variance in performance during decision making. If a specific cue stimulus was followed by a face on previous occasions, subsequent presentation of that cue stimulus reactivated the 'face' area in the brain (Fusiform Face Area), regardless of whether it was now followed by a face. We found similar results for cue stimuli followed by houses, which reactivated the 'house' area (Parahippocampal Place Area). On events that violated these cue-probe associations, Dorsolateral Prefrontal Cortex was activated suggesting that this area contributes to reorganizing or retrieving of information in working memory. Moreover, activation in medial frontal areas suggests that increased control was applied in trials when incompatible response tendencies (induced by both rule based expectations as by learned cue-probe associations) had to be corrected. This study shows that top down and bottom up processing interact during decision making.

D41

TO SATISFICE OR MAXIMIZE? NEURAL PREDICTORS OF HEURISTIC USE IN RISKY DECISION MAKING *Vinod Venkatraman[1,2], Kelsey Merison[1], John W. Payne[2,3], James R. Bettman[2,3], Mary Frances Luce[2,3], Scott A. Huettel[1,2]; [1]Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, [2]Center for Neuroeconomic Studies, Duke University Medical Center, Durham, NC, [3]Fuqua School of Business, Duke University, Durham, NC* – Human decision making is frequently characterized as a competition between a rational, cognitive system and an irrational, emotional system. Using a novel incentive-compatible task that sets heuristic and analytic choices into opposition, we demonstrate systematic violations of this dual-systems perspective. Young-adult subjects made decisions about improving five-outcome mixed monetary gambles by adding money to either a reference outcome that changed the overall probability of winning or losing (satisficing choice), or alternative extreme outcome whose selection was consistent with economic models (maximizing choice). Results from a behavioral study (n=128) as well as a fMRI experiment (n=23) revealed that subjects used the satisficing heuristic 70% of the time, with substantial intersubject variability. Greater activation in insular cortex and ventromedial prefrontal cortex, regions often associated with emotional function, predicted economically rational, maximizing choices. Conversely, satisficing choices were predicted by activation of the dorsolateral prefrontal cortex and posterior parietal cortex, regions associated with cognitive control. Most critically, the activation of dorsomedial prefrontal cortex exhibited a decision-by-trait interaction: greater activation for maximizers during satisficing choices and greater activation for satisficers during maximizing choices. Differences between satisficers and maximizers persisted through to evaluation of outcomes. The differential gain-loss activation in the ventral striatum was strongly correlated with the proportion of satisficing choices, suggesting that satisficers are more sensitive to reward consequences of their decisions. Our findings demonstrate that irrationality does not necessarily reflect a failure of cognitive brain systems; instead, control systems may potentiate either rational or irrational choices depending on traits and context.

D42

ELECTROPHYSIOLOGICAL INVESTIGATIONS OF ENDOGENOUS AND EXOGENOUS CONTRIBUTIONS TO LANGUAGE SWITCH COSTS IN OVERT PICTURE NAMING *Kim M. W. Verhoef[1], Ardi Roelofs[1,2], Dorothee J. Chwilla[1,2]; [1]Radboud University Nijmegen, [2]F.C. Donders Centre for Cognitive Neuroimaging* – Response times (RT) are usually longer when individuals switch between tasks (e.g., picture naming and word reading) than when tasks are repeated. Waszak, Hommel and Allport (2003) reported larger switch costs for picture-word stimuli associated with two tasks (picture naming and word reading) than for stimuli associated with one task only (e.g., reading). Moreover, Koch and Allport (2006) demonstrated that the effect of stimulus-task associations can be counteracted by endogenous preparation. We examined endogenous and exogenous contributions to the costs of a supposedly special form of task switching, namely switching between languages. Dutch-English bilingual speakers overtly named pictures in one language or another while we measured event-related brain potentials (ERP). In a first study, all pictures were named in both languages. Endogenous preparation was manipulated by cueing the target language at short (750 ms) and long (1500 ms) preparation intervals. RTs showed larger switch costs for long compared to short intervals. At frontocentral electrode sites, stimulus-locked ERPs were more negative for long compared to short intervals in the N2 time-window. These findings suggest that endogenous language preparation can counteract exogenous language influences. In a second study, picture-language associations were manipulated to test for exogenous language-switch costs directly. Pictures were named in both languages or in one language only. Compared to the single-language pictures, the pictures associated with both languages elicited larger switch costs and they should yield larger N2-type negativities. The RT and ERP results will be discussed in the context of a computational model of bilingual language control.

D43

AGE-RELATED DIFFERENCES IN DISSOCIABLE COMPONENTS OF COGNITIVE CONTROL: AN ELECTROPHYSIOLOGICAL INVESTIGATION OF RULE-SWITCHING *Matthew Waxer[1], J. Bruce Morton[1]; [1]University of Western Ontario* – Rule-switching is thought to involve distinct preparatory and response-related processes. The current study investigated developmental changes in these potentially dissociable aspects of cognitive control by mean of high-density event-related potentials (ERP's). Nine-year-old (n=20), 11-year-old (n=20), and adult (n=20) participants performed a deductive rule-switching task with distinct preparatory and response-related trial periods. On any particular trial, the sorting rule either changed (i.e., switch trials) or remained the same (i.e., repeat trials), and the imperative stimulus either embodied conflict (i.e., conflict trials) or did not (i.e., non-conflict trials). To investigate age-related changes in preparatory processes underlying rule-switching, for each group we compared ERP's in the preparatory period of switch trials and repeat trials. To investigate age-related changes in response-related processes underlying rule-switching, for each group we compared ERP's in the response period of conflict trials and non-conflict trials. All groups were slower and more error-prone on switch trials and conflict trials than on repeat trials and non-conflict trials. There was no interaction between switching and conflict. Analysis of ERP's time-locked to the preparatory period revealed a late negativity over frontal sensors whose amplitude was greater on switch trials than repeat trials and that was more sustained for adults than children. Analysis of ERP's time-locked to the response-period revealed a fronto-central N200 whose amplitude was greater on conflict than on non-conflict trials for 11-year-olds and adults but not 9-year-olds. These findings provide initial insight into age-related differences in dissociable processes involved in rule-switching.

D44

CHANGING THE RULES AT THE DROP OF A HAT: AN ERP STUDY OF PRESCHOOLERS' SET-SHIFTING ABILITY *Sandra Wiebe[1], Daniel Carroll[2], Megan Herrington[1], Sari Raber[1], Kimberly Espy[1]; [1]University of Nebraska-Lincoln, [2]University of Sheffield* – The preschool years are marked by the emergence of the ability to flexibly shift between response modes depending on contextual demands. High-density event-related potentials (ERPs) were used to study the neural bases of this emerging skill in 5-year-old children. A sample of 19 children completed a computerized version of the Shape School task (Espy et al., 2006) and provided usable ERP data. Cartoon shape characters appeared individually on the screen, and children pressed different buttons corresponding to each character's shape (if the character was wearing a hat) or color (if the character was hatless). The rule shifted unpredictably after 1 or 3 non-switch trials, yielding 3 switching condition (Switch-1, Switch-3, or Non-switch). Condition was related to both speed and accuracy ($ps < .05$): response time was significantly slower only for Switch-1 trials, but children performed more poorly on Switch vs. Non-switch trials (91% vs. 94% correct). The Switch-3 condition was associated with a larger N2 at anterior leads, with a corresponding positivity at right posterior leads, relative to both the Non-switch and Switch-1 conditions. The Switch-1 condition elicited a large anterior P3, accompanied by a posterior negativity, relative to the Non-switch and Switch-3 conditions. Timing and topography of neural activation associated with set-shifting varies depending on trial-by-trial contingencies, with earlier neural engagement and faster responses in the Switch-3 condition, and longer switch latencies corresponding to slower neural responses in the Switch-1 condition.

D45

ERP CORRELATES OF RESPONSE TIME DIFFERENCES IN THE IMPLICIT ASSOCIATION TEST *John Williams[1], Rebecca Neil[1], Ally Stevens[1]; [1]Biola University* – In the past decade the Implicit Association Test (IAT) has been widely used in social cognitive research to measure underlying implicit attitudes related to a variety of constructs. Many hypotheses have recently been proposed to explain the source of response time differences typically found between congruent and incongruent conditions. In the present study, event-related potentials (ERPs) were measured during an IAT task which collected responses to gay vs. straight targets and pleasant vs. unpleasant words. As in previous studies, response times were faster in the congruent conditions than the incongruent conditions. The ERP data revealed several differences between the two conditions: First, N200 amplitudes were slightly larger for the incongruent conditions than the congruent conditions, possibly reflecting greater response inhibition during incongruent trials. Second, N400 amplitudes were significantly larger for incongruent trials than congruent trials, a result typically found in semantic matching tasks. Finally, amplitudes of positive-going deflections occurring between 600-800 ms after stimulus presentation were significantly greater during congruent than during incongruent trials, possibly representing a greater familiarity effect in the congruent conditions. All differences were broadly distributed in frontal and parietal areas. Results are discussed with respect to the differing explanations for the source of IAT response time effects.

D46

BENDING THE RULES: INDIVIDUAL DIFFERENCES IN HIGHER-LEVEL CONDITIONAL MOTOR RESPONSES *Uta Wolfensteller[1], D. Yves von Cramon[1,2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Max Planck Institute for Neurological Research, Cologne, Germany* – In everyday life we constantly choose responses based on certain rules or rule combinations. The objective of this fMRI study was to investigate the cerebral correlates of higher-level conditional motor responses during congruent and incongruent rule combination. Participants were required to respond to visual stimuli by pressing the appropriate button according to a currently valid rule. This rule referred either to a single stimulus dimension, i.e. color OR shape, or to the combination of both dimensions, i.e. color AND shape. Congruent stimuli which required the same response in both single dimension rules led to the same response in the combination rule (congruent rule combination). In contrast, incongruent stimuli which required different responses in both single dimension rules led to a different response in the combination rule (incongruent rule combination). Behavioral analyses revealed two subgroups of participants; those showing a congruency effect when implementing the combination rule and those showing non-significant or reverse congruency effects. In the subgroup with a congruency effect, activation related to congruent rule combination was observed in the right intraparietal sulcus. In contrast, activation related to incongruent rule combination was revealed for the left lateral BA 10, left anterior insula, and right superior parietal lobule. Furthermore, the size of the behavioral congruency effect was positively correlated with activation associated with incongruent rule combination in the anterior insula, intraparietal sulcus, and orbitofrontal cortex. Together, the present findings provide novel evidence for interindividual differences associated with higher-level conditional motor responses both on the behavioral and cerebral level.

D47

ANTERIOR CINGULATE CORTEX SIGNALS THE REQUIREMENT TO BREAK INERTIA WHEN SWITCHING TASKS: *Todd Woodward[1], Paul Metzak[1], Clay Holroyd[2]; [1]University of British Columbia, Canada, [2]University of Victoria, Canada* – When switching tasks, if stimuli are presented that cue two of the tasks in the task set (i.e., bivalent stimuli), performance slowing is observed on all tasks, including those not cued by the bivalent stimulus. This slowing has been coined the bivalency effect, and may serve to optimize task switching performance by promoting flexibility at the cost of time when ambiguous stimuli are encountered. Recent work on the function of the dorsal anterior cingulate (dACC) cortex has suggested that this neural region may be recruited when breaking inertia is required to initiate a change in response, such as when bivalent stimuli are encountered. In the current task switching study, we used tightly matched experimental and control conditions in order to isolate the bivalency effect. As predicted, dACC activation was associated with the bivalency effect, supporting an account stating that the role of the dACC is to signal a break in task inertia, for the purpose of potentially changing the course of action. This result may extend the conflict monitoring account of dACC activation to situations where conflict occurred on past trials (i.e., conflict is not elicited by the current stimulus), and/or may support a more generalized account of dACC function involving monitoring internal states for breakdowns that may require interrupting the inertia set into motion by carrying out a series of tasks.

D48

DEVELOPMENT OF TOP-DOWN ATTENTIONAL MODULATION: AN FMRI INVESTIGATION *Samantha B. Wright[1], Carol L. Baym[2], Natalie Repin[3], Adam Gazzaley[4], Silvia A. Bunge[1,5]; [1]University of California at Berkeley, Helen Wills Neuroscience Institute, [2]University of Illinois at Urbana-Champaign, [3]University of California at Davis, [4]University of California at San Francisco / NeuroImaging Center, [5]University of California at Berkeley* – The top-down modulation of attention is a necessary component of goal-oriented behavior as it allows for the filtering out of irrelevant information. Previous studies (Gazzaley et al., 2005) have found that young adults are able to suppress or enhance the maintenance of information in working memory, whereas elderly adults are less able to suppress irrelevant information. The present study focuses on top-down control in children age 8-13, as well as in young adults (current N = 36). The fMRI task consists of three counterbalanced blocks, in which participants view two face and two scene images in random order followed by a probe image on each trial. One block requires participants to pay attention to faces, while ignoring scenes. In another block they are instructed to pay attention to scenes and ignore faces. In a control block, participants passively view all images. After fMRI scanning, participants are given a surprise memory test. We predict that, relative to children, young adults will exhibit stronger modulation of face-selective and scene-selective brain regions as a function of attentional demands (enhance vs. passive vs. suppress). Region-of-interest analyses will be used to test this hypothesis. We further predict that adults will exhibit stronger modulation of subsequent memory performance as a function of attentional demands. Preliminary behavioral analyses are consistent with this prediction, suggesting that there are developmental improvements in the ability to control attention to either faces or scenes in this working memory task.

D49

PARKINSON'S DISEASE REDUCES INHIBITORY CONTROL DURING ACTION SELECTION *Scott Wylie[1], Wery van den Wildenberg[2], Nelleke van Wouwe[1,3], Richard Ridderinkhof[2,3], Kara Downs[1]; [1]University of Virginia, [2]University of Amsterdam, [3]Leiden University* – The ability to inhibit strongly activated, but situationally inappropriate responses is an important aspect of executive cognitive control and is postulated to involve frontal-basal ganglia circuitry. Basal ganglia dysfunction resulting from Parkinson's disease (PD) is hypothesized to reduce inhibitory control, thus producing measurable interference on response time (RT) when an irrelevant response competes with the selection of a preferred response. Larger interference effects have been demonstrated in studies of PD, but a specific role for inhibition can only be speculated. The activation-suppression hypothesis (Ridderinkhof, 2002) offers a framework for understanding interference effects in PD that distinguishes between deficits in "response capture" by an irrelevant response and "selective inhibition" engaged to suppress this response. We administered two well-established measures of response interference, the Eriksen flanker task and the Simon task, to separate samples of PD subjects and healthy controls. Guided by the activation-suppression hypothesis and the prediction that PD would reduce inhibitory control, we focused on how PD affects response capture and response inhibition. Results from both studies show normal patterns of response capture among PD subjects, but diminished efficiency of inhibitory control compared to healthy subjects. These results support the postulation that a fundamental effect of basal ganglia dysfunction produced by PD is a reduced capacity to suppress conflicting responses.

D50

THE ROLE OF MEDIAL PREFRONTAL CORTEX IN RISK DECISION MAKING *Gui Xue[1,2,3], Zhonglin Lu[1,2,3], Irvin P Levin[4], Xiangrui Li[1,2,3], Antoine Bechara[1,2,3]; [1]University of Southern California, [2]Dana and David Dornsife Cognitive Neuroscience Imaging Center, University of Southern California, [3]Brain and Creativity Institute, University of Southern California, [4]University of Iowa* – Risky decision-making relies on evaluating both the value of a given outcome and the risk involved in receiving the desired outcome. Although patients with medial prefrontal cortex (MPFC) lesions are severely impaired on tasks involving risky decisions, the neural processes that support the evaluation of risk versus the evaluation of the outcomes remain to be elucidated. Thirteen healthy young adults were recruited to perform a task that simulates risky decisions (i.e., the Cups task) in a 3T fMRI scanner. The Cups task includes a gain domain and a loss domain. For both domains, each trial consists of a certain option of winning or losing $1 for sure, and a risky option with a probability of winning more than $1 or not winning at all (for the gain domain), or of losing more than $1 or not losing at all (for the loss domain). The risk (risky vs. safe) by outcome valance (win vs. loss) factorial design enabled us to examine their differential effects and interactions. We found that the dorsal and ventral MPFC were parametrically modulated by the experienced risk level versus the received gain/loss, respectively. Individual's risk preference was negatively correlated with the risk-related activation in the dorsal MPFC region, whereas it was positively correlated with the reward-related activation in the ventral MPFC region. These results suggest that the dorsal and ventral MPFC convey different decision signals (i.e., risk vs. the value of an outcome, e.g. reward), which can account for individual differences in decision under risk.

D51

DISSOCIABLE INFLUENCES OF PROBABILITY, MAGNITUDE, AND EXPECTED VALUE ON DECISION-MAKING *Tal Yarkoni[1], Todd Braver[1]; [1]Washington University* – Decision-making in the real world is a highly complex enterprise. To gain traction on the neural mechanisms underlying decision-making behavior, neuroimaging studies typically use relatively simple experimental designs that vary one or two dimensions of interest (e.g., probability or magnitude) while holding other key dimensions (e.g., expected value) constant. It is presently unclear to what extent the results of such studies generalize to more complex situations in which multiple decision-relevant dimensions vary independently and people's decisions may depend on a complex admixture of strategies. The present study used an experimental paradigm that allowed differences in probability, magnitude, and expected value to vary relatively independently across two choices on a trial-by-trial basis. Behavioral experiments demonstrated that the unique influences of these variables on choice behavior could be reliably estimated, and that most participants' choices were influenced by more than one variable. Subsequently, the same paradigm was used in an fMRI experiment, and multiple regression analysis was used to identify brain regions independently sensitive to differences in probability, magnitude, or expected value. Results identified both common and distinct regions associated with trial-by-trial differences in these parameters. Moreover, using different regression models, we identified distinct networks associated with different decision-making strategies—e.g., responding based on explicit computation of expected value versus responding based on heuristic biases such as risk aversion. Our results extend those of previous studies and demonstrate the viability of using relatively complex parametric designs to study the neural substrates of decision-making.

D52

SLEEP DEPRIVATION EFFECTS ON PERFORMANCE AND NEURAL ACTIVATION DURING SIMPLE AND INTEGRATIVE DECISION MAKING *Dagmar Zeithamova[1,2], Victoria Williams[2], W Todd Maddox[1,2], David Schnyer[1,2]; [1]Institute for Neuroscience, University of Texas at Austin, [2]University of Texas at Austin* – As decision making becomes increasingly complex, more anterior regions of prefrontal cortex are engaged. In the current work we hypothesized that sleep-deprived individuals will have difficulty engaging the processes supported by anterior prefrontal cortex, while other simpler decision making tasks will remain less affected. Healthy young participants performed simple and integrative decision making tasks while fMRI was simultaneously recorded using a 3T MRI. Stimuli were novel abstract shapes and subjects were asked to do either a simple alternative choice perceptual matching task or one that involves integration of two perceptual matching decisions. A network of regions including lateral occipital, inferior temporal, inferior parietal and lateral frontal cortices was recruited in both tasks when compared to a low level visual-motor control. Most importantly, polar and orbital regions of the anterior frontal cortex were recruited to a greater degree for the integrative decision making task. Participants were brought back for the same tasks after 24 hours of sleeplessness. There was a small drop of performance during perceptual matching, but a marked drop in performance for the integrative decision making. The performance decline was accompanied by a substantial reduction of activation in the prefrontal cortices. We concluded that anterior parts of the frontal cortex are more vulnerable to sleeplessness, providing a neural correlate of preferential break down of complex cognitive functions under mental fatigue.

Memory: Memory systems

D53

ERP INDICES OF ORTHOGRAPHIC AND NORMATIVE WORD FREQUENCY IN RECOGNITION MEMORY *Erika Nyhus[1,2], Simon Dennis[2,3], Tim Curran[1]; [1]University of Colorado at Boulder, [2]University of Adelaide, Australia, [3]Ohio State University* – Previous research has demonstrated that people are better at recognizing low frequency words than high frequency words. Rugg, Cox, Doyle, and Wells (1995) tested the effect of word frequency on ERPs. Their results showed greater old/new differences over left posterior, superior channels between 400-800 ms for low than high frequency words. These results are difficult to interpret as word frequency is often confounded with orthographic frequency. Therefore, we crossed orthographic frequency, the frequency of letters within a word, with normative word frequency and recorded ERPs during a recognition memory task. Subjects were better at recognizing words with low than high orthographic and normative word frequency. An early ERP effect (starting at 100 ms) recorded over posterior, inferior channels differentiated low from high orthographic frequency. A parietal old/new effect (500-800 ms) recorded over left posterior, superior channels, often thought to reflect recollection processes, was greater for words with low than high normative word frequency. These results suggest that orthographic frequency affects earlier item identification processes, whereas word frequency affects later memory processes. These results will aid in resolving the debate in the computational modeling literature between memory models that postulate that the word frequency effect occurs because of the frequency of the features within a word, such as orthographic frequency (e.g. REM model, Shiffrin & Steyvers, 1997), and those postulating that the word frequency effect occurs because of prior contexts in which the words have been experienced, such as normative word frequency (e.g. BCDMEM model, Dennis & Humphreys, 2001).

D54

AN FMRI INVESTIGATION OF SUCCESSFUL RETRIEVAL IN TESTS OF CUED RECALL AND RECOGNITION *Kayoko Okada[1], Michael D. Rugg[1]; [1]University of California, Irvine* – The majority of event-related fMRI studies of episodic retrieval have employed tests of recognition, and none has directly compared the neural correlates of successful retrieval as indexed by recognition versus recall. Thus the aim of the present study was to contrast 'retrieval success effects' in recognition and word-stem cued recall tests. Participants studied words and were then scanned while performing either a yes/no recognition or a word-stem cued recall test. In both cases, the requirement was to discriminate between studied and unstudied test items. For recognition, responses consisted of overt repetition of the test item followed by an old/new judgment. For cued recall, the requirement was to complete the stem with a study item if possible, or otherwise with any suitable word, and then make an old/new judgment. The neural correlates of retrieval success were operationalized as the difference in activity between items receiving correct old and new judgments. Effects common to the two tasks were found in bilateral lateral and medial parietal cortex. Importantly, a left inferior parietal region previously argued to be selectively activated during recollection-based recognition was among the regions demonstrating a common effect. In addition, several regions, including medial and lateral prefrontal cortex, demonstrated interactions with task. These findings indicate that regions previously associated with successful recognition are also responsive during successful recall. They highlight the potential benefits of memory tests other than recognition procedures to investigate the neural correlates of successful retrieval.

D55

HANDS-ON LEARNING: VARIATIONS IN SENSORIMOTOR EXPERIENCE ALTER THE CORTICAL RESPONSE TO NEWLY LEARNED OBJECTS *Robyn T. Oliver[1,2], Molly A. Parsons[1], Sharon L. Thompson-Schill[1,2]; [1]University of Pennsylvania, [2]University of Pennsylvania, Center for Cognitive Neuroscience* – For hundreds of years, philosophers and psychologists have considered the impact that direct sensorimotor experience has on learning and expression of conceptual knowledge. Here we report direct evidence that variations in sensorimotor experience during learning alter the neural systems involved in memory retrieval. We taught participants to recognize and name a set of 30 novel objects, after either purely visual exposure or after a multimodal exposure combining vision, touch, and action. While the total duration of exposure to each object remained constant across objects and subjects, the amount of tactile and action processing performed with the objects varied across objects and across individuals. After training, we collected fMRI data while participants made judgements about the shape, color, and size of these objects (in response to verbal prompts). Variations in sensorimotor experiences affected the response of two regions of parietal cortex that are thought to play multimodal roles in sensory perception. The results illustrate the distributed nature of the cortical representation of long-term knowledge about objects, and further, they demonstrate the casual effect of the learning modality on the recruitment of sensorimotor cortex during conceptual retrieval.

D56

PERIRHINAL CORTEX ACTIVITY IS RELATED TO ACCURACY IN RECOGNITION MEMORY AND ON PERCEPTUAL DISCRIMINATIONS *Edward O'Neil[1], Anthony Cate[2], Stefan Köhler[1]; [1]The University of Western Ontario, [2]VA Research Service, Martinez, CA* – The prevailing view of the medial temporal lobe (MTL) holds that its structures are dedicated to long-term declarative memory. Recent evidence challenges this position, suggesting that perirhinal cortex (PRc) in the MTL may also play a role in online processing of objects when perceptual discriminations of stimuli with highly overlapping visual features are required. Relevant neuropsychological findings in humans have been inconclusive, however, likely because studies have relied on patients with large, variable MTL lesions, resulting in inconsistent findings across studies. Also, perceptual and mnemonic tasks have not always been matched for difficulty. Here, we conducted an event-related fMRI experiment in 18 healthy participants to directly compare the role of PRc in perceptual discriminations and in recognition memory. We used sets of faces designed to have a large degree of feature overlap as stimuli. Prior to scanning, subjects were familiarized with a subset of faces. During scanning, all trials employed displays with three faces. The perceptual task required identification of an 'oddball', i.e. the face least similar to the other display members. The memory task involved forced-choice recognition of the previously studied face. Task difficulty was manipulated independently in the two conditions. When it was matched, there were no significant differences in PRc activation for the memory and perception trials. Instead, a conjunction analysis revealed a common region in right PRc whose activity was related to accuracy of both recognition memory and perceptual discriminations. These findings show that the functional role of PRc is not limited to long-term declarative memory.

D57

ENCODING ACTIVITY SUPPORTING ITEM-ITEM ASSOCIATIVE VERSUS ITEM-SOURCE MEMORY *Heekyeong Park[1,1], Michael Rugg[1]; [1]Center for the Neurobiology of Learning and Memory, University of California-Irvine* – Previous studies using the subsequent memory procedure have suggested that the successful encoding of associations recruits brain regions additional to those engaged during encoding of items. Here, we investigated whether the regions engaged during successful encoding of inter-item associations differ from those engaged during item-context encoding. Subjects were scanned while they made relational semantic judgments on a list of word pairs which were presented in one of four different locations. In a subsequent unscanned test phase, subjects made associative recognition judgments on studied and new pairs (same pair vs. rearranged pair vs. new) and, for pairs judged same or rearranged, a source judgment (location of the two words at study; for rearranged pairs, both items had always been studied in the same location). In accordance with previous findings, study pairs that were correctly endorsed as intact elicited greater activity in the left ventral inferior prefrontal gyrus and the medial temporal lobe than did pairs that were incorrectly endorsed as rearranged. Importantly these associative subsequent memory effects did not interact with the factor of source accuracy. These findings suggest that encoding of item-item and item-context associations depend upon at least partially dissociable brain regions.

D58

ASSOCIATIONS EVOKED DURING MEMORY ENCODING RECRUIT THE DEFAULT-NETWORK OF THE HUMAN BRAIN. *Jan Peters[1], Irene Daum[1], Elke Gizewski[2], Michael Forsting[2], Boris Suchan[1]; [1]Institute of Cognitive Neuroscience, Ruhr-University Bochum, Germany, [2]University Hospital Essen, Germany* – The brain regions activated during resting states (the so-called "default network") and those involved in the processing of contextual associations have recently been reported to show a remarkable overlap. At the same time, aging and dementia affect similar regions of the brain. Here we explored a recent proposal of associative processing being an important function of this network. In a novel episodic memory encoding task, participants were asked to indicate whether they memorized a picture based on an association evoked by the stimulus (association trials) or based on a distinctive feature of the stimulus (feature trials). Behaviorally, memory encoding with subjective associations enhanced memory formation relative to feature-based encoding, and this effect was more pronounced for rapidly evoked associations. Functional magentic resonance imaging revealed robust activity in all regions of the default network, i.e. medial prefrontal cortex, lateral parietal cortex, retrosplenial cortex / precunues and posterior medial temporal lobe (hippocampus and parahippocampal cortex) for associative relative to feature-based encoding. Importantly, this effect was similar for high-contextual and low-contextual stimuli. In addition to a role in the processing of internally generated information, such as during mind wandering, our data suggest that the default network may support the rapid linkage of external stimuli to stored long-term memory representations.

D59

TASK SWITCHING AFFECTS PREPARATION FOR EPISODIC AND SEMANTIC RETRIEVAL. *Jeffrey Phillips[1,2,3], David Wolk[5,4,1], Mark Wheeler[1,2,3,6]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition, University of Pittsburgh, [3]Learning Research and Development Center, University of Pittsburgh, [4]University of Pittsburgh Medical Center, [5]Alzheimer Disease Research Center, University of Pittsburgh, [6]Center for Neuroscience, University of Pittsburgh* – Memory performance depends partially on attentional factors, such as preparedness for memory search and retrieval. We investigated episodic and semantic task preparation with a task-cueing paradigm, in which subjects were cued randomly before each trial to perform an OLD/NEW (episodic) or LIVING/NON-LIVING (semantic) decision on previously studied and novel stimuli. Behavioral data indicated less efficient processing on trials when the cued task switched rather than repeated from the previous trial. We thus asked whether it was possible to neurally dissociate processing on switch vs. repeat trials. The use of a catch-trial fMRI design allowed independent estimation of preparatory and retrieval-phase responses. Preparatory responses in right thalamus were greater when the cued task switched rather than repeated from the previous trial, regardless of cued task. In contrast, preparatory activity in bilateral intraparietal sulcus and left fusiform gyrus was independent of task-switching requirements. We propose that thalamic preparatory effects reflect modulation by anticipated attentional demands, like the need to reconfigure the current task set. Additionally, task-dependent switch effects were found in bilateral fusiform, right parahippocampal, and medial superior frontal gyri. In these regions, preparatory activity rose and peaked 1-2 trials after subjects switched to episodic retrieval, then fell with repeated semantic task performance. This cyclical response suggests that the neural correlates of episodic task sets emerge and decay gradually, with repeated task performance. The application of a task-switching analysis may be useful in distinguishing voluntary task set reconfiguration from more slowly-evolving attentional states, such as an episodic retrieval mode or orientation.

D60

CORTICOSTRIATAL CONTRIBUTIONS TO THE ACQUISITION AND USE OF IMPLICIT CATEGORY KNOWLEDGE *Amanda Price[1,1]; [1]Elizabethtown College* – This study examined the role of feedback in implicit learning of a multidimensional category structure among PD patients and age-matched controls. Participants completed two implicit learning tasks; underlying category structure was identical on the two tasks though surface details differed. On the feedback-based task, participants received feedback after each categorization decision. In the no-feedback task, participants learned the category structure incidentally as they viewed each stimulus and made a judgment about its appearance; no mention was made of categorization or learning during this exposure phase. Following the feedback-based or incidental exposure phases for the tasks, participants completed an implicit assessment of category knowledge. Sixty trials were presented; half presented stimuli that had been previously seen and half presented stimuli developed by generalizing from the categorization structure to relevant stimuli that had not previously seen. For each stimulus, participants guessed whether it belonged to category A or B. Patients with PD exhibited normal levels of category knowledge for previously seen stimuli in both the feedback-based and no-feedback tasks. Performance on the two tasks did not differ, indicating that implicit category learning in PD is unaffected by the presence or absence of feedback. In contrast, PD patients were impaired relative to controls on novel stimuli generalized from the category structure. These results suggest that corticostriatal dysfunction associated with PD does not impair the implicit acquisition of category knowledge but disrupts the ability to generalize this implicit knowledge to novel situations or stimuli.

D61

WORD CATEGORY DEFICITS IN SEMANTIC DEMENTIA *Friedemann Pulvermuller[1], Elisa Pye[1], Clare Dine[1], Olaf Hauk[1], Karalyn Patterson[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge* – Does the cortex process meaning in a single local cortical module or are meaning representations spread out over different parts of the cortex? Evidence from patients with severe semantic and conceptual deficits, such as Semantic Dementia, SD, is pivotal in answering this question. Neuronal degeneration primarily affects temporal poles in SD, with often some additional involvement of orbito-frontal cortex. Using a lexical decision task, we asked whether word-processing impairments in SD are equally or differentially present for six different lexico-semantic categories. Stimulus matching ruled out possibly confounding factors, including length, frequency, imageability and other psycholinguistic features. The stimulus categories included written words related to actions usually performed, respectively, using the FACE, ARM or LEG, visually-related words with primary relation to COLOUR or FORM information, and ABSTRACT words. Previously published neuroimaging results suggest that brain regions near to the primary site of atrophy in SD may be especially important for processing of FACE and COLOUR words. SD patients (n=11) had significantly impaired lexical decision accuracy overall, compared to age-matched controls, but also showed reliably different rates of success in contrasts of interest. Performance on FACE words was reduced compared with ARM words (with LEG words in-between); visual words from the COLOUR category were more affected than FORM words; ABSTRACT words yielded the poorest performance. With the exception of the latter effect, category differences were absent in a matched control group (N=10). The results are interpreted in terms of a 'hybrid' theoretical framework including both regionally-specific and central components of semantic networks.

D62

DIFFERENCES IN VISUAL MEMORY: SCENE AND FACE FAMILIARITY *Dorian Pustina[1,2], Jan Peters[2], Irene Daum[2]; [1]International Graduate School of Neuroscience, Bochum, [2]Institute of Cognitive Neuroscience, Ruhr-University Bochum* – Memory research suggest the existence of two distinct mechanisms in recognition memory: recollection and familiarity. With respect to the Medial Temporal Lobe (MTL), recollection has been found to activate the hippocampal complex, while familiarity activates different areas in the parahippocampal region. On the other hand perceptual processes for different material types also activate a similar set of structures in MTL raising a new important question. How does memory for spatial (i.e. scenes) and non spatial stimuli (i.e. objects / faces) relate to different grades of recollection and familiarity? Traditional experiments require subjects to rate their own feeling of confidence and permit the creation of receiver operating characteristics (ROCs). Although it has demonstrated its validity this paradigm reduce memory mechanisms to the area of conscious awareness or decision making. In order to avoid subjective responses we manipulated the stimuli graphically to induce familiarity. 204 faces were paired and morphed using a commercial software. The 102 resulting faces gradually shift from one to another in 6 steps of 20% each (0% - 100%). Another 102 stimuli were created from high resolution pictures of scenes and landscapes by moving a virtual window in steps of 20%. We investigated the effect of objective stimulus familiarity on fMRI responses in the medial temporal lobe. Preliminary fMRI data suggest that objective familiarity of faces and scenes recruits distinct medial temporal lobe subregions.

D63

PATTERN CLASSIFICATION OF RECOGNITION MEMORY STATES IN FMRI *Joel Quamme[1], David Weiss[1], Kenneth Norman[1]; [1]Princeton University* – Pattern classification algorithms have been used in fMRI to examine distributed activity patterns in the brain associated with different cognitive states. In this study, we used pattern classification to examine the brain activity associated with strategic recollection and familiarity retrieval modes in a recognition task. Subjects studied singular and plural words, and performed recognition memory tasks in the scanner. We trained a logistic regression classifier to distinguish between subjects' fMRI brain patterns when instructed to recollect details about a previously studied item, and when instructed to pay attention only to general feelings of item familiarity. Then, in a second phase, subjects made old-new judgments to studied, non-studied, and switched-plural versions of studied words (e.g., study FLEAS, test FLEA). After training the classifier on the first phase, we tested it on brain activity from the second phase to obtain the classifier's "best-guess" concerning the subject's cognitive state before, during, and after old, new, and switched-plural trials. We found a network of parietal regions, including intraparietal sulcus and precuneus, that predict more switched-plural correct rejections when the classifier identified a recollection state prior to the stimulus. We discuss implications of the current results for theories of parietal contributions to memory.

D64

CO-OCCURRING PLASTICITY IN DISTRIBUTED NEURAL NETWORKS REVEALS THE COMPONENT PROCESSES CONTRIBUTING TO REPETITION PRIMING *Elizabeth Race[1], Shanti Shanker[2], Anthony Wagner[1,2]; [1]Neurosciences Program, Stanford University, [2]Stanford University* – Repeated conceptual processing of a stimulus results in behavioral facilitation (priming) and functional activation reductions in left ventrolateral prefrontal cortex (VLPFC) and posterior neocortical regions. While initially posited to reflect neocortical tuning, repetition-induced activation reductions have been recently associated with stimulus-response learning. To investigate whether cortical tuning and response learning co-occur and to determine the representational level at which response learning impacts cortical activation, event-related fMRI was used to examine repetition effects at three levels: (a) conceptual repetition, (b) stimulus-decision repetition, and (c) stimulus-response repetition. During study, participants performed one of two semantic classification tasks on words. Subsequently, studied words were represented (conceptual repetition) along with a set of novel words (no repetition). Half of the old words were classified under the same decision as at study (within-task repetition), and half were classified according to the other decision (across-task repetition). Of the across-task trials, half required the same response as at study (response repetition) and half a different response (response switch). Behavioral facilitation was observed for within-task compared to novel and across-task items, providing evidence for stimulus-decision learning. Facilitation was also observed for across-task response-repeat compared to across-task response-switch and novel items, providing evidence for stimulus-response learning. fMRI revealed three distinct patterns of neocortical plasticity: (a) conceptual repetition in left anterior VLPFC, middle temporal, and fusiform cortices, (b) stimulus-decision learning in left posterior/mid-VLPFC, and (c) stimulus-response learning in pre-SMA/anterior cingulate and right mid-VLPFC. Priming is associated with co-occurring neocortical plasticity that facilitates conceptual processing, stimulus-decision mapping, and stimulus-response mapping.

D65

SELECTIVE RECOLLECTION OF TASK RELEVANT INFORMATION: AN ERP STUDY *Elward Rachael[1], Wilding Edward[1]; [1]Cardiff University* – Event-related potential (ERP) old/new effects are differences between the ERPs associated with correct judgments to old (studied) and new test items. One effect - the left-parietal ERP old/new effect - is a correlate of recollection, and changes in the size of this effect have been employed in order to infer the degree to which recollection has been engaged. This logic has been employed in ERP exclusion task studies, where the test requirement is to respond on one key to items from one study context (targets), and on another key to unstudied items, along with items from a second study context (non-targets). In ERP exclusion studies where the likelihood of a correct target judgment is high, the left-parietal old/new effect for non-targets has been markedly smaller than that for targets. This has been interpreted as reflecting strategic retrieval processing, whereby target/non-target judgments are made by relying primarily on the success or failure of attempts to recollect information about targets. This is only an effective strategy when recovery of information about targets is highly likely, and this account explains the majority of published data points. Here, however, we report a marked attenuation of the non-target left-parietal old/new effect despite relatively low levels of target accuracy, contrasting directly with other findings in very similar paradigms. These findings challenge the account described above, and indicate that factors other than the likelihood of recovering information about targets also exert influence over when selective retrieval strategies will be employed.

D66

NEURAL CORRELATES OF IMPLICIT RELATIONAL MEMORY IN AGING *Kelly S. Giovanello[1], Wei-Chun Wang[1]; [1]The University of North Carolina at Chapel Hill* – Relational memory – the form of memory which represents the relationships among items or informational elements – can be tested using explicit tasks (e.g., associative recognition) or implicit tasks (e.g., perceptual relational priming). Older adults, relative to young adults, typically show impaired associative recognition performance, yet intact perceptual relational priming. Previous findings from our laboratory indicate that such age-related deficits in associative recognition reflect reductions in hippocampal specificity with aging. In the current study we tested the hypothesis that older adults, relative to young adults, would show equivalent hippocampal specificity under conditions in which intact perceptual relational priming was observed. Thirty-two individuals participated in the study. Each individual was scanned in four consecutive event-related functional MRI runs. The first two runs comprised the perceptual relational priming task and the second two runs consisted of the associative recognition task. Perceptual relational priming was assessed using a sentence reading task, while associative recognition was measured using a sentence recognition task. Behavioral results showed significant perceptual relational priming for both young and older adults. However, older adults, compared to young adults, demonstrated impaired associative recognition performance. Analysis of the neuroimaging data revealed that young adults activated left hippocampus for associative recognition, as well as during implicit perceptual relational priming as measured by the sentence reading task. Older adults demonstrated right hippocampal activity during associative recognition and bilateral hippocampal activity during perceptual relational priming. These results suggest that older adults' performance on explicit and implicit tasks of relational memory may arise from differences in hippocampal processing.

D67

DORSAL AND VENTRAL POSTERIOR CORTEX SUPPORT VIEW-DEPENDENT OBJECT CATEGORIZATION AND RECOGNITION: EVIDENCE FROM REPETITION SUPPRESSION EFFECTS *Haline Schendan[1,2,3], Chantal Stern[2,3,4]; [1]Tufts University, Medford, MA, [2]Massachusetts General Hospital, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, [3]Boston University, Boston, MA, [4]Center for Memory and Brain, Boston University, Boston, MA* – People are fast and accurate at categorizing and recognizing objects under various viewing conditions (object constancy), but perform worse when viewing objects from unusual angles. Functional magnetic resonance imaging tested the 'multiple-views-plus-transformation' account: While multiple view representations in the ventral pathway are sufficient for canonical views, mental rotation processes, implemented in parietal cortex, are required for unusual views. Participants categorized objects in canonical or unusual views during study and a later indirect memory test. Finally, they recognized each object as old or new. On both an indirect memory test and a recognition test, objects were repeated in the same or different view than studied, or were new. Transfer appropriate processing predicts the largest repetition suppression effects for same unusual views in ventral posterior object processing areas and parietal cortex for mental rotation. The pattern of repetition effects in independently-defined, object-sensitive and mental rotation (and not saccade) areas on both memory tests confirmed this prediction. A visual object knowledge network was revealed that includes a ventral hierarchy for perceptual and conceptual representations of objects. Clear evidence was also found that this network includes a dorsal hierarchy for spatial transformation of objects that is involved in mental rotation. Both the ventral and the dorsal pathways have key roles in visual object cognition, knowledge representation, and implicit and explicit memory. These findings support a two-state interactive framework of object knowledge that integrates vision and memory frameworks to characterize the cortical dynamics supporting meaningful interactions with objects in diverse situations.

D68

EFFECTS OF EMOTION AND REWARD MOTIVATION ON NEURAL ACTIVITY ASSOCIATED WITH EPISODIC MEMORY ENCODING: A PET STUDY *Yayoi Shigemune[1], Nobuhito Abe[1], Maki Suzuki[2], Aya Ueno[1], Etsuro Mori[1], Manabu Tashiro[2], Masatoshi Itoh[2], Toshikatsu Fujii[1]; [1]Tohoku University Graduate School of Medicine, Sendai, Japan, [2]Division of Cyclotron Nuclear Medicine, Cyclotron and Radioisotope Center, Tohoku University, Sendai, Japan* – It has been known that emotion and reward motivation promote long-term memory formation via limbic activations. However, the effects of emotion and reward motivation on memory processing have so far been studied separately; therefore, whether memory enhancement occurs in the context of combination of two factors is still unclear. In the present H215O positron emission tomography (PET) study, the subjects were scanned under four different intentional encoding conditions. These four conditions were made by the combination of two factors (i.e., emotional value of stimuli; negative or neutral, and monetary reward value of stimuli; high-reward or low-reward for subsequent successful recognition). In the recognition phase approximately 24 hours after the encoding phase, subjects were randomly presented with old and new pictures and were required to judge whether or not they had memorized it. Two-way repeated measures analysis of variance (ANOVA) with emotion and reward as factors was used to analyze the recognition memory performance, and yielded significant main effects of emotion (negative > neutral) and reward (high-value > low-value), without an interaction between two factors. Functional imaging data revealed that the left amygdala was activated during the encoding of negative pictures relative to neutral pictures, and the left orbitofrontal cortex was activated during the encoding of pictures with high-reward relative to those with low-reward. The present findings support the view that emotion and reward anticipation recruit limbic activations and enhance long-term memory formation.

D69

THE NEURAL BASIS OF THE COGNITIVE MAP: PATH INTEGRATION DOES NOT REQUIRE HIPPOCAMPUS OR ENTORHINAL CORTEX *Yael Shrager[1], C. Brock Kirwan[1], Larry R. Squire[1,2]; [1]University of California, San Diego, [2]Veterans Affairs Medical Center* – The hippocampus, entorhinal cortex, and related medial temporal lobe structures have been linked to both memory functions and to spatial cognition, but it has been unclear how these ideas relate to each other. An important part of spatial cognition is path integration (the ability to use self-motion cues to keep track of a reference location), and it has been suggested that the path integrator is located in the hippocampus or entorhinal cortex. Patients with bilateral hippocampal lesions or larger lesions that also included entorhinal cortex were led on a path while blindfolded and were then asked to point to their start location. Patients pointed as accurately as controls when they were encouraged to actively maintain the path in mind. They also accurately estimated the distance between the start and end locations. A separate rotation condition confirmed that performance was based on path integration. When demands on long-term memory were increased, the patients were impaired. Thus, in humans the hippocampus and entorhinal cortex are not essential sites where computations needed for path integration are carried out. One possibility is that these computations occur upstream in neocortex, perhaps in the parietal lobe. The hippocampus and entorhinal cortex could then operate on this information, as well as on other inputs, to transform perception into long-term memory.

D70

NEURAL BASIS OF IMPLICIT SEQUENCE LEARNING IN A PROBABILISTIC TRIPLETS LEARNING TASK *Jessica R. Simon[1], Kelly A. Barnes[1], Chandan J. Vaidya[1,2], James H. Howard Jr.[1,3], Darlene V. Howard[1]; [1]Georgetown University, [2]Children's Research Institute, Children's National Medical Center, [3]Catholic University of America* – Implicit learning is the acquisition of knowledge about environmental regularities (e.g. where or when something is likely to occur) without explicit awareness. We used functional Magnetic Resonance Imaging (fMRI) to identify brain activation associated with performance on a new implicit probabilistic sequence learning task involving triplets of trials, called the Triplets Learning Task (Howard et al, under revision). During three event-related fMRI runs, 11 college-aged adults responded to only the third (target) stimulus in sequences of three stimuli by pressing a corresponding button. Unbeknownst to participants, the location of the first stimulus predicted one target location for 80% of the trials (High Probability) and another location for 20% of the trials (Low Probability). Participants demonstrated learning, defined as faster performance on High than Low Probability trials. The neural basis of learning was examined by contrasting regions more active on High relative to Low Probability trials and vice versa. Across both contrasts, activated regions included premotor (BA 6), prefrontal (BA 9/10/11), parietal (BA 7/39/40), cerebellar and Medial Temporal Lobe (MTL) structures. Subsequent correlations with learning scores revealed changes in the neural substrates as training progressed. Learning correlated with MTL activation only in the first run, possibly reflecting binding of the three stimuli within the trials, and correlated with other brain regions later in training (e.g. caudate), reflecting probabilistic learning of triplets that occur more frequently. These results replicate findings of early MTL and late caudate involvement in probabilistic learning and extend them to a probabilistic sequence learning task.

D71

SEPARATING JUDGMENTS OF LEARNING FROM MEMORY ENCODING: AN EVENT RELATED POTENTIAL STUDY *Ida-Maria Skavhaug[1], Edward L. Wilding[2], David I. Donaldson[1]; [1]University of Stirling, [2]University of Cardiff* – We investigated the correspondence between objective and subjective event-related potential (ERP) measures of subsequent memory performance, in order to understand how people make Judgments Of Learning (JOLs). Participants studied a series of word pairs, and for each word pair made a JOL, which was an indication of how confident they were that they would remember or forget the word pair if it was re-presented at a later point in time. Memory for the pairs was assessed on a subsequent recognition memory task and JOLs were a reasonable predictor of the accuracy of memory judgments. ERPs were also recorded at study, and we compared the patterns of activity elicited by (i) items remembered or forgotten at test (the objective measure), and (ii) items rated likely or unlikely to be remembered later (the subjective measure). ERPs revealed two distinct patterns of neural activity; one ERP effect that was shared by the two contrasts, and a second ERP effect that was specific to the JOLs. The findings strongly suggest that while some processes are common to subjective and objective measures of memory accuracy, there are also processes that distinguish between them. Evidence from ERP data reveals that JOLs cannot simply be reduced to the processes that predict the accuracy of memory judgments.

D72

IMPLICATIONS OF THE MEDIODORSAL THALAMIC NUCLEI IN RELATIONAL AND NON-RELATIONAL MEMORY *Eleonore Xian-Chay Soei[1,2,3], Benno Koch[4], Michael Schwartz[4], Irene Daum[1,2,3]; [1]Ruhr-University-Bochum, Universitaetsstr 150, Bochum, Germany, [2]Institute of Cognitive Neuroscience, Ruhr-University-Bochum, Universitaetsstr Bochum, Germany, [3]Research School, Ruhr-University-Bochum, Universitaetsstr, Bochum, Germany, [4]Municipal Hospital Dortmund, Germany* – The mediodorsal thalamic nuclei (MD) have been shown to contribute to human recognition memory, which can be conceptually divided into relational and non-relational memory. To investigate the role of the MD in these processes, we assessed ten patients with focal ischemic lesions in the MD and ventrolateral thalamic regions (VL) on spatial and non-spatial relational and non-relational memory. Each patient was compared to an individual control group of fifteen age-, sex- and IQ-matched healthy participants, since parameters of relational and non-relational memory are significantly affected by age. Of the six MD patients, only one patient preformed similarly to the controls in spatial relational memory, and three patients performed in the normal range in non-spatial relational memory. Two of the four VL patients were impaired in both relational tasks. Neither MD nor VL lesions led to deficits in non-relational memory. This pattern suggests an involvement of the MD in relational memory and is consistent with an interpretation in terms of failure to accurately remember contextual information or retrieval deficits due to MD-prefrontal cortex disconnection. The relational memory deficits following VL lesions are discussed in relation to fronto-striatal circuit disturbances.

D73

PRIMING THE PAST: SALIENT TARGET STIMULI DISTINCTLY AFFECT PRECEDING-PRIME TRACES ACQUIRED WITH AND WITHOUT AWARENESS *Alexander N Sokolov[1], Pietro Guardini[2], Marina A Pavlova[3,4]; [1]Ulm University Medical School, Ulm, Germany, [2]University of Padua, Italy, [3]Children's Hospital, University of Tuebingen Medical School, Tuebingen, Germany, [4]Institute of Med Psychology & Behav. Neurobiology, MEG Ctr, Univ. of Tuebingen Medical School, Tuebingen, Germany* – Perceptual priming is commonly viewed as altered subsequent target processing by preceding prime stimuli. Here, we ask how, if at all, subsequent salient targets modulate memory-trace processing of preceding primes (i.e., backward priming) accomplished with and without awareness of prime identity. On a trial, participants saw a prime, a mask, and a target in succession, pressing a respective key to report prime identity (a square with or without gaps in its outline that was either congruent or incongruent with the target). In experiments 1 and 2, prime identification was either above or at chance level, respectively. With prime awareness (experiment 1), target-prime congruency yielded reduced response times, while without prime awareness (experiment 2), reduced error rates occurred for the congruent primes. The results show the existence of backward, retroactive priming of prime traces by subsequent salient target stimuli. Moreover, the findings suggest an awareness-dependent dissociation of backward priming: backward priming engages either response processing or solely sensory representations with discriminable and indiscriminable prime identity, respectively. The outcome has implications for methods commonly used with ordinary (feedforward) priming to assess detectability and discriminability of primes. Future studies are required that combine functional brain imaging with psychophysics to determine the precise neural mechanisms of backward priming.

D74

ENCODING-RELATED NEURAL ACTIVITY OF PERCEPTUAL PRIMING IN HEALTHY YOUNG AND OLDER SUBJECTS *Anja Soldan[1], Elaine Gazes[1], John Hilton[1], Yaakov Stern[1]; [1]Columbia University, Taub Institute, Cognitive Neuroscience Division* – In this event-related fMRI study we examined how neural activity during encoding of unfamiliar line drawings with or without a coherent 3-dimensional structure is related to behavioral priming on a structural possibility task. Healthy young (N=17; age=18-30 years) and elderly (N=16; age=65-80 years) subjects were tested. The decisions subjects made during the encoding task were unrelated to the structural coherence of these objects. Neural repetition effects occurring during the encoding phase and their relationship to subsequent priming were examined. We found that differential encoding-related neural activity for coherent 3D objects and structurally impossible figures predicted later priming on the structural possibility task. These findings provide evidence for differential neural plasticity as a function of a figures global structural coherence. They also indicate that neural changes occurring in one context during encoding can be associated with later priming in another context.

D75

AGE-RELATED CHANGES IN SLEEP-DEPENDENT CONSOLIDATION OF MOTOR BUT NOT COGNITIVE LEARNING TASKS *Rebecca Spencer[1,2], Jessica Wilson[1], Rich Ivry[1]; [1]University of California, Berkeley, [2]University of Massachusetts, Amherst* – Performance changes are greater on a range of motor and non-motor learning tasks following an interval spent asleep relative to an equivalent interval spent awake. Recently we reported an age-related decline in sleep-dependent consolidation on an explicit motor sequence learning task. Sleep-dependent improvements on this task have been associated with NREM-2 sleep. Sleep-dependent improvements on non-motor, declarative memory tasks have generally been associated with time spent in SWS. Given this distinction, we compared sleep-dependent changes in performance on an explicit sequence learning task and a paired associates task. There were twelve participants in each of the following age ranges: 21-30, 31-40, 41-50, 51-60, and 61-70 years. Consistent with our previous report, in older adults (> 40 yrs) performance improvements on the sequence learning task did not differ for the 12-hr interval awake and the 12 hr interval asleep. However, in both younger and older adults, performance improvements on the paired associates task were greater across the 12 hr interval spent asleep than the 12 hr interval spent awake. Preserved sleep-dependent consolidation of the paired-associates task but not the sequence learning task in older adults may reflect changes in the quantity of NREM-2 sleep in older adults. However, time spent in this sleep stage has been shown to be preserved or even increase with age. Thus, the dissociation between SDC for motor sequence learning and paired associate learning may be related to differential aging effects in neural regions involved in consolidation processes for these two forms of explicit learning.

D76

FUNCTIONAL DYNAMICS OF SUCCESSFUL ENCODING AND RETRIEVAL IN THE HUMAN MTL REVEALED USING INTRACRANIAL EEG RECORDINGS *Bernhard Staresina[1], Thomas Thesen[3], Chad Carlson[3], Orrin Devinsky[3], Lila Davachi[1,2]; [1]New York University, [2]New York University/Center for Neural Science, [3]New York University Medical Center* – How are episodic memories encoded and retrieved in the medial temporal lobe (MTL)? What is the division of labor between anatomically and functionally distinct MTL subregions? In recent fMRI studies, it has been shown that perirhinal cortex (PrC) supports item-level encoding, whereas the hippocampus supports associative encoding. Interestingly, however, we find that if associative information is directly related to an item (i.e., item-feature association), both PrC and the hippocampus show enhanced activation during successful binding. What is the nature of these shared encoding mechanisms? In order to address the spatiotemporal dynamics between PrC and the hippocampus, we recorded intracranial EEG (iEEG) from epilepsy patients with depth electrodes presurgically placed within the MTL. During encoding, participants were presented with concrete nouns superimposed on a colored background. Their task was to imagine the referent of each noun in the presented color and to indicate whether the imagined word/color combination was plausible. During the subsequent retrieval test session, participants were presented with previously seen and novel words. First, participants were asked to indicate whether a given word was 'old' or 'new' (item memory). Further, when they responded 'old', memory for the associated color was queried (item-feature memory). Preliminary data from two subjects point to differential activation within the MTL during encoding and retrieval, and memory-specific analyses will focus on event-related potentials as well as time-frequency representations for successful versus unsuccessful item-feature binding and retrieval across different MTL subregions.

D77

REALITY AND THE SELF WITHIN THE EPISODIC MEMORY NETWORK *Jennifer J Summerfield[1], Demis Hassabis[1], Eleanor A Maguire[1]; [1]Wellcome Trust Centre for Neuroimaging, Institute of Neurology, University College London, London, UK* – Episodic memory is supported by a distributed network of brain regions. Several areas within posterior medial parietal cortex (posterior cingulate, precuneus, retrosplenial cortex) and medial prefrontal cortex (ventral, dorsal) are consistently and strongly implicated. However, the exact contributions of these areas, and the subregions within them, remain unclear. A recent functional MRI (fMRI) study contrasted the recall of episodic memories with recall of closely matched but imagined fictitious experiences (Hassabis, Kumaran, Maguire, submitted). This revealed increased activation in these medial posterior and anterior regions for real personally-experienced events. In the current study we sought to define more precisely how these areas are modulated by the 'realness' of an experience and also the extent to which an experience is self-relevant. Three experimental sessions were conducted over three consecutive weeks. In the first two sessions naturalistic episodic events were elicited, viewed or created. These included real and imagined personal episodic events, and non-personal events from a fictitious film, events from real news clips, imagined film events and imagined news events. Events were matched for age, emotional content and spatial-temporal characteristics. In addition, control tasks required participants to view or imagine single acontextual objects. In the final session events and objects were recalled during fMRI. Several spatially distinct regions were identified within medial posterior parietal cortex and medial prefrontal cortex that were differentially responsive to the manipulations of 'realness' and self-relevance. These findings therefore identify specific functional roles of key regions within the episodic memory retrieval network.

D78

NEURAL MECHANISMS FOR THE RETRIEVAL OF TIME DURATION OF PAST EVENTS *Maki Suzuki[1], Nobuhito Abe[2], Syunji Mugikura[2], Aya Ueno[2], Shigemune Yayoi[2], Syoki Takahashi[2], Toshikatsu Fujii[2]; [1]Cyclotron and Radioisotope Center, Tohoku University, Sendai, Japan, [2]Tohoku University Graduate School of Medicine, Sendai, Japan* – It is still not well understood the neural mechanisms for the retrieval of time information attached with experienced events. In the present study, we investigated brain activation associated with the successful retrieval of 'time duration' of past events using event-related functional magnetic resonance imaging (fMRI). During an encoding phase, subjects were presented with black-and-white face photographs one by one either for long duration (8.5 seconds; LONG) or for short duration (2.5 seconds; SHORT), and were asked to memorize each face with its time duration. This encoding phase was followed by a visual distraction task. During a retrieval phase, the old or new face photographs were presented one by one for 2 seconds in a random order. The subjects were asked to judge whether or not they had seen each presented face, and if they judged it as old, to indicate the presented time (LONG or SHORT) at encoding phase. fMRI scanning was performed both in the encoding and retrieval phases. The results of only the retrieval phase were reported here. Compared with the successful time duration judgment of old SHORT faces, the successful time duration judgment of old LONG faces was associated with the activation in the right inferior occipital / fusiform gyri, dorsolateral prefrontal cortex, and the basal forebrain. The reverse comparison showed the activation in the left superior temporal gyrus. Our data indicate that information of time duration of past events is stored in brain regions engaged in the processing of those events at encoding.

D79

NEURAL SUBSTRATES FOR SOCIAL TRANSITIVE INFERENCE *Shannon M Tubridy[1], Sonja Schmer-Galunder[3], Wendy A Suzuki[2], Lila Davachi[1,2]; [1]New York University, [2]Center for Neural Science, New York University, [3]Columbia University* – While it is known that the hippocampus is critical for relational processing and memory (Cohen and Eichenbaum, 1993; Davachi 2006), little is known about the neural processes supporting memory for social relationships. A recent fMRI study reports no hippocampal activation during processing of social relations (Kumaran and Maguire, 2005). However, social judgments in that study were for relations in over-learned social networks, perhaps enabling use of semantic memory. Work in rats and monkeys (Dusek and Eichenbaum, 1997; Buckmaster et al., 2004) suggests that the hippocampal system is critical for expression of transitive inference (TI) – inferring relationships of nonadjacent items in a hierarchy of overlapping premise pairs – and recent fMRI studies in humans show hippocampal activation during transitive processing of arbitrary stimulus relations (Heckers, et al., 2004; Preston et al., 2004). To test whether the hippocampus plays a role in social relational processing in humans, we adapted a TI task known to rely on hippocampal mechanisms. Participants learned the relationships between pairs of individuals interacting in an office setting such that a dominance hierarchy across all individuals could be inferred from interactions between pairs of individuals. Participants were scanned during TI judgments of social dominance to examine the role of the hippocampus and medial prefrontal regions in the inferential processing of social relations. Preliminary data indicate that subjects were, indeed, able to learn the dominance hierarchy, achieving 90%, 76%, and 80% accuracy on anchor, premise, and transitive test pairs. The relationship of imaging results to behavioral performance is discussed.

D80

REACTIVATION OF MEDIAL TEMPORAL LOBE AND AREA MT/V5 DURING THE RETRIEVAL OF MOTION INFORMATION: A PET STUDY *Aya Ueno[1], Nobuhito Abe[1], Maki Suzuki[2], Yayoi Shigemune[1], Kazumi Hirayama[1], Etsuro Mori[1], Manabu Tashiro[2], Masatoshi Itoh[2], Toshikatsu Fujii[1]; [1]Tohoku University Graduate School of Medicine, Sendai, Japan, [2]Division of Cyclotron Nuclear Medicine, Cyclotron and Radioisotope Center, Tohoku University, Sendai, Japan* – Recent neuroimaging evidence suggests that the retrieval of a prior episode reactivates brain regions that were active when the episode was encoded. However, with regard to the reactivation of medial temporal lobe (MTL), the previous results remain controversial. In the present study, we used positron emission tomography (PET) to assess whether overlapping activity was found in both the MTL and motion-related cortical regions during the encoding and retrieval of motion information attached with meaningless shapes. PET measurements were carried out during four conditions: two encoding conditions (EM; encoding of moving shapes and ES; encoding of static shapes) and two retrieval conditions (RM; retrieval of moving shapes and RS; retrieval of static shapes). During the study, subjects were asked to encode moving (turning around to the right or the left) and static shapes. At subsequent testing, subjects were presented with only the static shapes that had been presented with or without motion during encoding, and were engaged in the retrieval tasks of shapes and motion. To determine whether brain regions activated during encoding were reactivated at retrieval, we used a conjunction analysis of EM vs. ES and RM vs. RS. Overlapping activity was found in the area MT/V5 in the right hemisphere and the left MTL during the encoding and retrieval of meaningless shapes with motion information compared with those without motion information. These results suggest that the retrieval of specific event information is associated with reactivation of both the MTL and the regions involved during encoding of the information.

D81

FMRI CORRELATES OF PERCEPTUAL SPECIFICITY IN IMPLICIT AND EXPLICIT MEMORY *Katja Umla-Runge[1], Hubert D. Zimmer[1], Christian Groh-Bordin[2], Christoph Krick[3], Wolfgang Reith[3]; [1]Brain & Cognition Unit, Saarland University, Germany, [2]Clinical Neuropsychology, Saarland University, Germany, [3]Saarland University Hospital, Germany* – The purpose of this fMRI study was to find out if there are overlapping brain regions responding to a perceptual specificity manipulation in explicit and implicit object memory. Earlier studies demonstrated the involvement of the fusiform gyrus in object priming. Furthermore, a hemispheric specialization was brought forward: right fusiform structures are hypothesized to represent specific properties, left fusiform regions more abstract features of visual stimuli. In the implicit memory task, participants made living/non-living judgments about objects depicted in photographs. Objects were either repeated identically or as different exemplars of the same concepts. A concomitant feature of the implicit task was that it served as an incidental learning phase for a subsequently conducted explicit memory test. Same and different exemplars were randomly intermixed with new objects. Participants were instructed to perform an inclusion task. In the implicit task, we obtained a significant repetition suppression effect in bilateral fusiform gyri only for identically repeated objects. Although fusiform regions were activated in the explicit test relative to a control condition, differential involvement modulated by perceptual specificity and/or memory status could not be observed. Repetition enhancement in explicit memory is supported by other brain structures which are also modulated by perceptual specificity (enhanced involvement of inferior parietal regions for different as compared to identical exemplars and of posterior cingulate cortex for the reverse contrast). Our results suggest that implicit and explicit memory for visual objects share perceptual processes but, apart from that, are supported by very different neural structures responding to perceptual specificity manipulations.

D82

MODULATION OF A NEURAL CORRELATE OF RECOLLECTION BY AMOUNT OF RETRIEVED INFORMATION *Kaia L. Vilberg[1], Michael D. Rugg[1]; [1]UCI* – In a prior experiment (Vilberg & Rugg, 2007), we reported that activity in the left inferior parietal cortex covaried with the amount of information recollected when the demands of the retrieval test required online evaluation of recollected content. The present experiment addressed the question whether activity in this region is modulated by amount recollected when no such online demands are present. At study, participants relationally encoded pictures of objects that were presented as pairs. Half of the pairs were studied for 1 second, whereas the remainder were studied for 6 seconds. Test items were single pictures. The test task was a standard remember/know procedure. A 'surprise' post-test, administered after fMRI data had been acquired, was used to evaluate the amount of information recollected at test for items given Remember responses. Participants correctly recollected more study details for those items presented for a duration of 6 seconds than those presented for 1 second. Recollection was associated with enhanced activity in posterior cortex, most notably left angular gyrus and medial parietal cortex (precuneus). Effects of amount of information recollected, as operationalized by the contrast between remembered items studied for 6 seconds vs. those studied for 1 second, were found in the left inferior parietal cortex, mirroring the results of our prior study. These findings provide further support for the proposal that retrieval-related activity in left inferior parietal cortex reflects processes supporting the representation of retrieved episodic information, irrespective of the evaluative demands at test.

D83

A SYSTEMATIC EXAMINATION OF TRANSITIVE INFERENCE IN OLDER AND YOUNGER ADULTS *Christina Villate[1], Sandra Moses[1], Jennifer Ryan[1,2]; [1]Rotman Research Institute, [2]University of Toronto* – Previous studies suggest that older adults have a deficit in binding multiple objects and their respective relations. We assessed relational memory binding in twenty younger and twenty older adults using the transitive inference task in which subjects learned a series of premise pairs (A>B, B>C, C>D, D>E, E>F) and were asked to make inference judgments (B?D, B?E, C?E). In addition, we administered a medial temporal lobe and a frontal lobe neuropsychological test battery to our older participants to examine whether success was dependent upon the integrity of other cognitive abilities. The transitive inference task revealed that older adults were impaired relative to their younger counterparts in learning the premise pairs and in making later inference judgments. Older adults were also less likely to be explicitly aware that a relational hierarchy existed among the stimuli (A>B>C>D>E>F). The results of the neuropsychological test batteries revealed that older participants who showed superior verbal associative memory showed superior transitive inference accuracy. Conversely, participants who showed superior memory for single items and iconic/pictorial tasks showed inferior transitive inference accuracy. Altogether these results suggest that successful transitive inference performance and conscious awareness for the hierarchical relationship rely on the relational organization of the premise pairs in memory, and such relational memory binding is impaired in normal aging. We speculate that transitive inference performance is mediated by interactions among multiple cognitive systems that support different aspects of processing and the degree of contribution varies depending on underlying cognitive/neural integrity.

D84

BEHAVIORAL AND ELECTROPHYSIOLOGICAL EVIDENCE FOR A NOVEL MECHANISM BY WHICH IMPLICIT MEMORY CAN DRIVE ACCURATE RECOGNITION *Joel Voss[1], Carol Baym[2], Ken Paller[1]; [1]Northwestern University Interdepartmental Neuroscience Program, [2]University of Illinois Urbana-Champaign* – Awareness of memory retrieval commonly accompanies behavioral indications of explicit memory, such as accurate responding in a recognition test. Implicit memory does not entail conscious memory retrieval and is generally preserved in amnesia, even when explicit memory is severely impaired. Whether recognition can instead be accomplished via implicit memory is highly controversial. We sought to unmask implicit memory contributions to recognition in healthy subjects by drastically reducing explicit memory. Forced-choice recognition accuracy for kaleidoscopes improved when explicit memory was degraded. Furthermore, recognition was most accurate when explicit memory was introspectively absent. Event-related EEG responses dissociated implicit and explicit recognition, as early-onset negative potentials indexed the former whereas later-onset positive potentials accompanied the latter. This evidence indicates that implicit memory was operative when explicit memory was unavailable to guide performance, such that objects could be correctly selected in a recognition test in the absence of the awareness of retrieval.

D85

EFFECTS OF ADVANCED AGING ON THE NEURAL CORRELATES OF RECOGNITION MEMORY *T.H. Wang[1,2], M.D. Grilli[1,2], M.D. Rugg[1,2]; [1]Center for the Neurobiology of Learning and Memory, UC Irvine, [2]UC Irvine* – Functional neuroimaging studies investigating the neural correlates of age-related differences in recognition memory have reported that retrieval-related activity ('old/new' effects) are larger and more widespread in older adults (a pattern of 'over-recruitment'). In the present study we investigated whether this pattern becomes more exaggerated with advancing age. We used functional magnetic resonance imaging (fMRI) to contrast retrieval-related activity in two groups of older adults: aged between 84 -96 yrs ('old-old') and 64-77 yrs ('young-old') respectively. At study, participants performed animacy judgments on a series of pictures of objects. In order to behaviorally match later recognition performance, half of the pictures were presented once and the other half twice. The test phase comprised the presentation of all studied items intermixed with new pictures. Subjects were required to indicate whether each test item was previously studied ('old'), new, or whether they were unsure of its study status ('guess'). Recognition performance of the old-old subjects for twice-studied objects was approximately equivalent to that of the young-old subjects for once-studied items. Consistent with previous findings, analyses of event-related BOLD activity revealed an extensive network of 'old/new' effects in the 'young-old' subjects, including medial and lateral regions of both parietal and prefrontal cortex. By contrast, old/new effects in the old-old participants were markedly more restricted, and were most prominent in bilateral superior frontal cortex. Thus, the pattern of cortical over-recruitment that is observed when comparing old/new effects in young-old individuals relative to individuals in their early 20's does not continue its development with advancing age.

D86

EFFECTS OF MEDIAL TEMPORAL LOBE LESIONS ON PERFORMANCE OF A COMPLEX VISUAL SEARCH TASK *David Warren[1], Melissa Duff[2], Daniel Tranel[2], Neal Cohen[1]; [1]Beckman Institute, University of Illinois Urbana-Champaign, [2]University of Iowa Carver College of Medicine* – Long-term declarative memory is widely acknowledged as the chief function of the medial temporal lobe (MTL) region, but recent evidence suggests that these structures may additionally contribute to performance in tasks with short or even no delays under certain circumstances. We tested this emerging view of MTL function in neurological patients with damage limited to the hippocampus or with more extensive MTL damage, as contrasted with normal comparison participants, on a novel visual search task. Successful performance required determining whether a target stimulus was present in a dense field of lure stimuli which varied systematically in their similarity to the target. A sample of the sought target was always available in the center of the screen. Both overt behavioral responses and eye movements were monitored throughout the experiment. Irrespective of the extent of their MTL lesions, all patients with hippocampal damage were able to perform the task, although patient performance was decremented relative to comparison subjects. Eye movement measures revealed that all participants made longer initial fixations to stimuli that more closely resembled the target stimulus. However, eye movement measures also revealed that normal comparison subjects changed their pattern of eye movements across trials, apparently reflecting more efficient search, but none of the patients with hippocampal damage exhibited any reliable changes on the same measures. These data suggest that the hippocampus may contribute to performance when comparisons must be made among stimuli that are sufficiently complex or sufficiently similar even under conditions in which no delays are imposed.

D87

EVIDENCE FOR DISTINCT NETWORKS RELATED TO PERCEPTUAL AND SEMANTIC PROCESSING REVEALED BY SPONTANEOUS FMRI CORRELATION PATTERNS *Gagan Wig[1,3], Daniel Schacter[1,3], Randy Buckner[2,3]; [1]Harvard University, [2]Howard Hughes Medical Institute, Harvard University, [3]Athinoula A. Martinos Center for Biomedical Imaging, MGH/MIT/HMS* – We recently described two dissociable patterns of activity related to semantic classification of visual objects within the context of a repetition-priming paradigm (Wig et al., Society for Neuroscience Abstracts, 2007). The first pattern was related to perceptual characteristics of the classified stimuli, while the second pattern highlighted regions demonstrating sensitivity to semantic (conceptual) processing. Amongst other regions, a region at the confluence of the left inferior temporal gyrus and fusiform gyrus (ITG-FG; BA 37) demonstrated perceptual specificity, while an adjacent region within the left middle temporal gyrus (MTG; BA 21/37) demonstrated conceptual specificity that also tracked frontal cortex. Based on these observations, we hypothesized that each region would demonstrate distinct patterns of spontaneous BOLD functional correlations with the rest of the brain. Participants were scanned at 3 Tesla during passive fixation. The ITG-FG correlated with bilateral regions in the superior, middle and inferior occipital gyri and the precuneus. By contrast, the MTG correlated with bilateral regions of the inferior frontal gyrus and the superior and inferior parietal lobules. Together, these results provide evidence for a functional sub-division between regions of the temporal lobe based on their correlated networks, and extend the application of spontaneous correlation analyses to defining and dissociating semantic and perceptual networks.

D88

MODULATION OF THE EARLY CONTEXT EFFECT IN ABSTRACT AND CONCRETE WORDS REFLECTS ACTIVITY IN THE SEMANTIC SYSTEM – EVIDENCE FROM ELECTRICAL NEUROIMAGING *Miranka Wirth[1], Helge Horn[1], Andrea Federspiel[1], Thomas Koenig[1], Annick Razafimandimby[3], Beat Meier[2], Thomas Dierks[1], Werner Strik[1]; [1]University Hospital of Psychiatry, Bern, Switzerland, [2]University of Bern, Institute of Psychology, Bern, Switzerland, [3]Groupe d'Imagerie Neurofonctionnelle, UMR 6194, CNRS, CEA, Universities of Caen and Paris 5, Caen, France* – Spatial and temporal characteristics of lexico-semantic retrieval are frequently examined with semantic context (i.e. priming) paradigms. These paradigms measure context (i.e. priming) effects in word processing evoked by semantically related context. Besides the well-known attention-dependent N400 context effect (> 250ms), recent Event-related Potential studies demonstrate early automatic context effects in the P1-N1 time period (< 200ms). However, in visual words the semantic origin of the early effects remains debated. This study examined spatio-temporal activation dynamics of the early context effect as well as the modulation of the effect by differences in structure and accessibility of verbal semantics existent in abstract and concrete words. The early context effect was measured in visually-displayed words that followed semantically related single word context. Spatial and temporal characteristics of the effect were analyzed with electrical neuroimaging. In abstract words the early context effect was enhanced compared to concrete words indicated by a topographic dissimilarity in the P1-N1 transition period (116 – 140ms). The concreteness-dependent modulation demonstrates the sensitivity of the early context effect to structural differences in verbal semantics. Moreover, the early context effect in abstract words was explained by enhanced activation in the left (inferior)prefrontal cortex for related compared to unrelated words in addition to temporo-parietal generators recruited in both conditions. Taken together our findings show that the early context effect reflects activation processes in verbal semantic memory.

D89

THE EFFECTS OF SLEEP DEPRIVATION ON CATEGORY LEARNING AND RETENTION *Sasha M Wolosin[1], Dagmar Zeithamova[1,2], David M Schnyer[1,2], W Todd Maddox[1,2]; [1]The University of Texas at Austin, [2]Institute for Neuroscience, The University of Texas at Austin* – We examined the effects of sleep deprivation on category learning and retention. Subjects completed an information-integration and two prototype category learning tasks over two consecutive days (24 hours apart), with sleep (control) or without sleep (sleepless). Information-integration requires integration of information from two or more stimulus dimensions, and is assumed to be mediated by the basal ganglia (Ashby et al., 1998). Prototype learning has been shown to involve different neural systems depending on whether stimuli are compared to a single prototype or are assumed to belong to one of two different prototypes (Zeithamova et al., 2007). By choosing tasks for which the underlying neurobiology is understood, we hope to elucidate how sleep deprivation affects different neural networks involved in categorization. In the information-integration task, subjects categorized stimuli during session 1, and continued to perform the same task 24 hours later. Pre-learned category structures were retained, as shown by initial performance on day 2 compared to final performance on day 1, in both the control and sleepless groups. In the prototype learning tasks, subjects were required to learn either one or two prototypes on each day and categorize stimuli based on those prototypes. In these tasks, subjects in the sleepless group showed a significant drop in performance on day 2, while controls did not. The results suggest that sleep deprivation impairs prototype learning, but does not affect retention of information-integration category structures.

D90

HYPERMNESIA FOR AUTOBIOGRAPHICAL EVENTS AFTER A ONE YEAR DELAY *Cindy Woolverton[1], Jenna Campbell[1], Lynn Nadel[1], Lee Ryan[1]; [1]University of Arizona* – In a recent study, we investigated the retrieval of remote autobiographical memories as a function of repeated retrievals and the passage of time (Nadel, Campbell, & Ryan, 2007). Results suggested that repeated retrievals throughout the course of one month led to an overall increase in detail, an effect known as hypermnesia, increased consistency, and a decrease in reported uncertainty. We were then interested to see if the increased detail and consistency was maintained over a long delay, over one year, or if the memories had returned to their original state. Eight of the original twelve participants came back into the laboratory for a single retrieval session of the same 36 memories that had been discussed in the initial study. We found that the level of internal details remained stable, while the external details increased significantly, approximately 50% above the previous retrieval session from the original study. As a result, there were further hypermnestic effects beyond the heightened level of detail obtained in the original study at this long delay. The highly consistent script that developed throughout the original study was changed with the addition of more detail. Participants recalled details from the initial retrieval sessions that had fallen out of the script in addition to new details that had not been mentioned in any previous session. These findings have implications for long-term consolidation processes and the longevity of short-term repetition effects.

D91

PRACTICE STRUCTURE LEADS TO THE SELECTIVE CONSOLIDATION OF MOTOR SEQUENCES *Nicholas Wymbs[1], Scott Grafton[1]; [1]University of California, Santa Barbara* – Learning a set of skills is easier when trials are distributed into blocks of a similar type compared to trials that are randomly distributed. However, consolidation is better for trials following random practice, an effect known as contextual interference (CI). Using CI and functional magnetic resonance imaging (fMRI), the neural mechanisms supporting consolidation were identified. Individuals learned a set of 4-element sequences with their left hand in a within-subjects design. fMRI was acquired during learning of three sequences acquired according to a block and three to a random practice schedule. Skill retention and fMRI was tested the following day. Behavioral results confirmed the consolidation benefit of random practice. A go-nogo design separated movement preparation from movement execution. To identify CI effects during skill acquisition, an interaction of practice structure and time was calculated. With increasing practice, fMRI activity in planning (nogo trials) and execution (go trials) of sequences from a random schedule were greater in sensorimotor and premotor regions, despite similar performance in the two groups. During retest, trials learned under block and random schedules were presented together. Effects of consolidation were measured by contrasting block and random practiced trials. This revealed greater activation in left sensorimotor and premotor regions for sequence retrieval (go trials) learned with a random practice schedule. These results demonstrate that motor and premotor systems support consolidation for novel motor skills. Manipulation of practice structure is a novel approach for studying consolidation.

D92

AN EVENT-RELATED POTENTIAL STUDY OF RECOGNITION MEMORY FOR WORDS AND FACES. *Yick Yee Ying[1], Wilding Edward[1]; [1]Cardiff University/School of Psychology* – This experiment was designed in order to determine the task-specificity of event-related potential (ERP) old/new effects. These effects are differences between ERPs associated with old and new items attracting correct old/new recognition judgments. They are assumed to index retrieval processes. ERP old/new effects for faces and words were contrasted, and these stimuli were selected because of indications that faces and words are associated with different old/new effects. Participants completed face and word study-test blocks. In all study phases, participants indicated the screen location where words/faces were presented (left, right, central). In all test phases, participants made recognition memory judgments. Discrimination was superior and reaction times were faster for words than for faces. Moreover, ERPs associated with correctly judged old items were more positive-going than those associated with correctly judged new items. These old/new effects were largest anteriorly from 300 to 500ms, and posteriorly from 500 to 800ms. Critically, there were reliable differences between the ERP old/new effects for faces and words from 500 to 800ms, where they extended anteriorly for faces to a greater extent than for words. This task-specific effect could not be explained by the different discrimination rates for the two stimulus types, and the findings indicate that there are retrieval processes common to faces and words, in addition to processes that are engaged selectively for faces. These stimulus types vary on multiple dimensions, and it will be important to vary these systematically in order to delineate the principal determinants of the task-specific old/new effects reported here.

D93

ELECTROPHYSIOLOGICAL CORRELATES OF LONG-TERM AND SHORT TERM MEMORY FOR FACES: MODULATIONS IN THETA, ALPHA AND GAMMA ACTIVITY *Elana Zion-Golumbic[1], Marta Kutas[2], Shlomo Bentin[1,3]; [1]The Hebrew University of Jerusalem, Jerusalem, Israel, [2]University of California, San Diego, [3]The Interdisciplinary Center for Neural Computation, The Hebrew University of Jerusalem, Jerusalem, Israel* – Social interaction depends on our ability to create, store and retrieve memories for human faces. This human ability involves multiple levels of representation which presumably must interact for successful memory retrieval. We investigated the neural mechanisms involved in creating and retrieving memories for new faces, with which subjects have no prior experience. These were compared to famous faces, for which participants have elaborate perceptual and semantic neural representations. Participants studied a series of faces which they later were asked to recognize when interspersed in a series of new faces. Famous and non-famous faces were presented in separate blocks. EEG was recorded throughout and analyzed in different frequency bands. Theta (4-7Hz) and Alpha (8-12Hz) amplitudes were modulated by memory, distinguishing between correctly remembered old faces (hits) and correctly categorized new faces (CR), regardless of pre-experimental face familiarity. In addition, hits exhibited increased theta phase-locking across many long-distance electrodes, relative to CRs. In contrast, induced Gamma activity (30-80Hz) was modulated by familiarity, being greater for famous than unfamiliar faces, similarly for both hits and CRs. This pattern suggests that Theta and Alpha rhythms are systematically related to short-term mnemonic processes, whereas induced Gamma activity is more related to the accessing of long-term memory representations.

Memory: False memory

D94

RECOLLECTION FAILURE INCREASES FALSE RECOGNITION IN PATIENTS WITH ALZHEIMER'S DISEASE *Nobuhito Abe[1], Toshikatsu Fujii[1], Yoshiyuki Nishio[1], Osamu Iizuka[1], Shigenori Kanno[1], Hirokazu Kikuchi[1], Masahito Takagi[1], Kotaro Hiraoka[1], Hiroshi Yamasaki[1], Kazumi Hirayama[1], Hyunjoo Choi[1], Etsuro Mori[1]; [1]Tohoku University Graduate School of Medicine, Sendai, Japan* — Recent neuropsychological evidence suggests that patients with Alzheimer's disease (AD) are impaired in recollection-based monitoring processes and therefore exhibit increased rate of false recognition. To obtain further evidence for this notion, we compared patients with mild AD with age-matched control subjects using a recognition memory task. Subjects studied animate or inanimate items. These items were presented either once or three times. Subjects were later asked to make a old/new recognition judgment in response to (1) same – items identical to those seen at encoding, (2) similar – items similar but not identical to items seen at encoding, and (3) new – non-studied, unrelated items. To the same items, repeated presentation of stimuli increased the proportion of 'old' response in both groups. To the similar items, repeated presentation of stimuli increased the rate of 'old' response in AD patients, whereas the 'old' response rate in control subjects did not differ between the single and repeated presentations of stimuli. The results indicate that repeated presentation of stimuli at encoding increased a feeling of familiarity for the studied items in both groups. In response to the similar items, the control subjects might be capable of counteracting this feeling of familiarity by recollecting the original items, but AD patients might not. Consistent with the results of previous studies, our results seem to further support the view that patients with AD are impaired in their ability to use recollection to reduce familiarity-based false recognition.

D95

FALSE MEMORIES: ENCODING PROCESSES AND THE WORD FREQUENCY MIRROR EFFECT. *Eve Attali[1,2], Francesca De Anna[1,2,3], Bruno Dubois[1,2,3], Gianfranco Dalla Barba[1]; [1]INSERM U610, Paris, [2]UPMC Paris, [3]Hopital Pitie Salpetriere Paris* — One of the most replicable empirical results in the recognition memory literature is the word frequency mirror effect (WFME). This effect refers to a phenomenon where the false recognition (FR) rate is higher for high frequency (HF) words, which are assumed to have a strong representation in semantic memory, while the hit rate is higher for low frequency (LF) words which are assumed to be also represented in episodic memory. This WFME in the recall tasks is still debated. Moreover, little is known about the role of encoding processes on the WFME. Sixty subjects were asked to study 3 lists of HF and LF words under 3 different encoding conditions: semantic, phonological and non-specific. After studying each list, subjects were asked to recall as many words as possible or to recognize studied words from a pool of 24 targets, 24 related foils and 24 unrelated foils. The WFME was confirmed in the recognition task but not in the recall task. Semantic encoding induced better recall and recognition than the two other encoding conditions. In contrast, phonological encoding induced more intrusions and FR than the two other encoding conditions. These results suggest that strongly represented semantic information plays a different role in recall and recognition, affecting differentially true and false memories. The results also show that encoding processes play a crucial role in the production of false memories and suggest that encoding that relies on semantic memory improves accuracy in a subsequent memory test, increasing correct responses and reducing false memories.

D96

REMEMBERING THE GENDER BUT NOT THE IDENTITY OF THE SPEAKER: AN MEG STUDY OF PARTIAL SOURCE MEMORY *Shih-kuen Cheng[1], Yuhan Chen[1], Daisy L. Hung[1,2], Ovid J.-L. Tzeng[1,2,3]; [1]Institute of Cognitive Neuroscience, National Central University, Taiwan, [2]Institute of Neuroscience, Naiontal Yang-Ming University, Taiwan, [3]Institute of Linguistics, Academia Sinica, Taiwan* — This study examined whether imprecise source information derived from gist memory supports source judgments in the form of recollection or familiarity. Participants listened to two lists of semantically related words spoken by two male voices and two female voices respectively. At test, participants made source judgments to visually presented items while MEG was recorded. MEFs were categorized into source correct hits (the identity of the speaker was correctly identified), within-gender source errors (the incorrectly identified speaker was of the same gender with the correct speaker), between-gender source errors (the incorrectly identified speaker was of different genders with the correct speaker), and correct rejections. During 400 to 700 ms after stimulus onset, the MEFs recorded over left temporal-parietal scalps were more positive-going for HIT/Source Correct trials than for Hit/Withing-Gender Source errors, which was of no difference from correct rejections. This MEG old/new effect resemble the left parietal ERP old/new effect, which has been linked to recollection based recognition. During 400 to 700 ms after stimulus onset, the MEFs recorded over the left occipital scalp regions was of similar amplitude for HIT/Source Correct and HIT/ Within Gender Source Errors, and were larger for these two response categories than correct rejections. This effect might reflect the magnetic-physiological correlates of retrieving partial, imprecise source information. The distributions of these two MEG old/new effects were not identical, suggesting different, non-overlapping neural substrates involved in the retrieval of specific and partial source information.

D97

MEMORY, CONSCIOUSNESS AND TEMPORALITY: TOWARD A TAXONOMY OF CONFABULATION *Gianfranco Dalla Barba[1,2], Marie-Françoise Boissé[2], Stéphanie Carrus[2], Bruno Dubois[1,3]; [1]INSERM U. 610, Paris, France, [2]Hôpital Henri Mondor, Créteil, France, [3]Hôpital de la Salpêtrière, Paris, France* — In the last two decades the literature on confabulation has been largely influenced by the distinction between spontaneous and provoked confabulation. However, this distinction has been challenged by several theoretical and experimental observations. In this study we administered to 10 patients with an amnesic confabulatory syndrome a new version of the "Confabulation Battery", which includes 15 questions for each of the following domains: Personal Semantic Memory, Episodic Memory, Orientation in time and place, Linguistic Semantic Memory, Recent General Semantic Memory, Contemporary General Semantic Memory, Historical General Semantic Memory, Semantic Projects, Episodic Projects, "I don't know" semantic questions (e.g., "What did Marilyn Monroe's father do?"), and "I don't know" episodic questions (e.g. "Do you remember what you did on March 13, 1985?"). Spontaneous Confabulations were also collected during informal conversation. A total of 412 provoked and 60 spontaneous confabulations were analyzed according to the type of their content and, for provoked confabulations, also according to the type of question that elicited them. Regardless their modality of appearance (spontaneous vs provoked), 75% of confabulations was classified as either misplacement of true memories in wrong time and place, or report of premorbid routine activities. Only 7% of provoked and 1% of spontaneous confabulations showed the 'fantastic' content described in the literature. Provoked confabulations were mainly restricted to Episodic Memory, Orientation in time and place and Episodic Projects. Following these results, we propose a new taxonomy of confabulation based on the Memory, Consciousness and Temporality Theory (Dalla Barba, 2002).

D98

CEREBRAL CORRELATES OF FALSE MEMORIES AFTER SLEEP AND SLEEP DEPRIVATION *Annabelle Darsaud[1], Hedwige Dehon[2], Virginie Sterpenich[1], Thanh Dang-Vu[1], Martin Desseilles[1], Steffen Gais[1], Luca Matarazzo[1], Manuel Schabus[1], Gilles Vandewalle[1], André Luxen[1], Fabienne Collette[2], Pierre Maquet[1]; [1]Cyclotron Research Centre, University of Liège, Belgium, [2]Cognitive sciences Department, University of Liège, Belgium* – Memory is often accurate but errors and distortions also occur. Although sleep has been shown to facilitate accurate memory consolidation, little is known as to its effects on memory distortions. Hence, we investigated the effects of sleep on the production of DRM false memories (FMs) and their neural correlates in an fMRI protocol. Subjects listened to a set of 32 thematic lists, each of which consisted in 15 semantic associates (target items) converging to a critical non presented theme word (lure). Subjects were divided in two groups that either slept (S, n=18) or were sleep-deprived (SD, n=18) on the first post-session night. Recognition was assessed after 2 recovery nights and consisted in a remember/know/new judgement on the targets items, lures and new words. Functional MRI data were acquired using a 3T Allegra MR scanner and analysed using SPM5. Behavioural results showed a significant main effect of sleep on true and false recognition with S group remembering significantly more studied words ($p<0.001$) and lures ($p=0.056$) than SD group. Patterns of brain responses significantly differed between groups suggesting that the two groups engaged different networks to retrieve true and false memories. That is, the production of "remember" responses for the target information was associated to parietal and cortical areas in the SD group, while a "remember" response to a lure was associated to activity in the hippocampus in the S group. This hippocampal activation may be understood as an offline processing of memories during sleep.

D99

TEMPORAL CONSCIOUSNESS AND CONFABULATION IN KORSAKOFF'S SYNDROME *Caroline Decaix[1], Richard Lévy[1,2], Gianfranco Dalla Barba[2,3]; [1]Hôpital Saint Antoine, Paris, France, [2]INSERM U. 610, Paris, France, [3]Hôpital Henri Mondor, Créteil, France* – Temporal Consciousness [TC, (Dalla Barba, 2002)] allows individuals to be aware of something as part of their personal past, present or future. TC is opposed to Knowing Consciousness (KC), which allows individuals to be aware of something as a meaning or as an element of impersonal knowledge or information. Patients who confabulate in episodic memory often confabulate also in tasks of orientation in time and place and in tasks tapping their ability to plan their personal future. Accordingly, it has been suggested that in these cases confabulation affects Temporal Consciousness rather than merely episodic memory. Patient PL is a 43 years-old man with Korsakoff's syndrome. His intellectual and memory functions where only mildly affected. We administered to PL a new version of the "Confabulation Battery", which includes 15 questions for each of the following domains: Personal Semantic Memory, Episodic Memory, Orientation in time and place, Linguistic Semantic Memory, Recent General Semantic Memory, Contemporary General Semantic Memory, Historical General Semantic Memory, Semantic Projects, Episodic Projects, "I don't know" semantic questions (e.g., "What did Marilyn Monroe's father do?"), and "I don't know" episodic questions (e.g. "Do you remember what you did on March 13, 1985?"). PL's confabulations were mainly restricted to Episodic Memory (73%), Orientation in time and place (33%) and Episodic Projects (53%). Results from PL's case provide further support to the hypothesis that confabulation affects TC and that it is reductive to consider confabulation a pure memory disorder. Dalla Barba, G. (2002). Memory, consciousness and temporality. Boston: Kluver Academic Publishers.

D100

FALSE MEMORIES: SHORT-TERM AND LONG-TERM EFFECTS COMPARED *Kristin E. Flegal[1], Alexandra S. Atkins[1], Patricia A. Reuter-Lorenz[1]; [1]University of Michigan* – We have previously documented false recognition and false recall in a modified Deese-Roediger-McDermott (DRM) task in which 4 semantically related words are retained for a mere 3-4 second delay. Here we investigate whether the processes associated with short-term memory distortions are dissociable from those that underlie false memories in the long term. We report the results from a novel task that allows us to examine distortions in short-term memory and long-term memory conjointly, following the same study phase. Age-related differences in younger and older adults are investigated as one variable along which memory processes might dissociate. Within both age groups, we replicate findings of rapid semantic distortions at short delays, as critical lures are falsely recognized more often than unstudied and semantically unrelated negative probes, although accompanied by lower confidence ratings than those following correct responses. At longer delays, false alarms to critical lures come to be made as quickly and nearly as frequently as accurate recognition responses, consistent with a decline in discriminability between lures and studied items as time elapses. A significant crossover interaction is seen in confidence ratings for these "yes" responses to critical lures at shorter and longer delays for younger adults, but interestingly, older adults remain (rightly) less confident in falsely recognizing lures even in long-term memory. Regardless of age, gist-based memory remains stable over time in the face of significant decreases in veridical remembering. The implications of these results for time-invariant versus dissociable memory mechanisms are discussed.

D101

PREFRONTAL REGIONS DIFFERENTIALLY CONTRIBUTE TO SOURCE MEMORY RETRIEVAL PROCESSES *David Gallo[1], Ian McDonough[1], Jason Scimeca[1]; [1]University of Chicago* – Prefrontal cortex is involved during memory retrieval, with potential processing differences between dorsolateral and ventrolateral regions. We investigated the function of these regions using event-related fMRI. Subjects studied two types of stimuli (red words and pictures) and subsequently were scanned while taking different source memory tests (always using black words as retrieval cues). On the red word test they accepted items that were studied in red font (irrespective of whether the item also was studied as a picture), on the picture test they accepted items that were studied as pictures (irrespective of whether the item also was studied in red font), and on the exclusion test they accepted items studied in red font but rejected items studied as pictures (i.e., unlike the other two tests, both sources were relevant on this test). Behavioral results confirmed that subjects had searched memory for the appropriate information on each test. Replicating prior work, right dorsolateral prefrontal cortex was more active on the red word test than on the picture test, owing to greater retrieval effort when recollecting font color. Further, this effect was greater for studied than for nonstudied items, implicating postretrieval monitoring processes. In contrast, more ventral prefrontal regions were recruited on the exclusion task, and this pattern was found for both studied and nonstudied items. This pattern implicates general retrieval orientation processes, such as the active maintenance of an exclusion rule. Although both regions were involved at retrieval, they differentially contributed to retrieval orientation and monitoring processes.

D102

WHEN RECOLLECTION HELPS YOU TO REALIZE SOMETHING DIDN'T HAPPEN: AN ERP STUDY OF FEEDBACK IN DISQUALIFYING FALSE MEMORIES *Taylor Joerger[1], Brian Maniscalco[1], Jennifer Mangels[1,2]; [1]Columbia University, [2]Baruch College, City University of New York* – Past studies suggest that recollection of a disqualifying event can reduce familiarity-based false alarms (FAs) produced in the Deese-Roediger-McDermott (DRM) paradigm. By examining the FN400 and late posterior component (LPC), which have been used as indexes of familiarity and recollection, respectively, we investigated how the recollection of feedback helps subjects overcome the familiarity associated with false alarms. Twenty-five subjects studied 28 DRM lists and then 24-hours later took a recognition test (first test) in which they made old/new decisions (with confidence ratings) to targets and distractors, including highly-related lures. Subjects received immediate feedback awarding points for accuracy and confidence, then took a surprise retest that included first-test targets and distractors along with additional distractors. Subjects indicated old/new, confidence and presence or absence of recollection of first-test feedback. ERPs measured at retest retrieval revealed that first-test old and new words were equally familiar and only the retest-unique words elicited a weaker FN400. Although the centroparietal LPC did not appear to differentiate first-test old and new items overall, it differentiated recollection of feedback at first test (feedback > no feedback). We then conditionalized ERPs to high confidence correct rejection (CR) of distractors depending on whether they represented a corrective switch from an earlier FA, or simply repetition of correct response made at first-test. The LPC associated with feedback retrieval was enhanced for CRs where the feedback served to disqualify the earlier error. Therefore, feedback recollection enables subjects to disqualify the familiarity of new words, especially when correcting FAs.

D103

UNVEILING ERP DIFFERENCES BETWEEN FALSE AND TRUE MEMORIES IN A FILM-WATCHING PARADIGM *Sascha Tamm[1], Anett Galow[2], Michael Niedeggen[1], Rainer Bösel[1]; [1]Freie Universitaet Berlin, [2]Charité - Universitaetsmedizin Berlin* – The present study examined the processes underlying false memories as compared to true memories in an EEG setting that resembled typical credibility assessment settings as close as possible. 27 participants saw a short film about a robbery and had to answer 35 yes-no-questions regarding its content about half an hour later. In order to distort participants' memories of the scenes, 25 of these questions contained misleading information according to a common schema of a robbery. Afterwards, participants were told to imagine the film scenes during the seven day interval between the first and a second session. During this second session, EEG was recorded while participants were asked the same 35 yes-no-questions. Behavioral data revealed an increase of the mean number of false alarms ("yes" to questions with misleading information) compared to the first session(6.6 to 9.1), whereas the hits ("yes" to questions without misleading information) did not change (8.7 to 8.8). Event-related potentials (ERPs) for false alarms are characterized by a negative going wave between 400 and 500 ms (N400) followed by a late positive deflection (P600), both focused predominantly at parietal sites. Whereas the first process is related to the processing of semantic incongruency, the latter is assumed to reflect memory retrieval. ERPs for hits and false alarms only differ with respect to the N400 component.

Memory: Memory disorders

D104

IMPLICIT SEQUENCE LEARNING CHANGES IN NORMAL AGING AND PARKINSON'S DISEASE *Kim Celone[1,3], Haline Schendan[2,3], Sule Tinaz[1,3], Stephen Maher[2,3], Chantal Stern[1,3]; [1]Boston University, Center for Memory and Brain, [2]Tufts University, [3]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital* – Recent findings suggest that in addition to the striatal memory system, the medial temporal lobe (MTL) system is necessary for implicit learning of complex multi-event contingencies. Schendan et al. (2003) found consistent learning-related activation of the MTL, dorsolateral prefrontal cortex (DLPFC), and striatum during the early acquisition phase of a serial reaction time (SRT) task in healthy young subjects. The present study contrasted fMRI activation patterns of 12 Parkinson's disease (PD; 56.8 ± 2.2yrs) patients, 12 age and education-matched controls (MC; 58 ± 2.0yrs), as well as 14 young controls reported in Schendan et al (2003). Group comparisons examined fMRI activity in MTL, striatal, and prefrontal regions to assess how changes in MTL function observed in normal aging, as well as compromised striatal function characteristic of PD patients, impacts the formation of multi-event associations. Both the MCs and PDs demonstrated significant higher-order learning of the repeated second-order conditional sequence; however the extent of this learning was reduced compared to the young controls. Direct comparison of sequence and random neuroimaging data demonstrated a similar, yet reduced, pattern of activation in the MTL, striatum and DLPFC regions across the three groups. Interestingly, this difference appeared to be driven by increased activation of these regions during random conditions in the MC and PD groups compared with the young subject data. These findings suggest an inability to regulate the activation in these regions as a result of aging and disease processes, which may adversely affect implicit sequence learning.

D105

IS RECOLLECTION NEEDED FOR RETRIEVAL OF SEMANTIC INFORMATION? RECOGNITION MEMORY FOR REMOTE MEMORIES IN HIPPOCAMPAL RETROGRADE AMNESIA *Asaf Gilboa[1,2], Shani Waidergoren[1]; [1]Haifa University, Israel, [2]Cognitive Neurology, Rambam Hospital, Haifa, Israel* – Background: Dual-process theories suggest the hippocampus and surrounding medial temporal cortex critically and independently support recollection and familiarity aspects of recognition memory, respectively. Others argue that both structures are critical for both processes, though their contributions may differ. A seemingly unrelated dispute surrounds the long-term fate of hippocampal contribution to memory: Multiple Trace Theory argues that semantic memories consolidate and becomes hippocampal-independent whereas episodic memories always depend on the hippocampus. Consolidation theories posit that all declarative memories become hippocampal-independent through consolidation as they age. Here we propose that the enduring role of the hippocampus in remote memory is better captured by a process distinction (recollection-familiarity) than a content/form distinction (episodic-semantic). Methods: we tested remote memory in patients with specific hippocampal lesions using a range of recognition memory tests, including: (i) Process Dissociation Procedures in which recollection is used to override familiarity, rather than jointly contribute to recognition performance. (ii) Receiver Operating Characteristic (ROC) curves which can reflect two processes contributing to recognition. (iii) Remember/Know judgments of subjective recollective experiences. (iv) Source memory which indexes recollection. Importantly, the content of the stimuli in some tasks was episodic and in others, semantic. Results: compared with normal controls, hippocampal patients showed specific deficits in recollection estimates and preserved familiarity estimates, regardless of whether the content was episodic or semantic. Conclusion: The hippocampus is critical for recollection regardless of memory age or content/form. Familiarity may support more complex forms of remote memory (e.g. generic) than it does in recent (anterograde) memory experiments.

D106

MEMORY AND METAMEMORY IN PATIENTS WITH TEMPORAL LOBE EPILEPSY *Charlotte E. Howard[1], Pilar Andrés[1], Giuliana Mazzoni[2], Paul Broks[1], Rupert Noad[3]; [1]University of Plymouth, UK, [2]University of Hull, UK, [3]Derriford Hospital, Plymouth Hospitals NHS Trust, UK* – Research has shown that the relationship between subjective complaints and actual memory deficits is weak in patients with epilepsy (Blake et al., 2000; Gleissner et al., 1998). The current study aims to investigate whether measures of metacognitive knowledge and cognitive performance were differentially disrupted in patients with temporal-lobe epilepsy. Fifteen patients with temporal-lobe epilepsy and 15 healthy controls participated in a paired-associates learning task. A combined Judgement-of-Learning and Feeling-of-Knowing task was introduced to investigate metamemory performance. Memory recall was measured after a 30-minute retention delay and at four weeks. The results revealed a lower recall performance in patients with temporal-lobe epilepsy compared with controls. The results also showed patients with temporal-lobe epilepsy were able to monitor their memory successfully at the item-by-item level, but tended to overestimate their memory when making global judgements-of-learning, whereas controls tended to underestimate their memory. These findings have an important implication for memory rehabilitation strategies with patients with epilepsy. The results are discussed in terms of their association with executive functioning and memory deficits in temporal lobe epilepsy.

D107

CONTRIBUTION OF PRIOR SEMANTIC KNOWLEDGE TO NEW EPISODIC LEARNING IN AMNESIA *Irene P. Kan[1,2], Michael P. Alexander[3,4], Mieke Verfaellie[1]; [1]Memory Disorders Research Center, Boston VA Healthcare System and Boston University School of Medicine, [2]Villanova University, [3]Beth Israel Deaconess Medical Center, [4]Harvard Medical School* – We evaluated whether prior semantic knowledge would enhance episodic learning in amnesia. Subjects studied prices that are either congruent (i.e., market value) or incongruent (i.e., four times higher) with prior price knowledge for household and grocery items and then performed a forced choice recognition test for the studied prices. Consistent with a previous report, healthy controls' performance was enhanced by price knowledge congruency; however, only a subset of amnesic patients experienced the same benefit. Patients with relatively intact semantic systems (i.e., damage restricted to the medial temporal lobes) experienced a significant congruency benefit, whereas patients with compromised semantic systems (i.e., damage also including the anterior and lateral temporal lobes) did not experience a congruency benefit. We also found that the extent to which patients experienced a congruency benefit was positively correlated with their prior price knowledge. Our findings suggest that when prior knowledge structures are intact, they can support acquisition of new episodic information by providing frameworks into which such information can be incorporated.

D108

HIPPOCAMPAL-DEPENDENT LEARNING AND GENERALIZATION IN THE HEALTHY ELDERLY AND INDIVIDUALS WITH MCI *Winifred M. Limmer[1], Catherine E. Myers[2], James Golomb[3], Alan Kluger[3,4], Steven Ferris[3], Mark A. Gluck[1]; [1]Center for Molecular and Behavioral Neuroscience, Rutgers University-Newark, [2]Rutgers University-Newark, [3]New York University Medical Center, [4]Lehman College/ CUNY* – Mild Cognitive Impairment (MCI) is associated with atrophy of the hippocampus, and it may be a prodrome of Alzheimer's disease (AD). In a previous study, cognitively healthy individuals and individuals with MCI learned to make a series of object discriminations. This phase was followed by a generalization phase, in which the irrelevant – but not the relevant – stimulus dimension changed. Individuals with hippocampal atrophy (HA) learned the initial discriminations as quickly as individuals without HA; however, individuals with HA exhibited impaired ability to generalize (Myers et al., 2002). Impaired ability to generalize has been associated with increased risk of decline to AD within two years (Myers et al., in press). Thus, the object discrimination task may be able to predict short-term risk of cognitive decline. For the reason that 10-15% of individuals were unable to complete the task, a "shaping" version, in which object discriminations are learned cumulatively, was developed. Non-demented elderly individuals with scores on the Global Deterioration Scale (GDS; Reisberg et al., 1982) of 2 (very mild cognitive impairment) or 3 (MCI) made fewer errors – during both the learning and generalization phases – on the shaping versus the concurrent version. Results indicate that better performance results if object discriminations are learned by means of a shaping rather than a concurrent method. The shaping version of the task may yield a reduced rate of failure; thus, it may be a more appropriate and efficacious instrument with which to evaluate hippocampal-dependent generalization in the healthy elderly and individuals with MCI.

D109

USING COMPUTERS TO TRAIN FACE-NAME ASSOCIATIONS IN PERSONS WITH DEMENTIA *Nidhi Mahendra[1,2]; [1]Department of Communicative Sciences & Disorders, California State University, [2]California State University - East Bay* – This study was designed to study the efficacy of computer-assisted cognitive interventions (CACIs) for training familiar and unfamiliar face-name associations in persons with Alzheimer's disease (AD). Given the low cost and widespread use of computers combined with increasing levels of computer literacy among seniors, it is very timely to document the feasibility and applicability of CACIs for individuals with dementia. Further, with the rapid aging of the United States population and the rising incidence of dementia, it is imperative that innovative non-pharmacological interventions be developed. Ten individuals (4 men, 6 women) with mild to moderate dementia were enrolled. They were administered a laptop-assisted cognitive intervention that employed errorless learning principles and spaced retrieval of novel and previously familiar face-name associations. Participants were screened for sensory impairments (hearing and vision), vascular etiology, cognitive status, and depression. Participants were administered the Dementia Rating Scale to quantify dementia severity and the Rivermead Behavioral Memory Test to quantify memory impairments. Preliminary results based on these ten individuals' performance reveal that CACIs were efficacious in helping persons with AD to learn novel and familiar (previously known but forgotten) face-name associations. Overall, participants learned familiar face-name associations in fewer sessions than novel ones. Eight out of ten participants retained these face-name associations for over six weeks after interventions ceased. These initial findings reveal the promise of CACIs for training recall of factual information in individuals with AD. Other directions being pursued include documenting the efficacy of CACIs for teaching novel and previously familiar procedures (motor acts).

D110

COGNITIVE AND NEURAL BASES OF SEMANTIC FLUENCY DEFICIT IN TRAUMATIC BRAIN INJURED ADULTS *Catherine Ngo[1,2], Vanessa Raymont[2,3], Jeffrey Solomon[4], Stephen Dopkins[5], Bobby Cheon[2], Amanda Greathouse[2], Jordan Grafman[6]; [1]Baylor College of Medicine, Houston, TX, [2]Henry M. Jackson Foundation, Vietnam Head Injury Study - Phase III, National Naval Medical Center, Bethesda, MD, [3]Mount Sinai School of Medicine, New York, New York, [4]Medical Numerics, Inc., Germantown, MD, [5]The George Washington University, Washington, DC, [6]Cognitive Neuroscience Section, National Institute of Neurological Disorders and Stroke, Bethesda, MD* – This investigation sought to understand the cognitive and neural bases for semantic fluency deficit in traumatic brain injured older adults. Studies 1 and 2 demonstrated that right frontal-temporal lesion patients performed poorly on a verbally mediated semantic task (repeated trials category fluency) and a non-verbally mediated semantic task (vocabulary and object-function matching), but performed comparably with controls on a phonemic fluency task (letter fluency). These results suggest that the semantic fluency deficit is not due to a difficulty with word retrieval, but is rather due to a fundamental breakdown in semantic knowledge stores. Consistent with this interpretation, the results of Study 3 using the Analysis of Brain Lesions (ABLe) Behavior Analysis program (Makale et al., 2002; Solomon et al., 2007) suggest the brain basis of the observed deficit in the anterior temporal region.

D111

INTERNAL-EXTERNAL SOURCE MONITORING IN KORSAKOFF'S AMNESIA. *Marie Rowland[1], Robert Rafal[1], Paloma Mari-Beffa[1]; [1]University of Wales, Bangor* – Source monitoring theory describes the discrimination of memories derived from different external sources as well as between internal and external sources (i.e. imagination and a perceived event). Past research indicates that amnesic patients are distinctly disrupted in source memory. The present study examined the performance of 11 Korsakoff amnesia patients to determine if there was a specific source monitoring deficit. Action tasks were performed by the participants, imagined by the participants, or performed by two research assistants. Following the completion of the actions tasks, participants completed a source monitoring task in which they were asked to indicate which actions were performed by self, others, imagined or new. When compared to a healthy control group, Korsakoff patients showed a bias towards believing an action was new when the action was actually imagined. These results suggest that Korsakoff patients have a specific deficit in internal-external monitoring rather than external source monitoring.

D112

DETAIL RETRIEVAL FOR REMOTE EPISODIC MEMORIES CAN BE IMPEDED BY IMPROPER RETRIEVAL ORIENTATION: IMPLICATIONS FOR CONSOLIDATION THEORIES *John D. Rudoy[1], Courtney M. Clark[2], M. -Marsel Mesulam[1,3], Sandra Weintraub[1,3], Ken A. Paller[1,2]; [1]Northwestern University/ Interdepartmental Neuroscience Program, [2]Northwestern University, [3]Northwestern University/ Cognitive Neurology and Alzheimer's Disease Center* – Retrograde amnesia after hippocampal damage generally involves deficits in retrieving memories for recent events but not for events from decades ago. Consolidation theories often explain this pattern by postulating that the hippocampus plays a time-limited role in memory storage; remote memories can be retrieved because hippocampal mediation is no longer required. This view has been challenged by findings that amnesic patients produced fewer remote episodic details than did controls (e.g., Moscovitch et al., 2006). Could such findings arise if patients developed a habit of relying on gist-based retrieval, such that they tended to refrain from retrieving and rehearsing remote episodic details? This novel idea was tested in subjects aged 60-75 years who were cognitively intact or diagnosed with amnesic Mild Cognitive Impairment. In each of two sessions in counterbalanced order, subjects recalled two early-adulthood events from a list they provided in advance. Session-A included a detail-oriented manipulation after the first recall test: subjects verbally described two photographs in detail. Session-B included a gist-oriented manipulation after the first recall test: subjects described nine photographs in 1-2 words each. In both subject groups, for the memory recalled after the manipulation, the number of episodic details systematically increased or decreased with the detail- or gist-oriented manipulation, respectively. Reduced episodic recall can thus be produced by adopting a gist-based orientation. Further research is needed to ascertain the extent to which an amnesic patient's apparent deficits in remote episodic remembering might result from habitual gist-based retrieval following prolonged amnesia.

Perceptual processes: Multisensory processing

D113

THE FEELING OF A PINCER BETWEEN ONE THUMB AND THE OTHER INDEX FINGER: A NOVEL MOVEMENT EFFECT PRODUCED USING A HALF-SILVERED MIRROR *Eric Altschuler[1,2], VS Ramachandran[2]; [1]University of Medicine & Dentistry of New Jersey, [2]Brain and Perception Laboratory, UCSD* – Previously we have noted that a strange feeling is produced if one places one hand on either side of a plane reflecting mirror and opens and closes both hands at slightly different speeds or with a small phase offset while watching the reflection of one hand. The unusual sensation is the brain trying to resolve the discrepancy between the inputs of the proprioception of one hand and the vision of the reflection of the other hand (which looks like the first hand) moving discordantly. Ourselves and subsequently others have found that this mirror effect may be beneficial for patients with diseases associated with poor mobility such as immobile phantom limbs and hemiparesis following stroke, whereby a patient watches the reflection of the good limb while trying to move both limbs simultaneously. We report a possibly related, but novel effect: If one places one hand on either side of a half-silvered mirror and looks at the mirror one can position the hands to create what appears to be a pincer grip between the thumb of one hand and the index finger of the other hand, as if they were from the same hand. Ourselves and a number of colleagues have found there is an odd sensation accompanying this "pincer" movement, though, interestingly, not the full proprioceptive capture as with the reflecting mirror. There is another odd sensation as the thumb and finger appear to be about to touch. We delineate this novel effect and discuss potential applications to patient groups.

D114

LIPREADING AND AUDIOVISUAL SPEECH INTEGRATION IN THE AUDITORY CORTEX REVEALED BY HUMAN INTRACRANIAL ERPS *Julien Besle[1,2], Olivier Bertrand[3,4], Catherine Fischer[3,5], Marie-Hélène Giard[3,4]; [1]Neurological Institute, Columbia University, [2]Cognitive Neuroscience and Schizophrenia Program, Nathan Kline Intitute, [3]INSERM U821, Brain Dynamics and Cognition, [4]Université Lyon 1, [5]Hopital Neurologique de Lyon* – It is well known that visual lip movements influence auditory speech perception. Several fMRI studies have shown that the auditory cortex plays a role in the integration of auditory and visual speech cues, but provide no information about the processing stage at which this happens. On the other hand, EEG/MEG have shown that the auditory N1 component, elicited by speech syllable after 100 ms, can be modulated by visual lip movements, but the spatial origin of this effect remain unclear. In the present study, we recorded intracranial event-related potentials to auditory, visual and audiovisual speech syllables with depth electrodes implanted at 900 sites in the temporal lobe of 10 epileptic patients, which gives us both good spatial and temporal resolutions. We show that visual lip movements activate the secondary, but not the primary, auditory cortex just after movement-specific visual area MT/V5. This feedforward crossmodal activation is followed by two types of audiovisual interactions in the secondary auditory cortex: one corresponding to the suppression of the unimodal visual activation by auditory syllables and the other to the decrease of early (from 50 ms) transient unimodal auditory responses by lip movements. These results show that speech processing does not respect the classical hierarchical model of sensory-specific and associative cortical areas.

D115

BRIDGING THE GAP BETWEEN SPEECH PERCEPTION AND READING: EVIDENCE FROM PEDIATRIC NEUROIMAGING *Vera Blau[1,2], Nienke van Atteveldt[1,2], Jochen Seitz[1,2], Rainer Goebel[1,2], Leo Blomert[1,2]; [1]Maastricht University, The Netherlands, [2]Maastricht Brain Imaging Center, Maastricht, The Netherlands* – Learning to associate letters and speech sounds is an important milestone in literacy acquisition [1]. Whereas the associations between letters and sounds are highly automatized in literate adults, they might be disrupted in dyslexia [2]. We used pediatric neuroimaging (fMRI) to investigate letter-speech sound integration in 8-12 year old children with and without reading impairment. Dyslexic (N=10) and control children (N=10) were scanned at 3T while viewing and/or listening to letters and speech sounds and performing a simple attention control task. Speech sounds and letters were presented in isolation or combined in congruent or incongruent combinations. Dyslexic readers activated early auditory cortex (Heschl Sulcus/Planum Temporale) less than fluent readers in response to congruent versus incongruent letter-speech sound pairs. Moreover, dyslexic readers show less pronounced activation for speech sounds in isolation. Finally, dyslexic readers but not fluent readers activate left-hemispheric pre-central motor regions in response to visual and bimodal stimuli. These findings suggest that during reading acquisition fluent readers but not dyslexic readers sufficiently automatize letter-speech sound associations. Moreover, the data suggest that the cause of this insufficient letter-speech sound binding reside in the phonological domain. On the basis of the present findings, we propose that the impaired neural binding of letters and speech sounds might act as agent between phonological processing deficits and reading problems in developmental dyslexia.

D116

THE NEUROPHYSIOLOGY OF AUDITORY-VISUAL MULTISENSORY INTEGRATION IN CHILDREN WITH AUTISM. *Alice Brandwein[1], John Foxe[1,2,3], Ted Altschuler[2], Dave Saint-Amour[4], Hilary Gomes[1,2], Sophie Molholm[2,3]; [1]Neuropsychology, City University of New York Graduate Center and Queens College, [2]Cognitive Neuroscience, City University of New York Graduate Center and City College, [3]Program in Cognitive Neuroscience and Schizophrenia, Nathan Kline Institute for Psychiatric Research, [4]Université de Montréal* – The integration of multisensory information is a fundamental component of typical learning and development in children. For most, this appears to occur effortlessly and often serves to enhance perception. But some children reportedly find the sensory environment overwhelming and it has been hypothesized that this is due to a failure to integrate the sensory inputs into meaningful and manageable units. Clinical and parent based observations have led to the theory that aberrant sensory integration is a major component of autism and related neurodevelopmental disorders. However, this has not been rigorously tested and is lacking direct neurophysiological evidence. Using high-density electrical mapping, we investigated basic auditory-visual integration in children with autism (ASD) and children with typical development (TD) who were matched for age and intellectual functioning. Children were presented with auditory (simple tones) and visual (red circles) stimuli together or alone and performed a simple reaction-time task while recordings of electrical brain activity were made. Our preliminary findings suggest that the time course and scalp topography of multisensory integration processes are different in the ASD compared to the TD children. In general the children with autism exhibited smaller multisensory interactions, and comparison of the topographies suggested that different cortical regions were involved in integrating sensory information for ASD and TD children. Data from the ASD group are considered in the context of observed multisensory interactions in children of various ages and stages of brain development.

D117

SYNESTHESIA AND LEARNED CONTEXTUAL PRIMING - AN EVENT-RELATED BRAIN POTENTIAL STUDY *David Brang[1], Vilayanur S. Ramachandran[2], Stanley Kanai[3], Seana Coulson[3]; [1]University of California, San Diego, [2]University of California, San Diego, Center for Brain and Cognition, [3]University of California, San Diego, Cognitive Science* – In grapheme-color synesthesia, individuals experience a specific and consistent color when viewing numbers or letters. We previously tested the brain activity generated by synesthetes and normal controls in a modified sentence-priming paradigm using event-related potentials (ERPs). In that study the brain waves of synesthetes, but not controls, revealed both N1 and P2 perceptual components and the N400 contextual effect in response to sentences such as "The grass is 7" compared to "The grass is 2," in which 7 is green and 2 is blue for one particular synesthete. Subjects were presented with sentences such as "The grass is," ending in either a color word ("green"), rectangular color patch such as a green box, or with a grapheme matched to each synesthetes' perceived color (e.g. "The grass is 7"). Half of the sentences in each block were congruous, half incongruous. To test whether the N1, P2, and N400 ERP components could be elicited in non-synesthetes, ERPs were recorded from two additional groups of control subjects. Three control subjects were trained to associate letters/numbers with colors and nine control subjects were shown sentence-ending graphemes in the physical color of the associated letter/number (a physically green 7). ERPs from both groups of non-synesthetes showed contextual N400 effects in response to sentences ending in color words, color patches, and, crucially graphemes. However, neither control group elicited either the N1 or P2 components that reflect the early perceptual effects seen in synesthetes, further demonstrating the non-associative, perceptual nature of synesthesia.

D118

A SUBJECTIVE-METRIC BASED MEASURE OF AUDIOVISUAL INTEGRATION EFFICIENCY *Hans Colonius[1], Adele Diederich[2], Stefan Rach[1,2]; [1]University of Oldenburg, [2]Jacobs University Bremen* – Audiovisual integration efficiency (IE) is a presumed skill employed by subjects independently from their ability to extract information from auditory and visual speech inputs (Grant 2002, JASA). However, currently there are no established methods for determining a subject's IE. One approach is based on employing models of auditory-visual integration to predict optimal AV performance. Differences between model predictions and obtained scores are then used to estimate IE. However, the validity of these derived estimates of IE should not be based solely on the accuracy of model fits. Here we present a novel measurement technique to address this issue without requiring explicit assumptions about the underlying audiovisual processing. It is based on a version of the theory of Fechnerian Scaling (FSDOS) developed by Dzhafarov and Colonius (2006, Psychometrika) that permits the reconstruction of subjective distances among stimuli of arbitrary complexity from their pairwise discriminability. After computing the unimodal (visual and auditory) and the bimodal subjective metric on the corresponding stimulus sets, the bimodal distance is compared to the sum of the unimodal distances, for each stimulus pair. The proposed index of audiovisual IE is based on the average result of this comparison across the stimulus set. The approach is demonstrated on data from an experiment on audiovisual integration of letters and speech. Among other desirable properties, it is shown that the new index can better account for effects of redundancy in visual and auditory information than previous approaches.

D119

WHAT IS THE POSITION OF AN ARM RELATIVE TO THE BODY? NEURAL CORRELATES OF EGOCENTRIC AND ALLOCENTRIC BODY REFERENCE FRAMES *Corrado Corradi-Dell'Acqua[1], Barbara Tomasino[1], Gereon R. Fink[1,2]; [1]Institute of Neuroscience and Biophysics, Research Center Jülich, Germany., [2]University Hospital Cologne, Cologne University, Cologne, Germany* – Neuropsychological studies suggest that the human brain is endowed with two body representations: the Body Schema (BS), coding the orientation of one's own body parts in space, and the Body Structural Description (BSD), coding the location of body parts relative to a standard body. We used fMRI to identify the neural mechanisms underlying these putative body maps. Participants carried out a handedness task, in which they assessed whether an arm or a handle of an object was right or left (STIMULUS: Arm vs. Handle). If the stimulus was an arm, subjects imagined (i) rotating their own arm until it matched the orientation of the stimulus (thus comparing the seen arm to their own), or (ii) seeing the stimulus moving towards its appropriate position in a simultaneously-presented human body (thus comparing the arm to the one of a standard body – STRATEGY: Motor vs. Visual imagery). If the stimulus was a handle of an object, subjects imagined (i) grasping the handle and placing it on its appropriate position on the simultaneously-presented object, or (ii) seeing it moving towards its position on the object. The analysis of the interaction STIMULUS*STRATEGY revealed activation ($p < 0.05$ corrected) of the left secondary somatosensory cortex, specifically when comparing the stimulus arm to one's own, and of the left posterior intraparietal sulcus when comparing the stimulus arm to the one of the standard body. The results associate BS and BSD with different neural substrates, thereby suggesting that these are independent and dissociable body representations.

D120

TIME-WINDOW-OF-INTEGRATION (TWIN) MODEL FOR MULTISENSORY INTEGRATION IN SACCADIC REACTION TIME *Adele Diederich[1], Hans Colonius[2]; [1]School of Humanities and Social Sciences/Jacobs University Bremen, [2]University of Oldenburg* – Saccadic reaction time (SRT) to visual targets tends to be faster when auditory or tactile stimuli occur in close temporal or spatial proximity even if subjects are instructed to ignore the accessory input (focused attention task). The

TWIN model proposed in Colonius & Diederich (J. Cog. Neurosci. 2004) distinguishes an early, afferent stage of parallel peripheral processing in the sensory pathways (first stage) followed by a second stage comprising neural integration of the input and preparation of an oculomotor response. Crossmodal interaction (facilitation or inhibition of SRT) only occurs if (1) the peripheral processing of the non-target wins the race and (2) the peripheral processing of the target stimulus terminates within a given temporal window of integration. TWIN distinguishes effects on SRT based on unimodal stimulus properties (e.g., intensity) from those based on crossmodal properties (e.g., distance between target and non-target). It also allows a separation of an unspecific warning effect from true multisensory integration. It can be tested with and without specifying probability distributions for the subprocess durations. Several experimental studies varying the spatial and temporal stimulus configurations and using different modality combinations (audio-visual, tactile-visual) have lent support for the model framework (e.g., Diederich & Colonius, 2007, Exp. Brain Res.). TWIN has recently shown to account for age-related multisensory effects in the elderly as well.

D121

SOCIAL MODULATION OF TOUCH REPRESENTATION *Valeria Gazzola[1], Fulvia Castelli[2], Michael Spezio[2], Christian Keysers[1,2], Ralph Adolphs[2]; [1]BCN-NeuroImaging Center, University Medical Center Groningen, University of Groningen, [2]Division of Humanities and Social Sciences, Caltech, Pasadena* – When a heterosexual man fancies a woman, her caress can feel divine; but an identical caress given by another man may feel repulsive. To what extent does this perceptual difference arise from reappraisal by high-level areas in prefrontal cortex, differential sensory coding at the level of somatosensory cortex, or both? We used BOLD-fMRI in 18 Caucasian heterosexual men while they viewed videos of (a) a woman they rated as attractive, (b) a man they rated as unattractive, or (c) a grey screen. Synchronized with the video, subjects were caressed on their legs by an experimenter who was blind to the three conditions. Condition (c), the caress only, activated somatosensory (SI, SII) and insular (posterior and anterior) cortices. Using this activation as a region-of-interest further revealed that the activation was modulated by the gender of the person in the video under the other two conditions (a and b). Specifically, associating a man with the caress led to a stronger anticipatory signal in somatosensory areas, while associating a woman with the caress led to a stronger potentiation of the caress response in the same areas, both compared to the grey screen condition. We also found that just seeing the toucher, without caress, evoked gender-related differential activation in fusiform gyrus and orbitofrontal areas. The latter regions may be a source of top-down influence on somatosensory areas. Thus, sensory regions that represent touch are tuned to the social valence that accompanies a gentle caress.

D122

DEPLOYMENT OF VISUAL ATTENTION TOWARDS RELEVANT AND NON-RELEVANT MULTISENSORY SPEECH SIGNALS UNDER NOISY ENVIRONMENTAL CONDITIONS *Hanna Krause[1], Daniel Senkowski[1], Till R. Schneider[1], Andreas K. Engel[1]; [1]University Medical Center Hamburg-Eppendorf* – Recent studies have shown that visual attention towards irrelevant signals reduces multisensory speech recognition performance. To further investigate the role of visual attention on speech processing, we examined the interfering effects of natural acoustic speech inputs and fully degraded acoustic speech signals on audiovisual speech recognition. Subjects performed a multisensory speech recognition task in which they were instructed to detect a target syllable among similar syllables from an attended center speaker while ignoring two surrounding distracter speakers. Sustained brain activity was monitored using steady-state visual evoked potentials (SSVEPs) as a real-time index of visual attention deployment. The visual inputs from a center speaker were presented at a flicker rate of 25 Hz, whereas the inputs from two distracter speakers were presented at 19 Hz. SSVEPs were monitored in a speech interference condition (syllables from all three speakers) and a non-speech interference condition, in which the interfering acoustic signals were directly derived from the original speech signals (center speaker produces speech syllables, distracter speakers produce fully degraded signals). Behavioral performance was reduced in both conditions compared to a no-interference control condition. The interference effect was stronger in the speech compared to the non-speech condition. Paralleling these findings, the degree of visual attention deployment in SSVEP towards non-relevant speakers was larger in the speech compared to the non-speech condition. We conclude that multisensory speech recognition under noisy environmental conditions is particularly affected by similar acoustic speech signals and that visual attention deployment towards non-relevant speakers has a negative impact on speech recognition.

D123

INVOLVEMENT OF VISUAL IMAGERY IN HAPTIC PERCEPTION OF FAMILIAR, BUT NOT UNFAMILIAR, OBJECTS *Simon Lacey[1], Peter Flueckiger[1], Randall Stilla[1], Michael Lava[1], K. Sathian[1,2]; [1]Emory University, GA, [2]Rehabilitation R&D Center of Excellence, Atlanta VAMC, Decatur, GA* – It is now accepted that visual cortical areas are routinely active during touch in normally sighted individuals. However, there is debate about whether this is due to visual imagery or engagement of multisensory representations. Here we performed functional magnetic resonance imaging while participants haptically discriminated object shape (HS task); HS-specific processing was isolated by a contrast against a control haptic texture discrimination task. In separate sessions, the same participants made shape judgments on visual images of objects represented by words they heard (VI task); this was contrasted against a control condition requiring word/non-word judgments on auditorily presented stimuli. We hypothesized that, if visual imagery is involved in haptic shape perception, then activations in the VI and HS tasks would overlap and moreover, inter-individual variations in activation magnitudes during VI would predict those in the HS condition. The HS condition employed a set of unfamiliar, meaningless shapes in one experiment and a set of familiar objects in a second experiment. VI- and HS-related activations overlapped in the lateral occipital complex bilaterally, left ventral premotor cortex and left posterior thalamus, whether the HS task involved familiar or unfamiliar objects. In the case of familiar objects, this overlap was more extensive and there were additional regions of overlap in left prefrontal cortex. In these overlap zones, activation magnitudes were positively correlated across subjects between the VI and HS conditions for familiar, but not unfamiliar objects. We conclude that the role of visual imagery in haptically-evoked activations is modulated by object familiarity.

D124

AN ERP STUDY OF CROSS-MODAL INTEGRATION OF SPEECH: WHEN THE WHOLE IS 'GREATER' THAN THE SUM OF ITS PARTS *Odette Megnin[1], Tony Charman[1], Torsten Baldeweg[1], Michelle de Haan[1], Atlanta Flitton[1]; [1]UCL Institute of Child Health* – Event-related potentials (ERPs) were recorded from 16 adult subjects during video presentation of monosyllabic words in one of four conditions: auditory-only (A), visual-only (V), audio-visual with face (AVF), and audio-visual with scrambled face (AVS). Multisensory interactions are regarded as significant when [AVF – (A+V)]>0 at a single electrode for a minimum of 24ms duration (Guthrie & Buchard, 1991). Positive interactions were seen at most fronto-central electrodes starting as early as 32ms and extending to 200ms post-auditory onset. AVF stimuli produced an attenuation of negativity at 121ms (N1) at Cz (with a reversal of polarity at mastoids) suggesting sensory-specific cortices may be attenuated by bimodal stimuli. In addition, increased negativity was observed at FP2 which precedes the auditory N1 response at the vertex. Importantly this pattern of results is not observed in the other audio-visual condition (auditory + scrambled face). In the AVF condition the initial lip movements precede the auditory onset by a mean of 332ms. The frontal enhancement and temporal suppression may reflect top-down modulation with lip movements being used to constrain predictions about the word that is to be produced, leading to attenuation of the auditory N1 (van Wassenhove et al, 2005). This hypothesized facilitation of processing through audio-visual interaction is supported by reaction time facilitation in the AVF condition, and a significant correlation between N1 attenuation and FP2 enhancement suggests that these responses are linked. This study is currently being applied to an adolescent sample with autism spectrum disorder (ASD) and an IQ-matched control group.

D125

VISUO-MOTOR MIRROR RESPONSES IN HUMAN MEDIAL TEMPORAL LOBE *Roy Mukamel[1,2], Marco Iacoboni[1,2,3], Itzhak Fried[3,4,5]; [1]UCLA Ahmanson-Lovelace Brain Mapping Center, David Geffen School of Medicine, University of California, Los Angeles, CA, [2]UCLA, Semel Institute for Neuroscience and Human Behavior, David Geffen School of Medicine, University of California, Los Angeles, CA, [3]Brain Research Institute, David Geffen School of Medicine, University of California, Los Angeles, CA, [4]Division of Neurosurgery, David Geffen School of Medicine, University of California Los Angeles (UCLA), Los Angeles, CA, [5]Functional Neurosurgery Unit, Tel Aviv Medical Center and Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel* – Mirror neurons are multi-modal brain cells that respond both when one performs a goal directed action and when one simply observes a goal directed action performed by someone else. Such cells have been directly recorded in the parietal (area PF) and frontal (area F5) cortices of the monkey brain. In humans, there is indirect evidence for the existence of such neurons in the anatomically corresponding motor regions (rostral inferior parietal lobule, and posterior inferior frontal gyrus – pIFG, respectively) on the lateral convexity of the brain. In addition we have recently described mirror neurons in the human medial frontal lobe. In the current study we recorded directly the activity of 601 neurons in the medial temporal lobe (Amygdala, Entorhinal cortex, Hippocampus, and parahippocampal gyrus) from neurosurgical patients while they were executing or observing hand movements or facial gestures. We found that 14% of the recorded neurons displayed visuo-motor mirror properties. Out of these 89 mirror neurons, 38% had excitatory responses for both components of the mirror task (observation/execution), and 27% had inhibitory responses. Another 33% of the neurons responded with excitation during one component of the task and inhibition for the other. While responses to action-observation may reflect perception, responses to action-execution could arise from proprioceptive feedback or represent efferent copies from motor cortex, or abstract representation of the movement. Our results suggest that the mirror neurons system may have wider distribution than previously suspected.

D126

ARE MEMORIES FOR DURATION MODALITY SPECIFIC? *Ruth Ogden[1], John Wearden[2], Luke Jones[1]; [1]The University of Manchester, UK, [2]Keele University, UK* – Ogden, Wearden and Jones (in press) reported that temporal reference memory is incapable of accurately storing multiple auditory standards of different durations. In a modified temporal generalization task participants were presented with and tested on a first standard (A), and then presented and tested on a second standard (B). After a delay of 0 to 30 seconds participants were retested on A without it being re-presented. Differences in the duration of A and B were also manipulated; A=B, A<B, A>B. When tested immediately peak responding occurred at or around that standard, however when retested after a delay and the encoding of the second standard a systematic shift in peak responding occurred. In the A<B condition peak responding shifted to the shortest of the comparison durations and in the A>B condition peak responding shifted to the longest of the comparison durations. The current series of experiments examined whether comparable interference effects could be found when both standards are visually presented, or when one is auditory and one is visual. In all experiments encoding a second standard of a different duration to the first did not lead to performance deterioration or systematic interference. The results suggest that durations presented in different modalities are stored separately in reference memory and do not interfere with each other. The results also indicate the possible superiority of visual temporal reference memory over auditory temporal reference memory.

D127

ENEMY OR FRIEND? EFFECTS OF EMOTIONAL FACE EXPRESSIONS ON PAIN PROCESSING IN ELECTROMAGNETIC BRAIN RESPONSES *Daniel Senkowski[1], Janine Kautz[1], Michael Hauck[1], Roger Zimmermann[1], Andreas K. Engel[1]; [1]University Medical Center Hamburg-Eppendorf* – In social settings it seems particular important to process the facial expressions of people surrounding us, especially if their actions can induce pain or bodily harm. Painful events automatically capture our attention, which enables us to rapidly evaluate the environmental conditions (e.g., was the painful event due to an accident or caused by an aggressive act). As such, it seems likely that facial impressions influence pain processing. Here we studied the effects of emotional face expressions (fear, happy, anger) on the processing of painful events using magnetoencephalography in a multisensory experimental setting. Subjects showed higher pain ratings when the painful inputs were presented simultaneously with a face expressing an emotion (fear, happy, anger) compared to when they were presented with a face with a neutral expression, and compared to unisensory-pain control stimuli. This effect was paralleled by an early modulation of gamma-band responses over visual areas. Our study provides behavioural and electrophysiological evidence that socially relevant inputs from other sensory modalities can affect pain processing. Furthermore, gamma-band responses and cortico-cortical synchronisation processes between the pain matrix and visual areas might play an important role for the integration of painful stimuli with inputs from other sensory modalities such as visual signals.

D128

IS AWARENESS OF AUDITORY STIMULUS POSITION NECESSARY FOR AUDIOVISUAL SPATIAL EFFECTS IN SACCADIC REACTION TIME? *Rike Steenken[1], Hans Colonius[1], Adele Diederich[2]; [1]Oldenburg University, Institut für Kognitionsforschung, [2]Jacobs University Bremen, School of Humanities and Social Sciences* – In a focused attention paradigm saccadic reaction time (SRT) to a visual target is modulated by the position and time of occurrence of an auditory non-target. The question addressed here is if and how this response to a visual stimulus depends on whether the participant can localize the auditory stimulus. Two tasks had to be performed in alternating blocks. In one block, they were required to respond as fast and accurately as possible to a visual target stimulus positioned while ignoring an acoustical non-target presented at the same top or bottom position (coincident) or at the opposite position (disparate). In another block, participants had to indicate via button press whether the acoustical non-target was presented from the top or bottom position. In the first experiment, localizability of the auditory accessory decreased with masker level while it had a diametrical effect on SRT: Responses to coincident visual-auditory stimuli were slowed down, whereas responses to disparate stimuli were speeded up. This suggests that increasing masker level enlarges the area of possible auditory stimulus locations implying that perceived distances decrease for disparate stimulus configurations and increase for coincident stimulus pairs. In the second experiment, an auditory masker was presented before, simultaneous to, or after the accessory stimulus. In all interstimulus interval (ISI) conditions, SRT enhancement went down both in the coincident and disparate configuration relative to the same configurations without masker. However, the decrement was fairly stable across the ISI values suggesting that multisensory integration does not solely rely on a feed-forward process.

D129

FRONTO-PARIETAL INFORMATION PROCESSING FOR ONLINE ADJUSTMENTS DURING VISUALLY-GUIDED REACH-TO-GRASP REVEALED BY ELECTRICAL NEUROIMAGING. *Eugene Tunik[1], Scott Grafton[2], Sergei Adamovich[3], Stephanie Ortigue[2]; [1]New York University, [2]UCSB Brain Imaging Center, Sage Center for the Study of the Mind, [3]New Jersey Institute of Technology* – Several human imaging studies have described the fronto-parietal circuit to be critical for on-line control of reach-to-grasp movements under visual control. This study simultaneously recorded hand kinematics and evoked-related potentials to relate spatiotemporal brain dynamics to on-line control of grasping. We used a perturbation task to dissociate neural mechanisms related to on-line control from planning (Tunik et al., 2005). Healthy humans (n=12) sat in a soundproof room and used a pincer grip to reach-to-grasp a rectangular object positioned 15cm away. Between trials, participants pressed a start button and awaited a tone that cued them to start reaching. The release of this button triggered a perturbation of the graspable dimension of the object from 1cm-to-5cm (requiring subjects to re-adjust their finger aperture, 25% of trials). On the remaining trials, the graspable dimension was unperturbed. Motion of 16 joints of the hand was measured with a CyberGlove (Immersion Inc.), and compared between perturbed-unperturbed trials. High-density electrical mapping revealed that ERPs for the perturbed trials were distinguished from the unperturbed trials over the 50-150 ms period by a distinct scalp topography, indicative of different intracranial generator configurations. A distributed linear source estimation (LAURA) of this distinct scalp potential field revealed a left-lateralized current density source in the intraparietal sulcus with the maximum in the anterior extent of the sulcus. These data support the existence of a specialized fronto-parietal network, notably the anterior portion of the intraparietal sulcus, for on-line control of movements within the first 100ms of goal-dependent reach-to-grasp actions.

D130

IMAGING A PHANTOM *Oliver Turnbull[1], Stanley Colcombe[1], Robert Rafal[1], David Linden[1], Caroline Bowman[1]; [1]School of Psychology, Bangor University, Gwynedd, Wales, U.K.* – Accounts of supernumerary phantoms are rare, but not unusual, in the literature concerning the abnormal perception of body parts. Such phantoms, which occur after brain injury rather than amputation, usually manifest as arms or legs, towards which patients often feel hostile. We introduce the case of E.B., who sustained extensive brain trauma, including somatosensory and motor cortex, after falling from a wall. In both the somatosensory and auditory modalities, E.B. experiences a manifestation of the head and upper torso of a 'man', from the upper-right hand side of his body. Unlike previous reports of such patients, E.B. attributes a remarkable degree of consciousness/sentience to his phantom, which is perceived as acting with malicious, and at times murderous, intent. Further, the size and quality of the phantom appears to be proportional to E.B.'s anger towards it. E.B. has developed some control over the phantom's emergence, providing the opportunity to compare brain activation when the phantom is subjectively rated as present or not. A functional magnetic imaging (fMRI) investigation, using an AB block design was created, in which E.B. was presented with either 'phantom-eliciting' or 'phantom-suppressing' words in alternating 20s blocks, with 'phantom-strength' rated after each word presentation. A 'self-paced' phase of testing where the patient rated phantom-strength after self-motivated generation and minimisation, without external influence, completed the experimental phase. The results of this study are discussed within the context of the neurobiology of hallucinations, and the potential role of emotion in their generation and maintenance.

D131

LOCALIZING SYNAESTHESIA USING REPETITION SUPPRESSION IN FMRI *Tessa van Leeuwen[1], Karl Magnus Petersson[1,2], Oliver Langner[1,3], Mark Rijpkema[1], Peter Hagoort[1,2]; [1]F.C. Donders Centre for Cognitive Neuroimaging, Radboud University Nijmegen, Nijmegen, The Netherlands, [2]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, [3]Behavioral Science Institute, Radboud University Nijmegen, Nijmegen, The Netherlands* – In grapheme-colour synaesthesia, perception of letters and/or numbers induces the additional experience of a specific colour. There are two distinct theories explaining the underlying neural mechanism of synaesthesia: the cross-wiring theory (Ramachandran and Hubbard, 2001) proposes synaesthesia is due to excess anatomical connectivity in the (left) inferior temporal cortex, while the disinhibited feedback theory (Grossenbacher and Lovelace, 2001) hypothesizes that synaesthesia does not depend on anatomical differences, but is due to increased feedback derived from higher order multimodal regions. The goal of our study was to distinguish between these two theories. We used BOLD repetition suppression in a synaesthetic priming task to localize the synaesthetic colour experience. For synaesthetes, the synaesthetic colour that is induced by a grapheme (the prime) should lead to a reduced BOLD response for a subsequently presented colour (the target) in areas that are responsible for (synaesthetic) colour experience. In matched controls, this effect should not occur. First, we localized colour areas, grapheme areas and the effect of synaesthesia in a separate experiment. Data from 18 synaesthetes show stronger activation for synaesthesia than for real colours in the left inferior parietal lobule, BA 40 (-34, -47, 39), replicating the results of Weiss (2005) and favoring the disinhibited feedback theory. Preliminary data from the priming experiment show stronger activations for neutral (no synaesthetic colour) than for incongruent synaesthetic priming bilaterally in fusiform gyrus: left BA 37 (-46, -55, -11) and right BA 37 (51, -53, -14), suggesting inferior temporal regions are involved in synaesthetic priming.

D132

MODAL AND AMODAL INFORMATION PROCESSING DEMONSTRATED IN THE VISUAL AND TACTILE DOMAINS *Christopher Wessinger[1], Eric Clapham[1], Saloni Sharma[1], Aaron Karst[1], John VanMeter[2]; [1]University of Nevada, Reno NV, [2]Center for Molecular and Functional Imaging, Georgetown University Medical Center, Washington DC* – Initial information processing that is modality specific has been linked to learning style preferences. Such preferences can be related to modality specific, or modal, information processing. Conversely, higher order conceptual information is often linked to modality non-specific, or amodal, information processing. Participants either palpated or viewed pictures of MR-compatible toy animals and tools. Their task was to name or retrieve the output associated with each item. The presentation of two levels of processing crossed with tactile and visual presentation of stimuli allowed us to assess initial and higher order information processing (naming vs output retrieval), in different modalities (visual vs tactile) across different categories of stimuli (animals vs tools). The behavioral data demonstrate significant main effects of modality, stimulus type, and complexity, as well as significant interactions between modality & category and modality & complexity. Regionally specific activations were found in a mixed-effects group analysis of the fMRI data that are related to differences in modal and amodal processing. Visual presentation of stimuli resulted in greater activation in visual association regions while tactile presentation resulted in greater activation in somatosensory and motor regions. Complexity comparisons demonstrate that, regardless of modality or category, inferior and medial frontal regions are involved in higher order processing. These data support the notion that modality specific regions are used for initial perceptual processing (i.e. modal processing) while higher-order conceptual processing relies on a common network of frontal lobe regions regardless of modality (i.e. amodal processing).

Poster Session E

Emotion

E1

THE PROCESSING OF SYMBOLIC EMOTIONAL HAND GESTURES: AN ERP STUDY *Harald Schupp[1], Tobias Flaisch[1], Britta Renner[1]; [1]University of Konstanz* – We often use gestures to convey emotional meaning in social interactions. Its practical significance is obvious: It is a very fast and frugal way of emotional communication. Within a split-second, a specific gesture may show approval, calm down a heated exchange, or can signal strong insult, offense and threat. Such gestures are referred to as symbolic or emblematic gestures to separate them from other gestural behaviors accompanying and illustrating verbal behavior. Like other nonverbal emotional expressions, we predicted that emotional gestures are efficient cues to direct the attention of the receiver. Towards this end, participants viewed pictures of the sexually insulting middle finger jerk gesture, the positive thumb up gesture, and as non-emotional control condition, the forefinger point gesture. Stimuli were presented as serial stream with each picture shown for 120 ms (880 ms ISI) while dense sensor ERPs (256 channel) were recorded. Results demonstrate the selective processing of emotional compared to neutral gestures, which appeared most accentuated for the insult gesture. Specifically, developing around 150 ms and lasting until 300 ms, emotional gestures elicited a more pronounced occipital negativity compared to the control gesture. Subsequently (~400-600 ms), the insult gesture elicited a more pronounced late positive potential over centro-parietal locations. Interestingly, similar ERP modulations have been revealed in previous studies showing biologically prepared emotional picture contents (erotica, mutilation, threat faces). These findings demonstrate that emotionally charged gestures are efficient in shaping selective attention processes already at the level of stimulus perception. (Supported by the German Reserach Society)

E2

POSITIVE AND NEGATIVE AFFECT MEASUREMENT IN HEALTHY VOLUNTEERS: A FREESURFER STUDY OF CORTICAL THICKNESS. *Judith Segall[1], Jeremy Bockholt[1], Ranee Barrow[1,2], Shirley Smith[1,2], Robert Chavez[1,2], Rex Jung[1,2]; [1]The MIND Research Network, [2]University of New Mexico* – Mood regulation in humans involves a widely distributed system of interconnected brain regions including limbic, basal ganglia, and frontal-subcortical circuits. Among normal individuals, Tellegen (1999) has argued that mood involves two psychometrically independent factors – positive affect (PA) and negative affect (NA) – for which the Positive Affect Negative Affect Scale (PANAS) was developed. We sought to determine the relationship between the PANAS and cortical thickness in a cohort of 64 neurologically and psychiatrically normal subjects (34 males, 30 females) ranging in age from 18 to 39. T1 images were analyzed using FreeSurfer to obtain gray matter volumes of subcortical structures, and related to mood measures using the General Linear Model. Briefly, cortical thickness measures were obtained by reconstruction of the pial surface, the gray-white boundary, and the thickness between the pial surface and gray-white boundary at approximately 320,000 points comprising the cerebral cortex. We found that PA was significantly related ($p < .0001$) to decreased cortical thickness across a broad network of brain regions, the largest cluster of which included Brodmann Areas (BAs) 20 and 21 within the right temporal lobe. Conversely, NA was significantly related to increased cortical thickness, the largest cluster of which included the left parietal lobe/cuneus (BA 40). To our knowledge, this is the first study to link cortical thickness measures to mood in a cohort of normal individuals, and may represent susceptibility factors relevant to the emergence of psychopathology across the lifespan.

E3

PARIETAL CORTEX MEDIATES THE SELECTIVE DISRUPTION OF SPATIAL WORKING MEMORY BY THREAT-INDUCED ANXIETY *Alexander Shackman[1], Jeffrey Maxwell[1], Brenton McMenamin[1], Andrew Fox[1], Lawrence Greischar[1], Richard Davidson[1]; [1]University of Wisconsin, Madison, Wisconsin* – Anxiety-inducing threats can exert profound effects on performance via their impact on the more elementary working memory (WM) processes underpinning goal-directed cognition. A key unresolved issue is whether the influence of threat on WM is specifically mediated by the impact of anxiety on task-related processing. We examined the impact of task-irrelevant threat of shock on activity associated with spatial ("where") and verbal ("what") delayed-recognition WM tasks ($n = 40$). Anxiety was assessed using facial electromyography (EMG) from the corrugator supercillii (brow), a well-validated measure of emotional valence. We recorded high-density event-related potentials (ERP) and modeled the cerebral generators of the delay-spanning posterior slow wave characteristically elicited by the retention of information in WM using a 2-mm3 finite element model and the Low Resolution Electromagnetic Tomography (LORETA) algorithm. We predicted that (1) individuals who experienced greater anxiety would show larger decrements in spatial, but not verbal, performance, and (2) the impact of anxiety on spatial performance would be statistically mediated by variation in delay-spanning activity under threat. Both hypotheses were supported. Participants who expressed more anxiety under threat also exhibited worse performance on the spatial, but not verbal, task and showed amplified delay-spanning activity in posterior parietal cortex (PPC) on correct trials. Voxelwise tests of statistical mediation showed that threat-induced modulation of delay-spanning activity in PPC significantly mediated reductions in spatial performance. These results suggest that the deleterious impact of anxiety on cognition is selective and may arise from interference with spatial (i.e., vigilance) or executive attentional processes instantiated in PPC.

E4

UNIQUE NEURAL RECRUITMENT DURING SUCCESSFUL RESPONSE INHIBITION ASSOCIATED WITH SUBSTANCE ABUSE AND PSYCHOPATHY *Matthew Shane[1], Amy Byrd[1], Carla Harenski[1], Kent Kiehl[1]; [1]The MIND Institute, [2]The University of New Mexico* – While one of the core characteristics of psychopathy is a difficulty inhibiting prepotent, maladaptive responses, empirical demonstration of attenuated response inhibition has been inconsistent. One reason for this may be the highly comorbid nature of substance abuse, which has also been linked to response inhibition difficulties. The present study utilized functional magnetic resonance imaging (fMRI) to evaluate the unique and shared influences of psychopathy and substance abuse on neural systems underlying inhibition of prepotent responses. Ten psychopathic substance-abusers (> 28 on the Psychopathy Checklist – Revised, PCL-R; Hare, 2003), 10 non-psychopathic substance-abusers (< 16 on the PCL-R), and 10 healthy controls performed a speeded Go/No-Go task that required participants to inhibit prepotent responses to No-Go stimuli. Consistent with previous reports, activity within frontal regions (e.g. anterior cingulate) and inferior parietal cortex were associated with successful response inhibition. Differential activation was evident across groups, however. Both substance-abusing groups displayed reduced inferior parietal cortex activity during successful response inhibition than did healthy controls, suggesting a substance abuse-related attenuation in this region. Psychopathic drug abusers, however, also evidenced reduced anterior cingulate activity than did non-psychopathic drug-abusers. This attenuated cingulate response may indicate reduced monitoring for, or sensitivity to, the emergence of response conflict that is specific to the psychopathic disorder. Together, these findings demonstrate that psychopathy and substance abuse are each related to unique patterns of neural recruitment during the inhibition of prepotent responses.

E5

THE (NEAR) FUTURE IS BRIGHT: HOW EMOTION MODULATES SIMULATION OF EVERYDAY FUTURE EVENTS *Tali Sharot[1], David Johnson[2], Candace Raio[2], Yadin Dudai[3]; [1]University College London, [2]New York University, [3]Weizmann Institute of Science* – People often tend to imagine their own future through rose-colored glasses. Here we examine (i) if this optimistic tendency extends to ordinary everyday events (such as "getting stuck in traffic" or "going to the movies") and (ii) how imagining possible future events is modulated by emotion. Past studies have reported differences in imagining positive and negative events that may occur in the future. However, it is unknown if imagination of positive and negative events is qualitatively different from imaging neutral events. Here, participants were presented with descriptions of 100 everyday events. They imagined these events happening in the upcoming month and rated their images on different scales. A month later they recalled which events had happened. Findings indicate that participants made optimistic predictions; they estimated positive events to occur with greater likelihood than either negative or neutral events. Moreover, they expected positive events to happen closer in time, although in retrospect there was no difference in the time the different types of events actually occurred. Second, emotion enhanced the vividness of the image (and memory); neutral events were imagined (and recalled) with less vividness than either positive or negative events. Positive future events were also experienced with greater vividness than negative future events, but positive and negative memories did not differ. The results suggest that although emotion modulates the subjective experience of imagining future events in a similar manner that it does memory, imagining future emotional events is also influenced by motivational factors that are less prominent in memory.

E6

THE SOUND OF JOY: INDIVIDUAL DIFFERENCES IN PROSODIC ABILITY AND EMPATHY CORRELATE WITH ACTIVITY IN THE INFERIOR FRONTAL GYRUS *Tong Sheng[1,2], Julie Werner[2,3], Sook-Lei Liew[2,3], Anahita Gheytanchi[4], Lisa Aziz-Zadeh[1,2,3]; [1]Neuroscience Graduate Program, USC, [2]Brain and Creativity Institute, USC, [3]Division of Occupational Science and Occupational Therapy, USC, [4]Pacific Graduate School of Psychology* – Prosody, the melody and intonation of speech, is an extremely important and often undervalued component of human communication. A significant component of human social interactions depends on prosody. In a previous fMRI study we found that areas in the inferior frontal gyrus (IFG) are involved during both the perception and production of prosody. Here, we ask: Why are some individuals better than others at picking up subtle intonations in speech? Are such individuals more empathetic to the emotions of others? Are they better at simulating another's prosodic input onto their own motor representations? To explore how the IFG may be involved in these processes, we administered behavioral measures of prosody production, perception, and empathy. Using regression models to correlate behavioral data with group fMRI data acquired during prosody production and perception tasks, we found that scores on certain components of empathy correlate positively with IFG activity. In particular, activity of the IFG showed positive correlations with aspects of empathy such as the tendency to emotionally identify with fictional characters, the tendency to feel emotional concern for others, and the tendency to adopt the perspective of others. Additionally, individuals who scored high on tests measuring the ability to produce and perceive prosody also showed more activity in the IFG. These results suggest the IFG plays a role in aspects of empathy and social understanding, and that these aspects contribute to how well an individual processes prosodic information.

E7

NEURAL MECHANISMS OF STRESS REACTIVITY: THE RESPECTIVE CONTRIBUTIONS OF ORBITAL AND LATERAL PREFRONTAL CORTICES TO COGNITIVE APPRAISAL AND PHYSIOLOGICAL RESPONSES TO SOCIAL STRESS *Avgusta Shestyuk[1], Michal Levinson[2], Michelle Mills[1], Margaret Kemeny[3], Robert Knight[1,2]; [1]Helen Wills Neuroscience Institute, [2]University of California at Berkeley, [3]University of California at San Francisco* – Psychosocial stress is often accompanied by activation of peripheral physiological systems such as the hypothalamic-pituitary-adrenal (HPA) axis and the autonomic nervous system (ANS). Although animal studies suggest that the prefrontal cortex (PFC) plays an important role in HPA and ANS regulation, human work has been limited in identifying how specific PFC regions contribute to stress appraisal and peripheral activation. The current study examined respective roles of the orbital (OFC) and lateral prefrontal (LPFC) cortices in social threat appraisal and regulation of peripheral responses to social stress. Individuals with OFC (N=5) or LPFC lesions (N=5) and matched controls were asked to give a short speech and perform a serial subtraction task in front of a panel of judges. Measures of subjective mood and HPA (salivary cortisol) and ANS (heart rate and skin conductance) activation were taken before and after the stress task. The control and LPFC lesions groups demonstrated increases ($p<.05$) in negative emotions and peripheral activation post-task. In contrast, the OFC lesion group failed to show increases in negative emotions or salivary cortisol following the task, but had a more sustained increase in skin conductance than control individuals ($p<.05$). Individuals with LPFC lesions had greater baseline levels of cortisol and greater increases in subjective negative emotions post-task than control individuals ($p<.05$) but showed comparable task-related increases in HPA and ANS activation. These findings suggest that the OFC and LPFC play dissociable roles in subjective appraisal of social threat and are directly involved in HPA and ANS regulation.

E8

ENHANCED ATTENTIONAL AND VISCERO-INTEGRATIVE NETWORK ACTIVATION IN RESPONSE TO POVERTY-RELATED IMAGE STIMULI BY LOW SOCIO-ECONOMIC STATUS SUBJECTS: AN EMOTIONAL VISUAL FMRI STUDY *Michael Silverman[1], Peter Muennig[2], Zohn Rosen[2], Michael Stitzer[1], Thomas Naidich[1], Martin Goldstein[1]; [1]Mount Sinai School of Medicine, [2]Columbia University* – Objective: Use fMRI to probe functional neural differences between low versus high socioeconomic status (SES) subjects during poverty-related visual stimulus processing. Background: Low SES is associated with increased morbidity. Material deprivations account for only part of this association, prompting study of other ways SES impacts health. One candidate mechanism involves low SES-related psychological stress yielding deleterious somatic effects. Confirming this would require extending insights derived from animal and human models involving environmental stress, and determining a mechanism by which low SES-related environmental stressor are neurally transduced (akin to neuroimaging explorations of acute stressor responses, e.g., PTSD). Design/Methods: 15 African-American subjects (8 low /7 high SES) underwent EPI-BOLD functional MR imaging while performing an activation paradigm consisting of serially-presented positive, neutral, negative and poverty-related visual stimuli. Subjects were instructed to judge whether the visual stimulus is a meaningful or scrambled image using a 2-alternative button press. Contrast of relevance, poverty versus neutral x low versus high SES, was analyzed via FSL. Regions of interest were defined by clusters of >30 contiguous voxels revealing a significant difference in brain activity across conditions ($Z>2.81$, $P<.005$ two-tailed). Results: Relative to high SES, low SES subjects demonstrated greater anterior cingulate, thalamic, occipital, and insula activation while incidentally-processing poverty-related visual stimuli. Conclusions/Relevance: Low SES subjects demonstrated recruitment of a neural network containing attentional (cingulate, thalamus), visual (primary, secondary), and viscero-sensory integrative (insula) components during incidental processing of poverty-related visual stimuli. These results offer a potential neural mechanism mediating the transduction of environmental stressors within low SES.

E9

ARE THERE VOICE SPECIFIC PROCESSING MECHANISMS? INTENSITY CHANGES RECRUIT MORE SENSORY PROCESSING RESOURCES IF ASSOCIATED WITH VOCAL AS COMPARED TO NONVOCAL SOUNDS *Elizabeth Simpson[1], Annett Schirmer[2], Nicolas Escoffier[2]; [1]University of Georgia, [2]National University of Singapore* – Changes in the intensity of both vocal and nonvocal sounds can be emotionally relevant. However, as only vocal sounds directly reflect communicative intent, intensity change of vocal but not nonvocal sounds is socially relevant. Here we investigated whether a change in sound intensity is processed differently depending on its social relevance. To this end, participants listened passively to a sequence of vocal or nonvocal sounds that contained rare deviants which differed from standards in sound intensity. Concurrently recorded event-related potentials (ERPs) revealed a mismatch negativity (MMN) and P300 effect for intensity change. Direction of intensity change was of little importance for vocal stimulus sequences, which recruited enhanced sensory and attentional resources for both loud and soft deviants. In contrast, intensity change in nonvocal sequences recruited more sensory and attentional resources for loud as compared to soft deviants. This was reflected in markedly larger MMN/P300 amplitudes and shorter P300 latencies for the loud as compared to soft nonvocal deviants. Furthermore, while the processing pattern observed for nonvocal sounds was largely comparable between men and women, sex differences for vocal sounds suggest that women were more sensitive to their social relevance. These findings extend previous evidence of sex differences in vocal processing and add to reports of voice specific processing mechanisms by demonstrating that simple acoustic change recruits more processing resources if it is socially relevant.

E10

SUBCORTICAL VOLUMETRIC CONTRIBUTIONS TO MOOD FUNCTIONING IN NORMAL SUBJECTS *Shirley Smith[1,2], Judith Segall[1], Robert Chavez[1,2], Jeremy Bockholt[1], Rex Jung[1,2]; [1]The MIND Research Network, [2]University of New Mexico* – Past research has shown a positive correlation between subcortical brain volumes and indices of psychopathology in patient cohorts. The goal of the current study was to determine whether this relationship was present within a group of normal subjects. We hypothesized that volumetric measures of subcortical gray matter (i.e., caudate, putamen, globus pallidus, thalamus) would relate to measures of psychopathology [Symptom Checklist - 90 (SCL-90)]. We also explored sex differences in this relationship based on research linking greater male psychopathology to brain volume abnormalities. We obtained T1 images and behavioral measures of mood functioning in a cohort of 64 neurologically and psychiatrically normal subjects (34 males, 30 females) ranging in age from 18 to 39. T1 images were analyzed using FreeSurfer to obtain gray matter volumes of subcortical structures, and related to mood measures using regression equations. We found that a model that included right thalamic and caudate volumes was significantly related the Global Severity Index (GSI) of the SCL-90 ($F = 5.90$, $p = .005$, $R2 = .16$), and that this relationship was substantially stronger in males ($R2 = .27$) as compared to females ($R2 = .006$). Post hoc analysis, limited to male subjects, found significant relationships between right thalamic volume and GSI subscales including Depression ($r = .58$, $p < .001$) and Interpersonal Sensitivity ($r = .41$, $p = .015$). To our knowledge, this is the first report assessing the relationship between subcortical brain volumes and mood regulation in a cohort comprised exclusively of normal, healthy subjects.

E11

AMYGDALA LATERALIZATION AND RISK-TAKING BEHAVIOR: EVIDENCE FROM UNILATERAL SELECTIVE AMYGDALOHIPPOCAMPECTOMY PATIENTS *Stephen D. Smith[1], David H. Zald[2]; [1]University of Winnipeg, [2]Vanderbilt University* – Damage to the amygdala leads to reduced reactivity to fear-related stimuli as well as blunted autonomic-nervous-system responses. However, less is known about how amygdala damage influences higher-order processes such as emotional decision-making. Specifically, will reduced sensitivity to fear influence an individual's propensity to take risks, and will unilateral damage to the left or right amygdala differentially affect risk-taking behavior? To examine these issues, ten temporal-lobe epilepsy patients who had undergone a surgical resection of their left or right amygdala and anterior hippocampus, as well as matched control participants, completed the Balloon Analogue Risk Task. This task is an empirical measure of risk-taking that correlates with several 'real-world' risk-taking behaviors (Lejuez, et al., 2002). On each trial, participants press the computer mouse to inflate a computerized balloon. Each mouse-press is worth money to the participant; however, if the balloon is inflated too much, it will burst, resulting in no reward. Participants, therefore, must decide whether to stop inflating the balloon early in each trial, or to continue inflating the balloon to earn more money (at the risk of the balloon bursting). The results demonstrated an interesting difference between patients with left or right amygdala damage. Patients with damage to the right amygdala were risk-seeking; they burst more balloons than did controls. Surprisingly, left-amygdala patients burst fewer balloons than controls (and earned less money overall), suggesting that they had become risk averse. These results demonstrate that damage to the left and right amygdalae leads to dramatically different effects on emotional decision-making.

E12

PREDICTION DETERMINES RELATIVE REPRESENTATION OF PAIN: A NEUROIMAGING STUDY OF PLEASANT PAIN *Gregory Snyder[1,2], Siri Leknes[1], Irene Tracey[1]; [1]Functional Magnetic Imaging of the Brain (FMRIB) centre, University of Oxford, UK, [2]Princeton University* – Pain is subjective and context-dependent. The current study employed functional magnetic resonance imaging (fMRI) during two consecutive sessions to investigate how context and prediction modulate pain. In the 'warm session' subjects were primed to expect a "high probability" pleasant warm stimulus. Similarly, in the 'intense session,' subjects expected a "high probability" intense pain. In both sessions, a moderate pain stimulus was administered 50% of the time. To disambiguate the moderate stimuli from the expected stimuli, the moderate pain was accompanied by a simultaneous visual cue. After each cue-stimulus presentation, subjects rated its sensation or outcome affect (positive versus negative). Behavioral results demonstrated that subjects felt more positive about the moderate pain in the intense session than in the warm session, despite the same temperature being used across sessions. In fact, subjects rated the moderate pain stimulus as mildly pleasant in the intense session only. Outcome affect was significantly correlated ($p<0.05$) with sensation ratings in both sessions. In addition, correlations were seen between subjective dread ($p<0.05$) or relief ($p<0.01$) and the moderate pain outcome in the intense session. Functional data further implicated prediction as significant in the subjective experience of pain, as activation of the ventral striatum during moderate pain in both sessions is consistent with its role in positive and negative prediction error. Finally, the primary contrast between moderate pain across sessions yielded greater activation of the medial orbitofrontal cortex (OFC) during the intense session, supporting its role in reward valuation and positive hedonic affect.

E13

EMOTION MINING: CONSCIOUS AND UNCONSCIOUS EMOTIONS RELATED TO THE SOCIAL PERCEPTION OF HABITS AND ADDICTIONS *Thomas Snyder[1], George Trksak[2]; [1]Emotion Mining Company, Wellesley, MA, [2]McLean Hospital/Harvard Medical School* – Social perceptions can have notable influence on how distinct concepts are internalized and subsequently shape the development of schemata. The social perceptions and/or schemata associated with drug abuse and the concept of drug addiction have changed dramatically over the past 50 years and are continually shaped by the media and public policy. Hence, a greater understanding of the current but changing social attitudes associated with drug abuse is critical in initiating social change and public drug policies. The involvement of conscious and unconscious emotion may be vital elements in understanding and extrapolating social perceptions and schemata associated with drug abuse and addiction. The present study was conducted in order to further identify current social perceptions of drug addiction. The Emotion Mining toolset is comprised of web-based interfaces that characterize conscious and unconscious emotional responses to specifically crafted topic questions with analysis of both categorized emotion words and written responses in an aggregate database. This innovative methodology was used to characterize the hypothesized differential emotional response profiles to the concepts of "ADDICTION" and "HABIT". 290 subjects responded in two 15-minute Emotion Mining sessions addressing 'How does "ADDICTION" or "HABIT" make you feel?' The results indicate intriguing differences in emotions related to "ADDICTION" and "HABIT", especially on the unconscious level and as reflected in individual subjects verbatim. Both the type and magnitude of emotional responses were different for "ADDICTION" and "HABIT". Differences were further explained by differences in age and ethnicity. These data are important as the association of drug addiction to negative, deviant, and pathological behavior has strong implications both socially and politically. The results may provide a communication bridge needed for the development of more effective drug addiction awareness and prevention strategies.

E14

THE ATTRIBUTION OF EMOTIONAL MENTAL STATES IN PATIENTS WITH PSYCHOPATHY *Monika Sommer[1], Katrin Döhnel[1], Beate Sodian[2], Johannes Schwerdtner[1], Jörg Meinhardt[2], Göran Hajak[1]; [1]University of Regensburg, [2]Ludwig-Maximilians University* – The human ability to make inferences about other people's mental states is known as Theory of Mind (ToM). Valid emotion attribution demands the fundamental abilities to conceive other people as intentional agents whose actions are directed at achieving goals and to understand that the outcome of an intended action influences the protagonist's emotional state. Psychopathy is defined by severe impairments of emotional processes and psychopathic patients show deficits especially in interpersonal emotional components. In the present fMRI study we investigated the neural correlates associated with inferring emotional states from the outcome of an intentional action. 16 healthy participants, 16 psychopathic and 16 non-psychopathic forensic patients were included. By presenting identical cartoon stories which only differ in their verbal vignette we realized three experimental conditions: intention fulfilled, intention not fulfilled and a non mentalizing reality condition. The task of the participants was to indicate the emotional state of the protagonist in respect to the fulfilled or unfulfilled intention. Results revealed a significant task by group interaction in the frontal anterior paracingulate gyrus (BA32) and posterior midline structures. The contrast unfulfilled vs. fulfilled intentions showed that in healthy participants emotion attribution in the context of unfulfilled intentions induced a significant decrease of activity in theses areas, whereas psychopathic patients showed a significant increase. These results provide evidence that brain areas associated with the default mode network play a central role in inferring emotional states from intentional actions and that psychopathic patients show divergent activation patterns during such fundamental processes of emotion attribution.

E15

THE SOCIAL INCENTIVE DELAY TASK (SID): PROBING SOCIAL MOTIVATION IN HEALTHY SUBJECTS *Katja N. Spreckelmeyer[1], Gregor Kohls[1], Soeren Krach[1], Arda Irmak[1], Tilo Kircher[1], Kerstin Konrad[1], Gerhard Gruender[1]; [1]RWTH Aachen, Germany* – Social reward has been identified as a strong incentive for goal-directed behavior. In addition, mesolimbic brain structures have been suggested to play a role in representations of predicted reward, irrespective of reward type. However, data enlightening the role of mesolimbic structures in social reward anticipation is still scarce. The aim of the present study was to test a new fMRI paradigm for probing anticipation of social reward. To set the results in relation to earlier findings on non-social reward prediction, the anticipation of monetary as well as social reward was examined in the same participants (N=16) by making use of the monetary incentive delay paradigm (MID) by Knutson et al, 2001. To design a comparable social incentive delay task (SID) the MID-paradigm was adapted by replacing monetary by social reward (approvingly smiling faces). In both conditions participants were given a cue indicating potential reward. In order to receive reward a target button had to be pushed within a certain time window (adapted for individual reaction time). Cues triggering either monetary or social reward anticipation were presented sessionwise. Imaging was performed on a 1,5 Tesla Siemens scanner in an event-related design. In both conditions activation of mesolimbic brain structures was stronger if reward could be anticipated than if nothing could be gained. However, regions of activation did only partly overlap between both conditions. While mesolimbic activation was stronger during anticipation of monetary than social reward, anticipation of social reward activated additional regions that money did not, e.g. the medial prefrontal cortex.

E16

ANTICIPATORY ANXIETY PREDICTS REDUCED GAZE FIXATION ON AVERSIVE STIMULI IN GENERALIZED ANXIETY DISORDER *Alison Staples[1], Desmond Oathes[1], Melissa Schmidt[1], Michael Jenson[1], Jack Nitschke[1]; [1]University of Wisconsin, Waisman Laboratory for Brain Imaging and Behavior, Madison WI* – Consistent with both vigilance and avoidance theories related to clinical anxiety including generalized anxiety disorder (GAD), our previous functional brain imaging (fMRI) results suggest that GAD patients are hypervigilant while anticipating emotional stimuli (Nitschke et al., 2007) but show a lack of reactivity during actual presentations of those pictures as indexed by amygdala activation (Oathes et al., 2007). In an attempt to uncover the mechanisms by which GAD patients engage or disengage attention to facilitate these processes, we tracked eye movements while participants viewed negative emotional pictures from the International Affective Picture System set. GAD patients were compared with individuals diagnosed with social anxiety disorder, a major depressive disorder, and non-psychiatric control participants. Significant group differences in fixation time on negative aspects of the pictures as well as anxiety ratings following warning cues suggest that GAD patients were more anxious during anticipation of the pictures but then spent less time fixating on negative parts of the pictures compared to non-GAD participants. For the GAD group, alone, there was a negative correlation between time spent looking at negative parts of pictures and anxiety ratings following warning cues. The data suggest that GAD patients are hypersensitive to emotional information and, as a result, fixate less on negative aspects of emotional stimuli and that this avoidance tendency is unique to GAD.

E17

EMOTIONAL ANTI-FACES: RECOGNITION OF FACIAL EXPRESSIONS AND THEIR STATISTICAL OPPOSITES *Joshua Susskind[1], Melissa Ellamil[1], Adam Anderson[1,2]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest Centre* – Basic emotions theory suggests that facial expressions represent distinct emotional entities. By contrast, we hypothesized that facial actions underlying expressions are not independent and have natural opposites that convey opposing visual information. Using a statistical model of facial appearance, we derived a set of photorealistic expression prototypes and associated anti-faces – visual-statistical opposites of the prototypes. In Experiment 1 participants' emotion ratings of model-derived faces established that prototypes express emotions consistent with overlap in their facial actions while their anti-faces express the opposite emotions. In particular, fear and disgust were found to have strongly opponent facial actions, with the fear anti-face recognized as disgust and the disgust anti-face recognized as fear, respectively. Although expression anti-faces visually oppose their prototypes, it is not clear whether the visual system is directly sensitive to contrasts in facial actions characterizing prototype-anti-face relations. In Experiment 2 we used a perceptual adaptation paradigm to examine discrimination of expressions from neutral after adapting to disgust and fear anti-faces. The fear anti-face significantly biased perception toward fear, enhancing fear recognition; likewise, the disgust anti-face biased perception toward disgust, enhancing disgust recognition. These results suggest that expressions are coded neurally through contrastive mechanisms sensitive to opposing facial actions. These data provide evidence that facial expression recognition is supported by opponent processes that define the perceptual space linking expressions to underlying emotions.

E18

AMYGDALA VOLUME PREDICTS RECOVERY FROM NEGATIVE STIMULI *Matthew J. Sutterer[1], Carien M. van Reekum[1], Brendon M. Nacewicz[1], Regina C. Lapate[1], Lawrence L. Greischar[1], Catherine J. Norris[3], Stacey M. Schaefer[1], David R. Bachhuber[1], Gina M. Beguhn-Madeska[1], Nicole M. Rute[1], Terrence R. Oakes[1], Richard J. Davidson[1,2]; [1]Waisman Laboratory for Brain Imaging and Behavior, University of Wisconsin-Madison, [2]University of Wisconsin-Madison, [3]Dartmouth College* – Animal and human studies have demonstrated that the amygdala plays a key role in emotional processing, especially in response to negative challenges. However, the role the morphometry of this region might have in emotion-related processes remains unknown. In a study assessing health and well-being across the life span in the United States, we collected structural magnetic resonance imaging (MRI) scans. Additionally, in a separate session, we also recorded electromyographic (EMG) activity of the corrugator supercilii muscle during as well as following the presentation of negative, neutral, and positive pictures. The amygdala was manually traced on each participant's own MRI using a previously published protocol (Nacewicz et al., 2006). Larger whole-brain corrected amygdala volumes significantly predicted greater corrugator activity immediately following negative picture presentation, even when controlling for corrugator activity during picture presentation. These data suggest that individuals with enlarged amygdalae, while experiencing no deficit in reactivity to negative information, may have a reduced ability to recover from a negative challenge.

E19

EMOTIONAL FACES PRODUCED LESS REPETITION SUPPRESSION THAN NEUTRAL FACES *Atsunobu Suzuki[1,2], Joshua Goh[1], Brad Sutton[1], Andy Hebrank[3], Lucas Jenkins[4], Blair Flicker[3], Denise Park[3]; [1]Beckman Institute, University of Illinois at Urbana-Champaign, [2]Program of Gerontological Research, University of Tokyo, [3]Center for Brain Health, University of Texas at Dallas, [4]University of California at Davis* – Emotional attributes of stimuli have been shown to modulate, mostly enhance, perceptual processing (Vuilleumier, 2005). In the present study, we investigated effects of emotion on repetition suppression, that is, reduction of brain activation with repetition of stimuli (Grill-Spector et al., 2006). Previous studies provided contradictory evidence on this issue, such that emotional stimuli produced less (Rotshtein et al., 2001) and more (Ishai et al., 2004) repetition suppression than neutral ones. We conducted an event-related functional magnetic resonance imaging (fMRI) experiment designed to resolve differences from the previous studies, and compared repetition suppression between emotional (angry and happy) and neutral faces in the fusiform gyrus and in the amygdala. When the same face was presented consecutively, we found that the peak amplitude of the fMRI signal in the middle and posterior parts of the fusiform gyrus was smaller for the second presentation than for the first, and this repetition-suppression effect was the most evidence for neutral faces. Results also suggested early deactivation of the amygdala associated only with repetition of neutral faces. It thus appears that emotional faces ensured more sustained activation than neutral ones both in the fusiform gyrus and in the amygdala, providing support for the notion that emotional information undergoes extensive processing.

E20

NEURAL MECHANISMS OF COGNITIVE-EMOTIONAL PROCESSING IN ALEXITHYMIA *Marte Swart[1], Richard Bruggeman[2], Durk Wiersma[2], André Aleman[1]; [1]BCN NeuroImaging Center, University Medical Center Groningen, The Netherlands, [2]University Medical Center Groningen, The Netherlands* – Introduction: Alexithymia, or no words for feelings, is an impairment of the ability to identify and communicate one's emotional state. In order to elucidate the neural mechanisms of the cognitive-emotional processing underlying alexithymia, we investigated nonclinical subjects with either high or low scores on an alexithymia questionnaire using functional magnetic resonance imaging (fMRI). Methods: 20 participants (9f) with high- and 20 participants (17f) with low scores on the verbalizing scale of the Bermond-Vorst Alexithymia Questionnaire (BVAQ), performed emotion related tasks during fMRI. Subjects performed a memory association task, an emotional working memory task and an auditory verbal imagery task. Functional images were acquired with a 3T Philips scanner using echo-planar imaging (EPI). We conducted random effects analyses and used t-tests for group comparisons (SPM5) thresholded at $p<0.005$, uncorrected. Results: Alexithymic participants had more activity in middle- and inferior frontal gyrus (MFG, IFG) and in superior temporal gyrus (STG) related to emotional IAPS pictures compared to neutral pictures during the memory association task. In the emotional working memory task alexithymic participants showed less activation in superior frontal gyrus (SFG) and cingulate cortex (CC) for emotional facial expressions compared to neutral faces. Conclusions: The high and low alexithymic groups showed different activation patterns in response to cognitive-emotional processing tasks. Brain areas associated with emotion experience (SFG) and emotion control (CC) were less activated in the alexithymic group. However, areas associated with emotion regulation and effortful suppression of emotion were more activated (IFG, MFG) in alexithymic individuals.

E21

LONG-LASTING EFFECTS OF SUBLIMINAL AFFECTIVE PRIMING FROM FACIAL EXPRESSIONS *Timothy Sweeny[1], Marcia Grabowecky[1], Satoru Suzuki[1], Ken A. Paller[1]; [1]Northwestern University* – Unconscious processing of visual stimuli with emotional content can automatically bias affective judgments made a moment later. However, it is unclear if subliminal affective priming is merely a transient phenomenon manifested in fleeting perceptual changes or whether long-lasting behavioral effects are also induced. We assessed unconscious emotional processing by requiring people to rate the valence of surprise faces subliminally primed by 30-ms fearful, happy, or neutral faces. Surprise faces primed by happy faces were rated as more positive than surprise faces primed by fearful faces, but only among subjects unaware of the primes. These subjects were categorized as strictly unaware of primes based on the absence of subjective reports of prime presentations along with chance-level performance at discriminating emotional expressions of subliminal faces. The next day, memory for surprise faces presented without any subliminal affective expressions was assessed using a four-point recognition confidence scale for each face. Surprise faces that had been primed by happy faces the prior day were remembered better than surprise faces that had been primed by fearful and neutral faces, again only among subjects unaware of the primes. Effects of subliminal affective priming thus were evident both immediately after prime presentation and 1 day later. The present findings underscore the power of affective information that escapes conscious perception and yet can still influence a person's attitudes and behavior, not just momentarily at the time sensory information is first processed but in an enduring way that remains operative at least 1 day later.

E22

TRAIT-ANXIETY AFFECTS EARLY PROCESSING OF IRRELEVANT THREAT WORDS: AN ERP STUDY *Isabel Taake[1], Fern Jaspers-Fayer[1], Mario Liotti[1]; [1]Simon Fraser University* – Recent evidence has shown that threat signals in the environment can be rapidly detected at a very early, possibly pre-attentive stage in the information processing stream. For example, visual event-related potentials (ERPs) to faces have been found to be enhanced in amplitude as early as 90 ms after stimulus onset in case of fearful vs. neutral faces (Pourtois and Vuilleumier, 2006). Such biased processing of negative information has been found to be exaggerated in anxious individuals, who have been characterized as hypervigilant to threat (Williams et al, 2006). Bias towards threat information has been implicated in the etiology and maintenance of anxiety states (Beck and Clark, 1997). In the present study, we examined whether high trait anxiety enhances early, pre-lexical stages of emotional word processing (before 200 msec). ERPs were recorded while healthy students with high and low Anxiety Sensitivity (n=14) performed a lateralized dot probe task employing word pairs of different types (threat-neutral, threat-positive and positive-neutral blocks). Reaction times to the probe revealed no statistical differences as a function of emotion type in either group. ERPs time locked to the onset of the word pairs revealed an early modulation of the occipital P1 wave (75-115 ms) to the threat-neutral pairs, with significantly greater P1 amplitude in the high than low anxiety group ($p < 0.026$). No P1 group differences were observed for threat-positive and positive-neutral blocks. Later on, enhanced N1 activity (120 – 160 ms) over temporo-occipital scalp was observed in both groups in response to threat-positive relative to positive-neutral blocks.

E23

SEEING RED: ASSOCIATIONS BETWEEN NEURAL CORRELATES OF VISUAL PROCESSING, EXTERNALIZING BEHAVIOR, AND EMOTION REGULATION IN SCHOOL-AGED CHILDREN *Rebecca M. Todd[1], Marc D. Lewis[1], Connie Lamm[1]; [1]University of Toronto* – Individual differences in temperament, particularly related to anxiety, have been associated with differences in perceptual processing. Although aggressive behavior is associated with deficits in the capacity for effortful emotion regulation, the relationship between aggression and perceptual processing in development is still unknown. The goal of the present study was to use event-related potentials (ERPs) to investigate links between visual processing, externalizing behavior, and the capacity for effortful control in late childhood. Participants were 45 children referred for externalizing behavior problems and 49 age-matched controls, 8 to 12 years of age. EEG was collected while children performed a challenging 3-block Go/Nogo task with a negative emotion induction in the middle block. The P1, an early posterior ERP component sensitive to both attentional modulation and emotional valence, was measured in correct Go trials. Temperament questionnaires were also administered. All children showed increased P1 amplitudes in response to the mood induction, indicating that early visual processing is enhanced by emotion in both normal and aggressive children. Aggressive children showed longer P1 latencies than controls, suggesting that slower visual processing is associated with externalizing behavior. Finally, among the antisocial children, lower effortful control scores predicted lower amplitude P1s, indicating that low regulatory capacity is linked to reduced visual processing. Whereas previous research has revealed associations between visual processing and anxiety, our results further suggest that, in school-aged children, neural correlates of rapid visual processing are linked to both externalizing behavior and the capacity for deliberate and flexible emotion regulation.

E24

ROLE OF INDIVIDUAL DIFFERENCES IN THE RESPONSE TO EMOTIONAL DISTRACTION: AN EVENT-RELATED FMRI INVESTIGATION *Sara Tomlinson[1], James Kragel[2], Jared Stokes[2], Florin Dolcos[1], Gregory McCarthy[3], Roberto Cabeza[2]; [1]University of Alberta, [2]Center for Cognitive Neuroscience, Duke University, [3]Yale University* – Increased susceptibility to emotional distraction is often among the debilitating features of mood and anxiety disorders. Although it is generally accepted that increased emotional distractibility may be linked to individual differences in the response to emotional challenge, little is known about the neural circuitry associated with such behavioral differences. The present study used functional magnetic resonance imaging (fMRI) in conjunction with behavioral measures to investigate the role of individual differences in the response to task-irrelevant emotional distraction. Event-related fMRI data were recorded while subjects performed a working memory (WM) task with emotional and neutral distracters presented during the delay interval between the memoranda and probes. In addition, behavioral data concerning participants' patterns of response in the affective and cognitive domains were also recorded using a battery of tools that assessed both general (e.g., emotional arousability, decision impulsivity) and specific (e.g., subjective emotional ratings of distracters) aspects of processing. Analysis of behavioral data revealed that participants showing increased susceptibility to emotional distraction during the WM task also tended to have higher emotional arousability and attentional impulsivity scores. Complementing these behavioral findings, analysis of the fMRI data showed that increased emotional reactivity and susceptibility to emotional distraction were associated with enhanced activity in the amygdala and the medial prefrontal cortex, consistent with the role of these regions in the response to emotional challenge. These findings provide novel evidence concerning the role of individual differences in the response to emotional challenge, which is relevant to understanding differential susceptibility to affective disorders.

E25

LOOK INTO MY EYES: THE EFFECT OF LOOKING BEHAVIOR ON FACE PROCESSING *Nim Tottenham[1], Tara Ann Gilhooly[1], Alexander Millner[1], Sarah Birch[1]; [1]Sackler Institute for Developmental Psychobiology, Weill Cornell Medical College* – When viewing another's face, healthy individuals look at the eyes because they hold information relevant to face processing, including expression interpretation. This study experimentally manipulated gaze location to the eyes or to the mouth region to observe the behavioral and neurofunctional effect on face processing. Fifteen adults identified the location of a visually-degraded cue superimposed on a face, forcing foveation to the eye or mouth region. Results suggest that the eye region holds information relevant for emotion processing. Specifically, adults' reaction time was relatively slower to angry faces but only when focus was directed to the eyes ($p<0.01$) or during a manipulation-free condition, and the effect disappeared when focus was on the mouth. This finding suggests that individuals naturally focus on the eye region and that the experimental manipulation of forcing foveation to the eye region mimics looking behavior during natural viewing. We collected concurrent imaging data (fMRI) and observed that signal change in the amygdala, a region sensitive to the emotional significance of stimuli, and fusiform gyrus, a region sensitive to faces, were modulated by focus (eyes > mouth), so that signal intensity changed as a function of where subjects looked. Manipulating focus within house stimuli did not produce differences in reaction time or activity in visual areas. These data support the hypothesis that visual information can bias socio-emotional processing even in typical individuals and raises the possibility that atypical visual information processing may underlie atypical face processing.

E26

EMOTION RECOGNITION: THE MODEL OF HUNTINGTON'S DISEASE *Iris Trinkler[1,2], Anne-Catherine Bachoud-Levi[1,2]; [1]Departement d'Etudes Cognitives, ENS, Paris, France, [2]INSERM U841, E1* – It has been repeatedly shown that patients with Huntington's Disease (HD) are impaired at recognising emotional expressions. Here we asked if this impairment might be paralleled by a production deficit for emotion expression which might suggest an implication of a motor mirror system coding the motor aspect of both recognition and production of emotional expressions that might be deficient in HD (see also Carr , Iacoboni, et al., Proc Natl Acad Sci USA 2003). We tested 13 HD patients and 13 matched control subjects on recognition of the six basic emotions (anger, disgust, fear, surprise, sadness and joy) using a forced-choice test using 60 images from the Karolinska Faces inventory and the 60 Ekman faces. For production subjects were filmed while they produced the six emotional facial expressions repeatedly. Expressions were rated by a group of naïve raters as a forced-choice recognition test. We found an impairment of recognition and production overall and specifically for anger, disgust, fear and suprise. This lends support to a potential impairment in a common motor (mirror) system. Alternatively, an underlying emotion identification module could drive both recognition and production deficit. We will discuss the two models of emotion impairment in HD by means of additional data from an assessment of alexithymia (TAS20) in these patients, and implications for further experiments necessary to disambiguate between the two.

E27

FRONTOLIMBIC MECHANISMS OF COGNITIVE BIAS IN MAJOR DEPRESSION *Don Tucker[1,2], Catherine Poulsen[1], Phan Luu[1,2], Stacey Crane[1], Jason Quiring[1], Pieter Poolman[1]; [1]Electrical Geodesics, Inc., Eugene, OR, [2]University of Oregon, Eugene, OR* – We asked depressed persons from the community and normal controls to complete a self-evaluation procedure in which they indicated whether or not individual trait words described themselves. Dense array (256-channel) electroencephalography (EEG) was recorded. Greater depression (specifically lower Positive Affect) was associated with endorsement of fewer favorable traits, and greater anxiety (greater Negative Affect) was associated with endorsement of more unfavorable traits. Consistent with prior literature, depressives evidenced suppressed visual responses over the right hemisphere, and a reduced P300. They also showed reduced reactivity to positive and negative self-appraisal. In controls, the trial-averaged EEG (Event Related Potential or ERP) showed an enhanced N1 over left occipital-temporal regions for trials in which a “Yes” response was given to “Bad” or unfavorable traits. For depressives, this N1 response was attenuated, specifically for these Yes Bad trials. Similarly, in medial frontal regions controls showed enhanced medial frontal negativity to Yes Bad items, whereas depressives showed an attenuated or absent medial frontal response on these items specifically. To extend conventional scalp ERPs, neural source analysis was conducted using an atlas-based head model, realistic tissue conductivities and geometries, and sources distributed throughout the cortical volume. The medial frontal effects at the scalp could be attributed to both anterior cingulate and ventromedial frontal sources, with activity in ventromedial frontal cortex showing a particularly strong response in controls that was specifically attenuated in the depressed sample.

E28

SLEEP DEPRIVATION INDUCED EMOTIONAL VISUAL AGNOSIA *Els van der Helm[1], Ninad Gujar[1], Caitlin Watts[1], Matthew P. Walker[1]; [1]Sleep and Neuroimaging Laboratory, University of California, Berkeley, CA* – Introduction: While the effects of sleep-deprivation on cognitive function have received considerable research interest, the impact of sleep loss on emotional processing remains surprisingly understudied. Here we demonstrate that a single night of sleep-deprivation induces a selective recognition impairment of specific facial emotions; an effect that was reversible following recovery sleep. Methods: The task involved evaluating three different affective face categories: Sad, Happy and Angry. For each emotion, ten picture-slides, ranging in a gradient from neutral to increasingly emotional, were presented in a random order, with subjects required to make an emotional-strength rating for each face-slide. Prior to performing the task, subjects either slept normally, or were sleep deprived. Following a recovery night of sleep, both groups repeated the task again. Results: Under conditions of sleep-deprivation, there was a significant impairment (blunting) in the recognition of happy and particularly angry facial expressions, yet a relative preservation for the recognition of sad expressions. Moreover, the effect was far greater in females than in males. This selective “emotional visual agnosia” was, however, ameliorated following a night of recovery sleep in the deprivation group, with performance returning to similar profiles observed in the control group. Discussion: Together, these data demonstrate that sleep-deprivation induces profound affective dysregulation, impairing the ability to identify specific human emotions. Such specificity suggests that sleep-deprivation impacts discrete neural systems, rather than imposing a global brain deficit, and may offer clinically relevant insights into the co-occurrence of sleep abnormalities in psychiatric mood disorders, including major depression and post-traumatic stress disorder.

E29

NEURAL ACTIVATION TO IMPLICIT TRUSTWORTHINESS JUDGMENTS AND ITS INFLUENCE ON SOCIAL DECISION-MAKING *Mascha van 't Wout[1], Luke Chang[1], Alan Sanfey[1]; [1]Neural Decision Sciences Laboratory, University of Arizona* – Previous studies in social neuroscience have demonstrated that the face is an important source of social information from which people infer complex social characteristics such as trustworthiness. Indeed, we recently demonstrated that facial signals of trustworthiness had a substantial influence on how people behave towards another person in an interactive two-player risky decision-making game, the Trust Game. Moreover, the evaluation of facial trustworthiness is associated with activation of emotional brain areas including the amygdala and insula. However, there are no studies that examine how brain activation associated with implicit processing of subjective trustworthiness influences decision-making. Fifteen people were scanned in the role of proposer in the Trust Game with 64 partners that were previously rated on trustworthiness, 32 of whom were trustworthy and 32 untrustworthy. Behavioral results replicated our previous finding of a significant relationship between subjective trustworthiness and the amount of money transferred to that partner ($p<0.001$). Functional MRI results showed increased amygdala activation for untrustworthy faces compared to trustworthy faces. We will further explore whether activation of emotional areas, including the amygdala, correlates with the amount of money offered to a partner at the expense of the more cognitive, deliberative brain areas, such as the prefrontal cortex. Interestingly not every participant showed a significant relationship between subjective trustworthiness and amount of money transferred to that partner. Therefore, we will test if in these participants amygdala activation might be down regulated by the prefrontal cortex, resulting in a reduced relationship between subjective trustworthiness and consequential decisions.

E30

INDIVIDUAL ATTACHMENT STYLE MODULATES HUMAN AMYGDALA AND STRIATUM ACTIVATION DURING SOCIAL APPRAISAL *Pascal Vrticka[1,2], Frederic Andersson[2], Didier Grandjean[1,3], David Sander[1,3], Patrik Vuilleumier[1,2]; [1]Swiss National Center for Affective Sciences, University of Geneva, [2]Laboratory for Neurology & Imaging of Cognition, Department of Neurosciences & Clinic of Neurology, University Medical Center of Geneva, [3]FPSE, University of Geneva* – Adult attachment theory refers to fundamental individual differences defining how people affectively perceive and respond to others during social interactions or conflicts. Recent models propose that different attachment styles might be mapped on two dimensions defined by orthogonal axes of anxiety and avoidance, with the secure style corresponding to people in whom both anxiety and avoidance are low. Although attachment theory has generated a rich body of research in social and clinical psychology, the neural bases of these individual differences remain unknown. We used functional magnetic resonance imaging (fMRI) to examine how attachment style modulates brain responses to facial expressions that convey positive or negative feedback about task performance, and thus appear either supportive or hostile. Activation of striatum and ventral tegmental area was enhanced to positive feedback signalled by a smiling face, but such responses were reduced in participants with avoidant attachment, indicating relative impassiveness to social reward. Conversely, a left amygdala response was evoked by angry faces associated with negative feedback, and correlated positively with anxious attachment. Secure attachment showed mirror effects in striatum and amygdala, but no other specific correlate. These results reveal a critical role for brain circuits implicated in reward and threat processing in the biological underpinnings of adult attachment style, and support models postulating two separate affective dimensions to explain these individual differences.

E31

A META-ANALYSIS OF NEUROIMAGING EVIDENCE FOR DISCRETE BASIC EMOTION STATES *Katherine Vytal[1], Stephan Hamann[1]; [1]Emory University* – Current debate exists regarding the proposal that basic emotion states such as fear, disgust, anger, sadness, and happiness are reliably associated with characteristic patterns of brain activation. Proponents of alternative views associated with dimensional emotion models have pointed out that evidence for differentiable basic emotions, especially from neuroimaging, has been equivocal. Because previous meta-analyses reached somewhat discrepant conclusions and did not include many recent studies or new analysis methods, we reexamined this proposal. Using the recently developed Activation Likelihood Estimation (ALE) meta-analysis method, we analyzed 78 neuroimaging studies that elicited discrete emotion states. Reported activation foci were converted into nonparametric statistical whole-brain maps and assessed for clustering of activation within each discrete emotion (activations characteristic of each emotion) and for regions reliably discriminating between emotions in direct contrasts between basic emotions. ALE results demonstrated that all five basic emotion states examined elicited differentiable patterns of regional brain activation (surprise was omitted because of high variability). Further, activation patterns that reliably characterized a given emotion also tended to differentiate that emotion from other emotions (e.g., fear was associated with amygdala activation, and the amygdala was prominent among several regions reliably differentiating fear from disgust, etc.). These results clarify earlier meta-analysis results and converge with recent multivariate psychophysiological studies that indicate basic emotions can be reliably differentiated. Along with previous evidence, these results suggest that both dimensional (arousal and valence) and discrete basic representations of emotion have characteristic neural correlates.

E32

UNPACKING PREFRONTAL FUNCTION IN EMOTION REGULATION: FMRI EVIDENCE FOR INDEPENDENT FUNCTIONAL PATHWAYS THROUGH AMYGDALA AND NUCLEUS ACCUMBENS *Tor D. Wager[1], Brent Hughes[1], Matthew Davidson[1], Martin Lindquist[1], Kevin N. Ochsner[1]; [1]Columbia University* – A growing number of studies support a role for the lateral prefrontal cortex (LPFC) in the cognitive regulation of emotion, but little is understood about the cortical-subcortical interactions that mediate this process. We identified ventrolateral (VLPFC) and dorsomedial (DMPFC) frontal regions that correlated with reduced negative emotional experience during cognitive reappraisal of aversive images. Using these as regions of interest, we applied path analysis recursively within subcortical regions to locate mediators of the association between VLPFC activity and reductions in reported emotion. Results showed that two separable pathways mediated effects of VLPFC on emotion: A path through nucleus accumbens predicted greater reappraisal success, and an additional path through ventral amygdala predicted reduced success. Together, these two pathways explained ~50% of the variance in reported emotional experience. The results suggest that VLPFC may be involved in both the generation and regulation of emotion, through different subcortical pathways—roles which are consistent with the idea that VLPFC is involved in cognitive appraisal that can either increase or decrease emotion.

E33

ACUTE TRYPTOPHAN DEPLETION ALTERS NEURAL RESPONSES TO TARGETS AND EMOTIONAL DISTRACTORS *Lihong Wang[1,2], O'Dhaniel Mullette-Gillman[1], Kishore Gadde[2], Cynthia Kuhn[2], Gregory McCarthy[1,3], Scott Huettel[1,2]; [1]Duke University/Brain Imaging and Analysis Center, [2]Duke University, [4]Yale University* – Serotonin (5-HT) is a key neurotransmitter for emotional regulation and memory, and deficits in serotonergic function have been implicated in the affective symptoms of depression. Although biases toward negative events are endemic to depression, few studies have investigated the effect of low 5-HT on the neural systems underlying emotional memory. Using functional magnetic resonance imaging (fMRI) and acute tryptophan depletion (ATD), we investigated the effect of a temporary reduction in 5-HT synthesis on emotional encoding and executive function. Thirteen healthy volunteers participated in an open-labeled design with counterbalanced control and ATD sessions, each with behavioral and fMRI components. Our "emotional oddball" task required subjects to detect infrequently presented circle targets from frequent rectangle standards while novel distracting negative and neutral pictures were intermittently presented. Subsequent memory on the distracting pictures was tested one hour following the fMRI session. During the ATD session, subjects exhibited enhanced memory for negative pictures relative to neutral pictures, and lower positive affect scores (PA). Compared to the control session, ATD increased activation to negative distractors in two regions: the inferior frontal gyrus (IFG) and the posterior intraparietal sulcus. Conversely, ATD resulted in decreased activation to attentional targets in the dorsolateral prefrontal cortex. These findings highlight the importance of central 5-HT in context-dependent control of behavior and may have implications for neuropsychiatric disorders including depression and post-traumatic stress disorder.

E34

AUDITORY NARRATIVES MODULATE EMOTIONAL NEURAL PROCESSING OF NEGATIVE VISUAL STIMULI *Helen Weng[1], Jenna Sheftel[1], Diane Stodola[1], Richard Davidson[1,2,3], Antoine Lutz[1]; [1]Waisman Center for Brain Imaging, [2]Department of Psychology, [3]University of Wisconsin-Madison* – Interpretation of events is postulated to affect subsequent emotional processing. This has been studied in voluntary emotion regulation paradigms. However, further investigation is needed to understand how a stimulus is processed after a certain interpretation is accepted. Therefore, we paired negative social pictures with an auditory narrative which either enhanced or suppressed the emotional content. The Enhance narrative told the participants (N=36) that the scene depicted was happening to a loved one, where the Suppress narrative stated that the scene depicted was from a movie and not real. Half the participants viewed the pictures with a specific picture-narrative pairing. The other half viewed the pictures with the opposite picture-narrative pairing, demonstrating that neural changes seen between conditions are due to the interpretation of a given stimulus rather than the visual stimulus per se. Preliminary functional magnetic resonance imaging (fMRI) results show that the Enhance condition recruits greater activation in right superior frontal gyrus, right medial frontal gyrus, bilateral dorsal and anterior cingulate cortex, bilateral posterior cingulate, bilateral insula, and left thalamus compared to Suppress. The Suppress condition recruits greater activity in the right middle frontal gyrus, left inferior frontal gyrus, right inferior parietal lobule, visual cortex, and bilateral superior temporal gyri. These results suggest that the Enhance condition increases the emotional salience of a visual stimulus and subsequent neural processing in regions associated with emotion. The Suppress condition may recruit prefrontal regions involved in emotion regulation, increase visual processing of the stimulus, and increase auditory processing of the narrative.

E35

FEAR OF PUBLIC SPEAKING AND NEUROPHYSIOLOGICAL CORRELATES OF FACE PROCESSING *Matthias J. Wieser[1], Paul Pauli[1], Phillip Reicherts[1], Antje B. M. Gerdes[1], Martin J. Herrmann[1], Andreas Mühlberger[1]; [1]University of Würzburg* – Fear is supposed to interfere with emotional processing and has been associated with an attentional bias for angry faces. In this study, the effect of anticipatory fear of public speaking on emotional processing was investigated by means of event-related brain potentials. Fifty participants were randomly assigned to one of two conditions: In the fear condition, actual fear of public speaking was induced by instructing the participants to perform an oral presentation on an unknown topic later during the experimental session. The participants were made to believe that their rhetoric performance would be video-taped and evaluated by faculty members. In the control condition, the participants were told to have to do a brief written summary of arguments on an unknown topic. Participants then viewed angry, happy and neutral faces for 1000 ms without any task while EEG was continuously recorded. The fear-induction was successful as enlarged state anxiety scores for the experimental group revealed. Furthermore, higher fear was associated with larger P100 amplitudes in response to all facial expressions and shorter latencies for angry faces. The N170 was modulated by emotion over the right hemisphere for the fear group. Furthermore, angry facial expressions were associated with an enlarged EPN in fearful participants (experimental group), whereas emotional modulation of the LPP was not affected by fear. The results point at an influence of actual fear of public speaking on early perceptual processing of emotional facial expressions.

E36

NEURAL CORRELATES OF RECOLLECTION FOR EMOTIONAL ASSOCIATIONS ASSESSED WITH FMRI *Jennifer S. Wilson[1], Stephen M. LaConte[2,3], Stephan Hamann[1]; [1]Emory University, [2]Baylor College of Medicine, [3]Emory/Georgia Tech Biomedical Imaging Technology Center* – Emotional arousal elicited by emotional stimuli has been proposed to specifically enhance recollection and relational binding to neutral, contextual information, including source information. Associative recognition, in which two items that occurred together as a paired associate must be distinguished from new, recombined pairs of old items, is typically characterized as supported almost entirely by recollection, vs. item recognition, which can also be mediated by familiarity. Here we explored the influence of emotion on recollection for associative information, examining whether successful associative recognition memory for emotional paired associates would depend on regions typically implicated in the emotional enhancement of recollection in item memory tasks, particularly the amygdala and hippocampus/parahippocampal cortex, and whether these correlates would differ for positive vs. negative emotional stimuli. Eleven young adults encoded paired associates composed of a neutral cue and a word with either positive, negative, or neutral valence (e.g., camera—PARADISE; camera—DEATH; camera—MUSEUM) with a deep encoding task while being scanned at 3T in an event-related design. Subsequent memory was assessed after each run with free recall and cued recall, and associative recognition for all pairs (vs. recombined pairs, camera—TONIC) was tested immediately after scanning. Successful memory for positive emotional associations recruited regions implicated in reward and emotional memory, ventral striatum, left amygdala/hippocampus, and medial PFC, whereas successful memory for negative emotional associations recruited bilateral amygdala, hippocampus/parahippocampal cortex, and insula. Results suggest that successful encoding of recollection-based emotional associations recruit amygdala-based modulatory mechanisms that differ as a function of emotional valence.

E37

AUTOMATIC OR ATTENTIONAL CONTROL? NEURAL RESPONSE TO EMOTIONAL EXPRESSIONS *Charlene Wu[1], Samantha Crowe[1], Derek Mitchell[1,2], James Blair[1]; [1]National Institute of Mental Health, Mood and Anxiety Disorders Program, Unit on Affective Cognitive Neuroscience, [2]University of Western Ontario* – An event-related fMRI study investigated the impact of attentional load on the BOLD response to emotional expressions. Participants were presented with composite stimuli consisting of semi-transparent words superimposed on neutral, fearful, and disgusted faces. This manipulation held stimulus-driven features constant across multiple levels of attentional load. Participants made either (1) gender discriminations based on the face; (2) case judgments based on the words; or (3) syllable number judgments based on the words. A significant main effect for processing load was found in prefrontal cortex, parietal cortex, visual processing areas, amygdala, and insula. Results indicate activation in attention-related regions, such as dorsolateral prefrontal cortex and parietal cortex, increased with greater attentional load. Critically, enhanced activity in the amygdala and insula to emotional expressions during low attentional load (gender discriminations) was significantly reduced during higher levels of attentional load (linguistic discriminations). Collectively, these data support the view that processing task-irrelevant emotional information, whether fear- or disgust-based, is like neutral information subject to the effects of attentional load and top-down control.

E38

SOMATIC MARKER IS NOT NECESSARY TO FACILITATE DECISION MAKING IN A GAMBLING TASK *Nai-Shing Yen[1,2], Hui-Kuan Chung[1], I-Chen Chou[1], Kuan-Hua Chen[1]; [1]National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan* – The somatic maker hypothesis (SMH) proposed that decision making is guided by emotion and posited that past emotional bodily experiences (i.e. somatic maker) can appear before individual makes a decision (Damasio, 1994). An Iowa Gambling Task (IGT) was used to support SMH. In the IGT, somatic maker (i.e. anticipatory SCR) is interpreted as correlates with the bad decks, and it operates as an alarm to make subjects withdraw from bad decks. Nevertheless, the bad decks are associated with higher magnitude of reward and punishment than the good decks. To clarify the SMH, Tomb et al. (2002) changed the schedule of punishments and rewards and observed that anticipatory SCR was not associated with correct vs. incorrect decision making. On the contrary, they found that anticipatory SCR was associated with the risk level of the decks. In order to further clarify the SMH, the expected value (positive or negative) and the risk level (low risk or high risk) of the decks were manipulated in the present study. In our modified IGT, a significant interaction between expected value and risk level was found. That is, participants chose more bad decks in high risk condition and chose more good decks in low risk condition. More importantly, the anticipatory SCR showed the same pattern as the behavioral data. Therefore, the SMH is not supported.

E39

PHYSIOLOGICAL FACTORS IN EMPATHIC ACCURACY *Jamil Zaki[1], Niall Bolger[1], Kevin Ochsner[1]; [1]Columbia University, New York* – Empathy research has demonstrated that perceivers whose autonomic activity covaries with that of social targets (physiological linkage) are more accurate about the negative affect reported by these targets (empathic accuracy, or EA). However, the utility of physiological linkage in facilitating EA assumes that a target's autonomic arousal is correlated with their affective experience (affective coherence), which is not consistently the case. The current work investigated how affective coherence and physiological linkage affect EA. Targets were videotaped while talking about emotional autobiographical events, and their skin conductance response (SCR) was measured concurrently. Targets then watched the videos they had made and continuously rated the affect they had felt while talking. A separate group of perceivers watched these videos and made continuous ratings of the affect they thought targets were feeling; their SCR was concurrently recorded. Timecourse correlations were used to calculate EA (correlation between target and perceiver affect ratings), physiological linkage (correlation between target and perceiver arousal), and targets' emotional coherence (correlation between targets' arousal and affect ratings). We replicated the finding that physiological linkage predicts EA only for negatively valenced affect, and further found that a target's affective coherence increased perceivers' EA across valences. For negative emotions, target coherence also predicted physiological linkage, and its effect on EA was partially mediated through physiological linkage. These findings suggest that social targets whose reported affect coheres with their autonomic arousal are more "readable" by perceivers, partially because they cause perceivers to share their autonomic states.

E40

WHAT? DON'T YOU LIKE MY GIFT: USING FMRI TO STUDY AFFECTIVE-MOTIVATIONAL INCONGRUENCE DURING SOCIAL EXCHANGES *Nancy Zucker[1,2], James Morris[2,3], Steven Green[2], Kevin Pelphrey[5], Cynthia Bulik[4], Kevin Labar[2]; [1]Duke University Medical Center, [2]Duke University, [3]University of North Carolina, Chapel Hill, [4]Yale University, [5]Carnegie Mellon University* – Astute social perception requires integration of transitory and often conflicting nonverbal affective and motivational information during social interactions. Prior research has investigated congruent and incongruent goal-directed behaviors as prescribed by social context. However, the role of affect when making inferences from the actions of others warrants further investigation. We employed fMRI to study affective-motivational incongruence in a controlled, animated environment featuring virtual avatars. A virtual arm extended from the participants' field of view to offer a gift to an avatar. Across trials, the avatar's facial affect (disgust/happy) was fully crossed with arm gesture (accepting/rejecting) to create conditions of: 1) social reward (happy/accepting), 2) social rejection (disgust/rejecting); 3) faux pas (disgust/accepting), and 4) social rebuff (happy/rejecting). Participants were asked to determine the degree to which the avatar liked a proffered gift. Incongruent facial expression/arm gesture conditions evoked strong activity in the posterior superior temporal sulcus and anterior cingulate cortex. These regions have been reported to show strong sensitivity to inconsistencies between expectation and action as prescribed by social context. Here we show that these inconsistencies may be introduced via affect during social interaction. Finally, the social reward condition evoked strong activity in the putamen relative to the other conditions, suggesting that tokens of social benevolence are capable of evoking a response in a region often implicated in the processing of primary rewards. These findings offer promise for the application of this task to investigate complex, ephemeral affective communication in clinical populations characterized by deficits in reciprocal social interaction.

Linguistic processes: Lexicon

E41

AN MEG STUDY ON SEMANTIC PRIMING *Diogo Almeida[1], Ellen Lau[1], David Poeppel[1]; [1]University of Maryland, College Park* – The N400 varies as a function of lexical-level variables, such as frequency and wordlikeness, as well as context-level information, such as semantic fit in sentences and semantic relatedness in priming tasks. In MEG, lexical-level attributes modulate a component called M350 (~300-450ms), whereas sentential context effects are observed around 450ms (Halgren et al., 2002). This suggests that the MEG signal fractionates in time the individual contributions of lexical and contextual processing. To explore this hypothesis, we employed the semantic priming paradigm in a lexical decision task conducted while subjects were undergoing MEG recordings (n=22), comparing target words that were either semantically primed or not, and target strings that were either pronounceable/wordlike (pseudowords) or unpronounceable/unwordlike (nonwords). We predicted that lexicality and pronounceability would modulate the M350. Moreover, if semantic relatedness in word-pairs acts analogously to semantic fit in sentences, priming effects should appear around 450ms. If semantic relatedness also influences lexical-level processes, then priming should also affect the M350. However, our results showed no modulation of the M350. Window-analyses revealed (1) an early and sustained divergence (200-550ms) of pseudowords from the other conditions, (2) a surprisingly late and brief divergence between nonwords and unprimed words (450-500ms), and (3) a late and sustained amplitude reduction for primed when compared to unprimed words (400-600ms). These results cast doubt on a purely lexical interpretation of the M350, and also suggest that context plays a functionally similar role across lexical and sentential processing.

E42

PHONOLOGICAL FEATURE CONGRUENCY EFFECTS APPEAR BEFORE THE PHONOLOGICAL MAPPING NEGATIVITY (PMN) IN VISUAL WORD RECOGNITION: EVIDENCE FROM MASKED-PRIMING *Jane Ashby[1], Lisa D. Sanders[1], John Kingston[1]; [1]University of Massachusetts, Amherst* – Recent evidence indicates that skilled readers process sub-phonemic feature information in lexical decision tasks. However, it is unclear when this information is activated during lexical access. Previous experiments indicate phonological congruency effects (PMN) between 260-320 ms. Two ERP experiments investigated the time course of the activation of feature information during visual word recognition. EEG was recorded as adult participants read target words with voiced and unvoiced final consonants (e.g., fad and fat). A four field masked-priming paradigm was used to present nonword primes that were incongruent or congruent with targets in terms of voicing and vowel duration (e.g., fap or faz). Each nonword prime served as an incongruent prime (e.g., fap) for one target (fad) and served as a congruent prime for another target (fat). Experiment 1 used a long duration mask (100 ms) between prime and target, whereas Experiment 2 used a short mask (22 ms). Phonological congruency modulated the amplitude of the first negative peak (N1) in scalp potentials evoked by targets, with more negative potentials in the incongruent condition than the congruent condition. The timing of the N1 peak was delayed in the experiment with longer backward mask, suggesting that the increased prime-target ISI in Experiment 1 allowed further processing of the prime than in Experiment 2. Results suggest that skilled readers use sub-phonemic feature information in the early stages of visual word recognition.

E43

FNIRS BRAIN IMAGING INVESTIGATION OF BILINGUALISM: A NEW VIEW FROM SIGN-SPEECH BIMODAL BILINGUALS *Ioulia Kovelman[2], Katherine White[4], Mark Shalinsky[3], Shawn Nelson Schmitt[5], Melody Berens[1,5], Laura-Ann Petitto[1,5]; [1]University of Toronto Scarborough, [2]Massachusetts Institute of Technology, [3]Anthinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, [4]University of Rochester, [5]Dartmouth College* – Does early and systematic exposure to two languages modify brain tissue that underlies language capacity? Which brain mechanisms underlie bilinguals' remarkable ability to use two languages without confusion? We employed a unique population and innovative imaging technology to address these questions: Bimodal bilinguals proficient in sign and spoken languages who can use both languages simultaneously and functional Near Infrared Spectroscopy neuroimaging (fNIRS; Hitachi ETG-4000), which allows unconstrained speech and sign production. METHODS fNIRS Neuroimaging (N=32). Groups: (i) hearing ASL-English bilinguals, (ii) Deaf ASL monolinguals, (iii) English monolinguals. Tasks (1) Sign Repetition. (2) Picture Naming: (2a) in one language - Monolingual context, (2b) in two languages simultaneously – Bilingual context. RESULTS Behavioral. ASL speakers outperformed English monolinguals on Sign Repetition. Picture Naming accuracy was equal among groups and conditions. Imaging. Bilinguals showed lower left parietal activations than ASL monolinguals during Sign Repetition and lower right parietal activations than English monolinguals during Picture Naming (2a). Bilinguals in Bilingual context (2b) showed greater recruitment of posterior temporal regions (BA 21/22, "Wernike area") than in Monolingual context (2a). SIGNIFICANCE Early and systematic exposure to two languages in different modalities (sign and speech) may modify the way in which bimodal bilinguals recruit parietal regions to process language thereby rendering a "bilingual brain signature." Bilinguals' ability to use two languages effortlessly and without confusion may be rooted in posterior temporal regions ("Wernike area"). Using both fNIRS and bimodal bilinguals shed new light on the extent and variability of brain tissue that underlies language. Funding-Petitto: NIH R21HD05055802, R01HD04582203.

E44

THE TEMPORAL LOCI OF CONSISTENCY EFFECT IN READING CHINESE PSEUDOCHARACTER: AN ERPS STUDY *Wen-Hsuan Chan[1,2], Chia-Ying Lee[1], Jie-Li Tsai[2]; [1]The Institute of Linguistics, Academia Sinica, Taiwan, [2]National Chengchi University, Taipei, Taiwan* – Previous study has demonstrated a consistency effect in early (P200) and late ERP (N400) components and suggested that the phonetic radical is a functional sublexical unit for Chinese lexical processing. The validity of a phonetic radical in representing the pronunciation of a character affects lexical processing from the early extraction of orthographic and phonological information to the late lexical competition. The present study attempts to trace the time course it takes to extract phonology while reading Chinese pseudocharacters by using event-related potentials (ERPs). Participants were asked to attend to a set of pseudocharacters which were created by arbitrarily combining a semantic radical and a phonetic radical. Half of the phonetic radicals were extracted from the consistent phonograms and the other half were extracted from the inconsistent phonograms. Each pseudocharacter was paired with a spoken syllable which was either predicable or unpredictable by the constituent phonetic radical of the pseudocharacter. The data showed significant interaction between consistency and predictability on both P200 and N400. The pseudocharacters paired with unpredictable pronunciations elicited a greater P200 and an enhanced N400 than reading pseudocharacters paired with predictable pronunciations. However, the predictability on P200 was only found in reading high consistent pseudocharacters and the N400 effect was only found in reading low consistent pseudocharacters. These findings suggested that the phonetic radicals played a role in the pronunciation of pseudocharacters and confirmed that the consistency effect occurred at both early and late stages of lexical processing.

E45

INVESTIGATING SIGN AND GESTURE RECOGNITION: EVIDENCE FROM REPETITION PRIMING IN AMERICAN SIGN LANGUAGE *David Corina[1,2], Michael Grosvald[1,2], Christian Lachaud[1]; [1]Center for Mind and Brain, University of California at Davis, [2]University of California at Davis* – In our ongoing efforts to develop a theory of sign language recognition, we have explored how the processing of sign language forms diverges from that of non-linguistic human actions. The present study uses a novel repetition priming paradigm to investigate lexical access in American Sign Language and gesture recognition in deaf signers and hearing non-signers. In this experiment, subjects were presented with short video clips of signs and gestures and were asked to make a speeded categorization as to whether each stimulus showed a sign or gesture. Within this self-paced continuous categorization task, we manipulated sequential co-occurrences of particular image pairs to examine the effects of repetition priming across stimulus class (Signs versus Gestures) and by viewpoint (Upright, Left or Right side, and Inverted). We hypothesized that one property which may differentiate language perception from gesture recognition more generally is the degree to which sign language recognition may be robust to perceptual changes that arise from shifts in viewpoint. Preliminary results indicate that, as expected, deaf subjects were faster and more accurate at making categorizations of signs and gestures than hearing subjects. Surprisingly, effects of rotation on prime-target pairing were largely similar for signs and gestures across groups; however, a group difference emerged when inverted sign and gesture targets were preceded by an upright prime. In these cases, deaf subjects showed little evidence of priming effects, while hearing subjects showed robust priming. We explore the implications of these effects in relation to theories of expertise in visual perceptual processing.

E46

DISSOCIATING CONSTITUENT FREQUENCY EFFECTS IN COMPOUND WORDS: BEHAVIORAL AND ELECTROPHYSIOLOGICAL EVIDENCE *Jon Andoni Duñabeitia[1], Marta Vergara[1], Itziar Laka[2], Manuel Perea[3], Manuel Carreiras[1]; [1]University of La Laguna, [2]University of the Basque Country, [3]University of Valencia* – Word-into-constituent decomposition of compound words has often been examined by orthogonally manipulating the frequency of their constituents. Compounds with high frequency second constituents are recognized faster than those with low frequency second constituents. However, the role of the first constituent remains unclear: facilitative effects have been found in English and Finnish, while inhibitory effects have been found in Spanish and Basque. Here we present evidence from three experiments that consistently show that the frequency of the first constituent plays an inhibitory role in the whole-word recognition process, whereas the frequency of the second constituent exerts a facilitative influence. In Experiment 1 Basque and Spanish participants were presented with compound words and completed a go/no-go lexical decision task on them. In Experiment 2, Spanish participants read sentences with compound words for comprehension, while their eye movements were tracked. In Experiment 3, ERPs of Basque participants were recorded while reading compounds. Results from the behavioral tasks confirmed a clear dissociation between inhibitory effects of the first constituents and facilitative effects of the second constituents. Results from the ERP experiment revealed that high frequency first constituents showed less positive going amplitude in the P200 and more negative going amplitude in the N400, while high frequency second constituents only showed less negative going amplitude in the N400. Following an activation-verification framework, we argue that the P200 difference reflects candidate triggering, whereas the N400 difference for the first constituent reflects the inhibitory effects for selecting the correct candidate (a competition at the verification stage).

E47

SIGN LANGUAGE AND PANTOMIME PRODUCTION DIFFERENTIALLY ENGAGE FRONTAL AND PARIETAL CORTICES *Karen Emmorey[1], Stephen McCullough[1,2], Sonya Mehta[3], Laura Ponto[3], Thomas Grabowski[3]; [1]San Diego State University, [2]The Salk Institute, [3]University of Iowa* – We investigated the ramifications for the neural organization of language production when the primary language articulators are also used for meaningful, but non-linguistic, expression such as pantomime. Fourteen hearing non-signers (7 males) and 10 native Deaf users of American Sign Language (ASL) (6 males) participated in an H2 15O-PET study in which they generated action pantomimes and/or ASL verbs in response to pictures of tools and manipulable objects. For pantomime generation, participants were instructed to “show how you would use the object.” For verb generation, signers were asked to “generate a verb related to the object.” The objects for this condition were selected to elicit handling verbs that resemble pantomime, e.g. TYPE (fingers move as if typing) for typewriter. For the baseline task, subjects viewed pictures of manipulable objects and an occasional non-manipulable object and decided whether the objects could be handled, gesturing “yes” (thumbs up) or “no” (hand wave). Relative to baseline, generation of ASL verbs engaged the left inferior frontal gyrus, but when non-signers produced pantomimes for the same objects, no frontal activation was observed. Both groups recruited left parietal cortex during pantomime production; however, the activation for Deaf signers was more extensive and bilateral. We hypothesize that this difference is due to more complex pantomimes and to larger and more integrated neural representations for hand actions for Deaf signers. We conclude that the production of pantomime versus ASL verbs (even those that resemble pantomime) engage partially segregated neural systems that support praxic versus linguistic functions.

E48

MECHANISMS OF SOCIAL AND DISTRIBUTIONAL WORD LEARNING *Michael C. Frank[1], Rebecca Saxe[1]; [1]Massachusetts Institute of Technology* – Even early in the process of learning object names, children rely on two qualitatively different information sources. The first is their inferences about the speaker's intended referents (as conveyed by social cues like pointing and eye-gaze, c.f. Bloom, 2002). The second is the cross-situational statistics of which words co-occur with which objects (Yu & Smith, 2007). Recent computational work suggests that combining these two information sources in a single model via mechanisms of probabilistic inference allows for the explanation of many experimental results in early word learning (Frank, Goodman, & Tenenbaum, 2007). In the current project, we used an artificial language paradigm to test whether adult participants could learn words from each of these information sources independently. A cartoon face presented a pair of objects accompanied by a single word (referring to one of the objects). Across trials, participants either saw multiple distractor objects along with a word-object pairing, disambiguating the referent of the word via distributional information, or an eye-movement to the target object, disambiguating the referent via social information. We found that social disambiguation was very useful for adult participants: they were able to learn word-object pairings as well from two socially-cued presentations as they were from six ambiguous presentations. An fMRI study currently in progress tests whether the process of learning using these separate information sources are subserved by separate neural mechanisms and whether regions involved in the perception of social stimuli (e.g., Pelphrey et al. 2003) are also involved specifically in social word learning.

E49

AN ELECTROPHYSIOLOGICAL STUDY OF THE EFFECTS OF PHONOLOGY AND ORTHOGRAPHY ON PSEUDOWORD PROCESSING *Beth Friedman[1], Joyce Tam[1], Maya Misra[1]; [1]The Pennsylvania State University, University Park* – Previous event-related potential (ERP) studies have shown that pseudohomophones (pseudowords that sound like real words) are processed more like real words than are non-homophonic pseudowords. These effects are observed even when care is taken to ensure that the two types of pseudowords are closely orthographically matched. However, the question still remains of the extent to which orthographic and phonological features of these items may interact. In the present study, ERP correlates of pseudoword phonology and orthography were further investigated. Participants read real words, pseudohomophones, and non-homophonic pseudowords while 32 channels of ERPs were recorded. A semantic monitoring task was used to encourage naturalistic reading rather than directing attention to orthographic and/or phonological features of these items. The pseudowords were carefully designed to be either orthographic neighbors of the real word basewords they were derived from (e.g., pseudohomophone "skar" or non-homophonic pseudoword "smar" for baseword "scar") or orthographically distinct from their basewords (e.g., "stupe" or "stape" for "stoop"). Results suggest that the two levels of orthographic similarity impacted pseudohomophones and non-homophonic pseudowords in different ways, with N400 amplitudes being larger for orthographically distinct pseudohomophones than for pseudohomophones which were neighbors of their basewords, while the opposite pattern was observed for non-homophonic pseudowords. Effects of item type began as early as the P200 component and continued throughout the recording epoch. Implications for the interactions between orthography and phonology during skilled reading will be discussed.

E50

UNDERSPECIFICATION IN NEURONAL WORD FORM ACTIVATION *Claudia K. Friedrich[1], Ulrike Schild[1], Brigitte Röder[1]; [1]Biological Psychology and Neuropsychology/University of Hamburg* – The featurally underspecified lexicon (FUL-model) proposed by Lahiri and Reetz (2002) assumes that not all features contained in the speech signal are specified in the listener's mental lexicon. For example, the coronal value of the place of articulation feature (PLACE) is not stored in the lexicon, whereas other values of PLACE are specified. We recorded event-related potentials (ERPs) in a unimodal auditory word fragment priming paradigm to test whether a neuronal correlate of word form activation, namely the P350 deflection (Friedrich, 2005, BMC Neuroscience), reflects underspecification. Spoken fragments preceded spoken target words that either began with a coronal PLACE (e.g., Drache [engl. dragon]) or with a non-coronal PLACE (e.g., Münze [engl.coin]). In an Identical condition, the target matched the fragment (e.g., dra-Drache, mün-Münze); in a Control condition, fragment and target were completely unrelated (pul-Drache, trep-Münze). Crucially, in a Variation condition fragment and target only varied in the initial PLACE: Fragments preceding coronal targets began with a non-coronal PLACE (e.g., gra-Drache); fragments preceding non-coronal targets began with a coronal PLACE (e.g., nün-Münze). The ERP results support the FUL model's assumption of asymmetric effects in the Variation condition: Coronal targets elicited similar P350 amplitudes in the Variation and in the Identity condition; non-coronal targets elicited comparably P350 amplitudes in the Variation and in the Control condition. That is, coronal word forms can be activated by PLACE variation, because no PLACE value is specified in the lexicon. By contrast, non-coronal word forms have a PLACE value specified, and, therefore, cannot be activated by PLACE variation.

E51

EFFECT OF LANGUAGE TASK DEMANDS ON NEURONAL RESPONSE DURING VISUAL WORD RECOGNITION: A FUNCTIONAL MAGNETIC RESONANCE IMAGING (FMRI) PRIMING-STUDY *Gabriela Gan[1,3], Christian Buechel[2], Frederic Isel[1,2]; [1]Research Centre on Multilingualism, University of Hamburg, Germany, [2]University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [3]Heinrich-Heine University, Duesseldorf, Germany* – We investigated to what extent language task demands shape the neuronal networks, which are assumed to support the processes involved during visual word recognition. We approached this issue by varying systematically the language task in two fMRI priming experiments. Native speakers of German saw two consecutive German words [repetition priming: koffer (suitcase) - KOFFER; associative priming: koffer - REISE (journey)]. In experiment 1, sixteen participants performed a semantic categorization task (natural vs. manmade) on the target words. In Experiment 2, sixteen other participants were presented with the same word pairs but they had to think silently of the meaning of each target (pure semantic task). We predict that whereas semantic categorization should allow us to tap automatic semantic processes, pure semantic task should lead to study more controlled semantic processes. Behavioral data of experiment 1 indicate a significant 45-ms repetition priming effect. The fMRI data of experiment 1 reveal a repetition suppression (RS) effect in the posterior part of the left visual ventral stream (L VVS; middle occipital gyrus) and a repetition enhancement (RE) effect in the anterior part of the L VVS (i.e. inferior temporal gyrus). In experiment 2, a RE was found in a left fronto-temporo-parietal network, as well as in a right temporo-parietal network. For associative priming, we observe associative suppression effects. While semantic categorization activated a fronto-temporal network, pure semantic task involved an occipital region and a temporo-parietal network. Taken together, the present results suggest involvement of different neuronal networks depending on the language task demands.

E52

AN EVENT RELATED POTENTIAL ANALYSIS OF NOVEL DENOMINAL VERB INTERPRETATION *Micah Goldwater[1], David Schnyer[1], Arthur Markman[1], Victoria Williams[1], Caitlin Tenison[1], Natalie Dailey[1]; [1]University of Texas at Austin* – Linguistic and conceptual abilities are crucially involved in comprehension of novel uses of words. We used Event Related Potentials (ERP) to investigate the novel uses of nouns as verbs, i.e. novel denominal verbs. Participants read a total of 160 passages, 26 that contained a sentence with a novel denominal verb, e.g.

"He hairpinned the lock open" and 26 that contained a paraphrase "He used a hairpin to jiggle the lock open". The critical sentences were presented one word at a time in the center of the screen so that ERP responses could be recorded to the critical use of the denominal verb. After the completion of each critical sentence participants were asked to judge the sensicality of the sentence; approximately 15 % of sentences were non-sensical. ERP's were examined for 3 conditions: 1) The novel verb, e.g. "hairpinned," 2) The root noun of the novel verb, e.g. "hairpin" and 3) The verb from the paraphrase, e.g. "jiggle." Preliminary results have indicated that, relative to conditions 2 and 3, the novel verb elicited an increased negative potential in the range of 300-500 msec. consistent with the location of the N400 amplitude, which has been demonstrated to reflect ease of semantic processing. The novel verb also elicited a more positive wave from 500-700 ms post stimulus onset, consistent with the P600, which has been shown to be sensitive to detection of a syntactic anomaly. This pattern suggests that both semantic and syntactic processes are involved in novel word interpretation.

E53

MOTOR INVOLVEMENT DURING PERCEPTION OF HUMAN ACTIONS: EVIDENCE FROM AMERICAN SIGN LANGUAGE *Michael Grosvald[1,2], Christian Lachaud[1], David Corina[1,2]; [1]Center for Mind and Brain, University of California at Davis, [2]University of California at Davis* – There is now growing evidence for motor system involvement during the perception of human actions. To investigate the relevance of this phenomenon for linguistic processing, we compared hearing individuals and deaf signers as they performed a handshape monitoring task. Each subject saw a series of 180 brief video clips, each of which showed either an American Sign Language (ASL) sign or a phonologically possible but non-lexical "non-sign." Subjects were asked to configure their dominant hand in a particular handshape, and then to respond as quickly as possible with their non-dominant hand when a video clip displayed an action (sign or non-sign) formed with a particular handshape. The monitored-for handshape and the handshape held by the subject were sometimes the same ("consistent") and sometimes different ("inconsistent"). We explore the effect of consistency on this task and discuss its implications. Our findings show evidence of consistency effects that were modulated by group variables and temporal progression of the task. These effects suggest that age of language acquisition may impact the degree of motor interference on language processing.

E54

ERP INDICES OF ORTHOGRAPHIC AND PHONOLOGICAL CONTRIBUTIONS IN BACKWARD MASKING *Laura Halderman[1], Charles Perfetti[1]; [1]University of Pittsburgh* – Backward masking has been useful for teasing apart the pre-lexical contributions of orthography and phonology in behavioral research. In this experiment, EEG was recorded from 128 electrodes while participants completed a backward masking task in order to further investigate the time course of these processes. In this task, participants saw a pattern mask (e.g. XXXX) immediately followed by a target word (e.g. crew). The target word was backward masked by a nonword that was orthographically and phonologically similar (e.g. CRUE; O+P+), orthographically similar but phonologically dissimilar (e.g. CRAE; O+P-), orthographically dissimilar but phonologically similar (e.g. KROO; O-P+) or unrelated (e.g. FAMS; O-P-). The nonword was backward masked by another pattern mask (e.g. XXXX). Each component of the trial was presented for 67 ms with a 0 ms ISI. Participants recognized the target word in a two-alternative forced choice task. Targets and distractors differed by only one letter (e.g. crew, brew). The EEG record indicated a significant effect at 460 ms after the onset of the nonword. At this time point, the O-P+ and O-P- conditions were not statistically different and were more negative than the O+P+ and O+P- conditions which were also not statistically different. We interpret this effect as a marker of the ease of recovery from the nonword mask which interrupts processing of the target word. Within this time frame, orthography, but not phonology allows for easier integration of the target and nonword mask.

E55

DO YOU RESTORE WHAT YOU THINK YOU RESTORE? *Ronny Hannemann[1], Carsten Eulitz[1]; [1]University of Konstanz* – Phonemic restoration, which means perceiving complete words despite missing segmental information, is an intriguing phenomenon in speech perception and was mostly examined behaviourally. The present EEG study was designed to overcome possible caveats by attentional or decision-making processes by directly assessing the pre-attentive mechanisms of speech perception by means of induced gamma band responses (GBR). Subjects listened to small blocks of German nouns being a minimal pair and a derived stimulus where the onset of the contrastive second syllable (noise-superimposed) was noise-replaced. Assuming underspecification of certain phonological features, one of the critical consonants was not specified for place of articulation in the mental lexicon. Behavioural pre-tests suggested that noise-replaced stimuli behave like the noise-superimposed nouns with the underspecified place of articulation. Pivotal to this study were the brain responses to the noise-replaced stimuli which were preceded by either a noise-superimposed stimulus containing a specified or underspecified place of articulation compared to the corresponding noise-replaced stimuli with identical precursors. The modulation in induced GBR indicating the phonemic restoration of missing segmental information was dependent on the phonemic information in the preceding stimulus category. The GBR was larger when the place of articulation was specified compared to the underspecified condition. Contrary to the behavioural results, our finding suggests that restoration of phonological place features is pre-attentively based on predictions derived from the preceding stimulus category. Thus, assessing phonemic restoration at the pre-attentive level can shed light on the top-down influences on speech perception which goes beyond the findings gained behaviourally.

E56

EVENT-RELATED REGRESSION ANALYSIS OF THE EEG REVEALS EARLY DIFFERENCES IN WORD AND PSEUDOWORD PROCESSING *Olaf Hauk[1], Matthew H. Davis[1], Michael Ford[1], William D. Marslen-Wilson[1], Friedemann Pulvermuller[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge* – Results are presented from a multiple linear regression analysis of event-related electrophysiological responses to words and pseudowords in a visual lexical decision task. This analysis yields event-related regression coefficients (ERRCs) instead of the traditional event-related potential (ERP) measure, avoiding the need to select a restricted or unrepresentative stimulus sets. In this study we attempted to disentangle the earliest effects of word length and neighbourhood size (N) on the brain response. Data were taken from our previous study using similar methodology, which did not include pseudoword data into the regression analysis (Hauk et al, Neuroimage 2006, 30(4), 1383-1400). Our results demonstrate that N and word length have distinct neurophysiological manifestations around 100 ms after written word onset. The effect of N differed in topography between word and pseudoword processing. Source distributions obtained using minimum norm estimation for N were left-lateralised, with the most dominant activation peak located more anteriorly in the left temporal lobe for words compared to pseudowords. The earliest effects of word length were localised to bilateral posterior brain areas consistent with early visual processing of written words. However, these length effects did not differ between words and pseudowords. We discuss the implications of these results for the time course of word recognition processes, and emphasise the value of ERRCs in combination with source analysis in psycholinguistic and cognitive brain research.

E57

ELECTROPHYSIOLOGICAL CORRELATES OF REPETITION AND TRANSLATION PRIMING IN DIFFERENT SCRIPT BILINGUALS *Noriko Hoshino[1], Katherine Midgley[1,2], Phillip Holcomb[1], Jonathan Grainger[2]; [1]Tufts University, [2]CNRS, Université de Provence* – Past research on bilingual word recognition has shown that there is resonance among the lexical codes across two languages even when only one language is required. The present study examined the time course of reading words with same and different scripts in the first language (L1) and in the second language (L2) using a masked priming paradigm with event-related potentials (ERP). In the present study, Japanese-English bilinguals whose two languages differ in script read Japanese and English words in separate blocks. Target words were preceded by a related (the same word) or unrelated prime in the same or different language. Similar to previous behavioral studies on masked translation priming, Japanese-English bilinguals showed within-language repetition priming in both languages but cross-language repetition priming in the L1-L2 direction only. The N250 (sensitive to orthographic processing) was observed only for within-language priming in different script bilinguals, whereas the N400 (sensitive to semantic processing) was obtained for both within- and cross-language priming. Furthermore, the N250 was delayed both in L1 and in L2, whereas the N400 wasn't. These results suggest that script differences delay orthographic processing but not semantic processing. Implications for models of bilingual word recognition will be discussed.

E58

TWO DISCRETE PROCESSING STRATEGIES FOR ACCESSING WORDS IN A SECOND LANGUAGE DEPENDING ON THE AGE OF ONSET OF ACQUISITION: AN FMRI INVESTIGATION. *Frederic Isel[1,2], Jürgen Meisel[1], Christian Büchel[2]; [1]Research Centre on Multilingualism, University of Hamburg, Germany, [2]University Medical Center Hamburg-Eppendorf, Hamburg, Germany* – The present study investigates whether the visual processing of concrete nouns in first- (L1) and second (L2)-language involves overlapping neuronal networks in the bilingual brain. We examined to what extent the age of onset of acquisition (AOA) of L2 has an effect on (1) the magnitude of overlap between the neuronal networks, and (2) the L2 word recognition strategy. The functional magnetic resonance adaptation paradigm was used in simultaneous (acquisition of both languages before the age of three-years) and in successive (acquisition of L2 after the age of ten-years) French-German bilingual speakers. Words were repeated across language [e.g. valise(suitcase)-Koffer(suitcase)] and participants performed a semantic categorisation task (natural/artificial) on the second word of the pairs, i.e. the target [e.g. Koffer]. Critically, if French and German word processing involves neuronal networks that largely overlap, then a repetition-related effect should be observed on the target words. Whereas simultaneous bilinguals showed a repetition enhancement (RE) effect in the left superior temporal gyrus (lexical processing), successive bilinguals showed a RE effect in the left anterior insula (phonological processing) and in the left middle frontal gyrus (language switching). Our data suggest that both the extent of the overlap between the neuronal networks assumed to support words in L1 and L2 and the L2 word recognition strategies might depend on the AOA. Taken together, the present results lend support to dual route models of reading words that postulate two different routes for accessing a mental lexicon: a direct lexical route and a phonologically mediated route.

E59

DISSOCIATION OF STEM AND AFFIX SELECTION PROCESSES IN POLISH FLUENT AND NON-FLUENT APHASIA *Aleksandra Jelowicka[1,3], Thomas Bak[2], Joanna Seniow[3], William Marslen-Wilson[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK, [2]University of Edinburgh, UK, [3]Institute of Psychiatry and Neurology, Warsaw, Poland* – Word production in morphologically rich languages such as Polish requires accessing both the stem of a word and appropriate inflectional affixes. Several lines of research suggest that stem access primarily involves posterior temporal cortex (possibly bilaterally), while inflectional processes implicate a strongly left-lateralised fronto-temporal circuit. This predicts different patterns of impairment of word production in individuals with aphasia caused by LH damage that varies in its anterior/posterior distribution. Ten non-fluent and eight fluent aphasic Polish speakers diagnosed on the basis of neuropsychological tests and neurological assessment were tested using a verb elicitation task. Subjects heard a sentence, e.g. 'Oni wczoraj pisali, a teraz ty…' [Yesterday they wrote and now you…] and were asked to complete it with the correct form of the same verb (here 'piszesz' [write]). This required the choice of the correct stem (alternated or not) and of the appropriate person/number/tense inflection. Stem and inflectional complexity varied across conditions. The two groups of patients exhibited contrasting impairments. Non-fluent subjects, with more left frontal damage, had difficulty changing the stem to an alternated form and frequently made contextually inappropriate inflectional errors. The more posterior (left temporal) fluent aphasics showed a general impairment in verb stem retrieval but made very few errors of inflectional choice. These results are consistent with cross-linguistic evidence for the separability of stem-based and inflection-based neural systems, and with behavioral evidence for differential effects of stem and inflectional complexity in speeded production studies with young normal Polish speakers.

E60

THE SHAPE OF WORDS IN THE BRAIN *Vanja Kovic[1], Kim Plunkett[1], Gert Westermann[1]; [1]Oxford University, Oxford Brookes University* – The principle of arbitrariness in language assumes that there is no intrinsic relationship between linguistic signs and their referents. For instance, the label 'dog' has no intrinsic relationship with the animal to which it refers. However, a growing body of sound-symbolism research suggests the existence of some naturally-biased mappings between phonological properties of labels and perceptual properties of their referents (Köhler, 1929/1947; Wertheimer, 1958; Holland & Wertheimer, 1964, Ramachandran & Hubbard, 2001; Maurer, Pathman, & Mondloch, 2006). Nevertheless, the sound-symbolic choices that participants make in these experiments may not reflect the processes that are involved in natural language interpretation. The aim of our study was to investigate whether sound-symbolic preferences could be demonstrated in a complex categorisation task (Medin & Schafer, 1978; Rehder & Hofmann, 2005) in which the sound-symbolic relationships were incidental to task performance and where participants were unlikely to be aware of such contingencies during the study. The behavioural results showed that participants were faster to identify novel objects when label-object mappings are sound-symbolic than when they are not. Moreover, early negative EEG-waveforms indicated a sensitivity to sound-symbolic label-object associations (within 200ms of object presentation) highlighting the non-arbitrary relation between the objects and the labels used to name them. This sensitivity to sound-symbolic label-object associations may reflect a more general process of auditory-visual feature integration where properties of auditory stimuli facilitate a mapping to specific visual features.

E61

A WITHIN-SUBJECTS COMPARISON OF WORD- AND SENTENCE-LEVEL MEG RESPONSES *Ellen Lau[1], Diogo Almeida[1], Paul Hines[1], David Poeppel[1]; [1]University of Maryland, College Park* – The ERP response to words shows a negative deflection around 300-500 ms (N400). Variation in N400 amplitude has typically been demonstrated through sentential-context and word-priming manipulations: Higher amplitudes are observed for incongruous sentence completions (relative to congruous), and for unrelated word pairs (relative to related). This amplitude difference has been observed to be greater in sentential contexts than in word pairs (Kutas, 1993), but a direct comparison across elicitation conditions has not been performed using MEG, where topographical differences across these two manipulations could be better explored. In our experiment both a sentential-context and a word-pair manipulation were carried out in the same MEG session for each participant. Our results are consistent with those observed in the ERP literature. Preliminary analysis (n=17) reveals a clear sentential effect in RMS amplitude at 300-500 ms, in the left hemisphere only. The word-pair conditions showed a trend towards a reduction in amplitude for the related pair. However, there was no correlation within individuals between the size of the amplitude reduction for sentences and for words. Further analyses explore differences in topography between words and sentences within individuals. Interestingly, a side-by-side comparison of word and sentence conditions showed a reduction in amplitude in the congruous sentential context compared to all other conditions, supporting a model in which the sentential-context effect in MEG actually results from a relative facilitation in congruous cases, rather than an increase in difficulty in anomalous cases as the N400 ERP effect has often been framed.

E62

ELECTROPHYSIOLOGICAL CORRELATES OF MASKED MORPHOLOGICAL PRIMING *Minna Lehtonen[1], Philip J. Monahan[1], David Poeppel[1]; [1]University of Maryland, College Park* – Masked priming has been used to study the representation and processing of morphologically complex words. We aim to combine this psycholinguistic tool with an electrophysiological measure magnetoencephalography (MEG) particularly adept at indexing processes involved in lexical access (Pylkkänen & Marantz 2003). Morphologically transparent (cleaner–CLEAN) and opaque (corner–CORN) prime/target pairs show facilitation under masked priming conditions. Prime/target pairs with only an orthographic relationship (brothel–BROTH) do not show similar priming (Rastle, et al. 2004). This suggests early, obligatory morphological decomposition, opposing models that claim no role for structure in lexical representations. The neural correlates, however, are controversial. Monahan et al. (ms.) used masked identity priming in MEG and found earlier latencies for repeated (VIDEO–video) than unrepeated words in a component peaking around 230ms. We investigate the neuromagnetic correlates of masked morphological priming. Visual lexical decision with simultaneous MEG recording was performed (n=11). Target words were preceded by primes (duration=39ms) that were either morphologically (transparent or opaque) or orthographically related to the target, or unrelated. Transparent (p<.001) and opaque (p=.007) morphological conditions elicited behavioral facilitation, while the orthographic overlap condition did not (p=.289). The MEG results showed that the latency of a component peaking roughly 220 ms post-onset of the target was sensitive to morphological (transparent, p=.012; opaque, p=.059) but not to solely orthographic (p=.717) relations. Thus, the timing of a robust MEG component is sensitive to the morphological relatedness of prime/target pairs and can be used to further understand the neural substrates and the timeline of lexical processing.

E63

MODALITY- AND TASK-SPECIFIC BRAIN REGIONS INVOLVED IN CHINESE LEXICAL PROCESSING *LI LIU[1,2], Xiaoxiang Deng[1], Danling Peng[1], Fan Cao[2], Guosheng Ding[1], Zhen Jin[3], Yawei Zeng[3], Ke Li[3], Lei Zhu[3], Ning Fan[1], Yuan Deng[4], James Booth[2,5]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, PR China, [2]Northwestern University, Evanston, IL, [3]MRI Center, 306 Hospital of Beijing, PR China, [4]Institute of Psychology, Chinese Academy of Sciences, Beijing, PR China, [5]Evanston Northwestern Healthcare, Evanston, IL* – Functional magnetic resonance imaging (fMRI) was used to examine lexical processing in native adult Chinese speakers. A 2 task (semantics, phonology) ×2 modality (visual, auditory) within subject design was adopted. The semantic task involved a meaning association judgment and the phonological task involved a rhyming judgment, to two sequentially presented words. The overall effect across tasks and modalities was used to identify 6 regions of interest, including left fusiform gyrus (FG), left superior temporal gyrus (STG), left ventral inferior frontal gyrus (VIFG), left dorsal inferior frontal gyrus (DIFG), left inferior parietal lobule (IPL) and left middle frontal area (MFG). ROI analyses revealed two modality-specific areas: FG for visual and STG for auditory; three modality-independent but task-specific areas: IPL and DIFG for phonology, and VIFG for semantics. The modality and task effects in Chinese revealed by this study are similar to those found in alphabetical languages. Brain-behavior analysis showed greater DIFG activation was correlated with higher error rates for the visual rhyming task suggesting that lower accuracy was associated with inappropriate reliance on the phonetic radical. In addition, we found that MFG was both modality- and task-specific suggesting that MFG may be responsible for the visuo-spatial analysis of Chinese characters and the orthography-to-phonology integration at a syllablic level, demanded by the logographic and monosyllabic nature of written Chinese.

E64

THE EFFECTS OF AGE-OF-ACQUISITION AND FREQUENCY ON CHINESE WORD PROCESSING: EVIDENCE FROM BEHAVIORAL AND EVENT-RELATED FMRI STUDIES *Youyi Liu[1], Hua Shu[1], Brendan Weekes[2]; [1]State Key Laboratory of Cognitive Neuroscience & Learning, Beijing Normal University, Beijing, PR China, [2]University of Sussex* – Frequency effects on behavioral responses and brain activation during Chinese word recognition were widely reported previously, but the age at which a word is acquired i.e. age-of-acquisition (AoA), which correlates highly with frequency, was not controlled. Recently, AoA was found to have effects on both behavioral indexes and brain activation in English and German, whereas the frequency effects were relatively weak. Zevin & Seidenberg (2002) suggested that there may be a lasting advantage for early learned words in Chinese because of the more arbitrary nature of the mapping. Our aim here was to examine the relationship between AoA and frequency in Chinese during word processing and to test whether effects of AoA in alphabetic scripts can be generalized to Chinese. Behaviorally, both factorial manipulation and large-scaled multiple regression methods found the main effects of AoA and frequency, and also the interaction between AoA and frequency on the response time in word naming and lexical decision tasks when other variables were controlled. The results from event-related fMRI showed that early-acquired words generate more activity than late-acquired words in the left precuneus, whereas late-acquired words generate more activity than early-acquired words in left mid-inferior frontal cortex, medial frontal gyrus, fusiform gyrus and right middle occipital gyrus. These effects were largely though not completely independent of frequency effects that were widespread throughout the cortex. We argue that although AoA effects may vary across script, common areas of modulation across languages suggest these effects are real.

E65

DEVELOPMENTAL STABILITY AND CHANGES IN THE NEURAL SUBSTRATE FOR LEXICAL PROCESSING: A LONGITUDINAL FMRI STUDY *Dong Lu[1], Douglas Burman[1], Donald Bolger[1], James Booth[1,2]; [1]Northwestern University, Evanston, IL, [2]Evanston Northwestern Healthcare, Evanston, IL* – Previous cross-sectional neuroimaging studies on lexical processing cannot provide information about brain stability within individuals over development and may also be limited in demonstrating developmental changes because of differences between individuals. In the current study, children were asked to make rhyming judgments to two visually presented words during functional magnetic resonance imaging (fMRI). One cohort was examined at 9 and 11 years old and another at 13 and 15 years old. Across age groups and time points, peaks of brain activations were found in left inferior frontal gyrus (IFG, BA 47 and BA 9), left fusiform gyrus (FG, BA 19 and BA 37), right fusiform gyrus (BA 37), left superior temporal gyrus (STG, BA 22), and left inferior parietal lobule (BA 40). Regions of interest (ROIs) were defined as cubes centering on group peaks and beta values were extracted from individuals. Significant correlations between Time 1 and Time 2 beta values were found in left FG (BA 19 and BA 37), left IFG (BA 47) and left STG (BA 22), suggesting that areas involved in orthographic and phonological processing have high stability over development. In support of this stability, activated clusters around these peaks also had high overlap between Time 1 and Time 2. Interestingly, a 2 Cohort x 2 Time analysis of variance (ANOVA) on beta values for each peak revealed significant interactions between Cohort and Time for left STG and left FG (BA 37). Thus, brain areas demonstrating high stability also demonstrated large developmental changes during lexical processing.

E66

THE REPRESENTATION OF VOWELS AND CONSONANTS IN EARLY WORDS: AN EVENT-RELATED POTENTIAL STUDY *Nivedita Mani[1], Kim Plunkett[1]; [1]University of Oxford* – Using behavioural tasks such as the inter-modal preferential looking task, previous research has found that infants look longer at a familiar target object when the label is correctly pronounced than when the label is mispronounced by either a single consonant or a single vowel (Swingley & Aslin, 2000; 2002; Mani & Plunkett, 2007a, b). This suggests that infants' lexical representations contain adequate phonological specification of the consonants of familiar words. The current study examines whether Event-Related Potential studies (ERPs) lead to the same conclusions regarding infants' sensitivity to mispronunciations of familiar words. Furthermore, the experiments separately test 14- to 18-month-old infants' sensitivity to mispronunciations of the vowels and consonants in familiar words, in order to test a perspective supported by some previous research that the role of consonants and vowels differs in speech recognition (Nazzi, 2005). In contrast to a previous study (Mills et al., 2004) where labels were presented in the absence of visual stimuli, in the current experiment, infants were presented with an image of a familiar object, followed by a label for the image. The label was either correctly pronounced, mispronounced (by the word-initial consonant in Experiment 1 and the word-initial vowel in Experiment 2) or a nonsense word unrelated to the label for the image. A systematic difference in ERPs to the different conditions suggest that infants are sensitive to word mispronunciations in the presence of pictorial context and raise further questions regarding the roles of vowels and consonants in early lexical representations.

E67

STATISTICAL AND COMPUTATIONAL INVESTIGATIONS OF THE TIME COURSE OF SPOKEN WORD RECOGNITION IN APHASIA *Daniel Mirman[1,2], Eiling Yee[3], James Magnuson[1,2], Sheila Blumstein[4]; [1]University of Connecticut, [2]Haskins Laboratories, [3]University of Pennsylvania, [4]Brown University* – The time course of spoken word activation and the effects of lexical competition on word recognition processes are critical to understanding the dynamics of spoken language processing in non-impaired and aphasic individuals. A recent visual world paradigm eye-tracking study examined cohort (beaker-beetle) and rhyme (beaker-speaker) competition in Broca's and Wernicke's aphasic patients, and age-matched control participants (Yee et al., in press). We applied a combined statistical (growth curve analysis) and computational modeling approach to examine the time course of lexical activation and competition at a finer grain and possible bases for differences between aphasic and control groups. Statistical modeling revealed that both Broca's and Wernicke's aphasics were slower to activate target lexical representations, and that the two patient groups contrasted in that Wernicke's aphasics had greater and longer-lasting cohort activation and Broca's aphasics had greater rhyme activation. These results suggest differences in the dynamics of lexical activation for the two aphasic groups. We used the TRACE model of speech perception (McClelland & Elman, 1986) to examine what kind of changes in processing dynamics could lead to these patterns. Preliminary results suggest that increased decay (possibly reflecting degraded phonological memory function) and increased processing noise produce a pattern of results consistent with Broca's aphasia, and reduced inhibition between lexical nodes (possibly reflecting failure to inhibit competitors) produces a pattern of results consistent with Wernicke's aphasia. We discuss the effects of manipulating other parameters and how our results provide empirical and computational constraints of theories of spoken language processing impairments in aphasia.

E68

CLOZE PROBABILITY DOES NOT ALWAYS AFFECT N400 AMPLITUDE: THE CASE OF COMPLEX PREPOSITIONS *Nicola Molinaro[1], Francesco Vespignani[1], Paolo Canal[2], Cristina Cacciari[2]; [1]DiSCoF, Università degli studi di Trento, [2]Dipartimento di Scienze Biomediche, Università degli studi di Modena e Reggio Emilia* – Complex prepositions (CP) are multi-word bound strings (P1NP2, e.g., "with respect to") in which the final constituent is rather predictable without manipulation of semantic or pragmatic constraints. It is well known that N400 inversely correlates with cloze probability. When closed class words are unexpected in semantically constrained sentences, they elicit modulations of the N400 amplitude (DeLong et al., 2005). We compared the ERPs elicited by the third constituent of a CP with those elicited by another preposition collocationally unexpected. Both were inserted in Italian well-formed sentences. The third constituent of the standard CP elicited the two left-lateralized components usually associated with the parsing of closed class words: the N280 and the N400-700, a frontal slow wave. These two components typically emerge when closed and open class words are compared (Kutas et al., 2006). When the final preposition of the CP was changed, no N400 emerged despite the large cloze-probability difference between the changed and unchanged CP. In contrast, only the N280 emerged, while the N400-700 was suppressed. The paradigm we used in which we compared two closed-class words allowed us to functionally dissociate the two components. Our results show that the N400-700, differently from the N280, is not a mandatory brain response to closed-class words. The N400-700 found for the standard CP can be related to a preparatory slow wave activity. This finding claims against the uniqueness of anticipatory mechanisms during language comprehension.

E69

ORTHOGRAPHIC AND ASSOCIATIVE NEIGHBORHOOD DENSITY EFFECTS: WHAT IS SHARED, WHAT IS DIFFERENT? *Oliver Müller[1], Jon Andoni Duñabeitia[1], Manuel Carreiras[1]; [1]University of La Laguna* – Words with a high number of orthographic neighbors elicit a larger N400 than words with a low number of orthographic neighbors. Holcomb, Grainger, and O'Rourke (2002) interpreted this in terms of an increasing overall semantic activation: Not only is the semantic representation of the presented word activated, but also the semantic representations of its orthographic neighbors. To test this semantic explanation of orthographic density effects on ERPs, we conducted an experiment manipulating orthographic as well as associative neighborhood density. Similar to the results of the orthographic neighborhood study, we expected that words with a high number of associates would elicit a larger N400 than words with a low number of associates, as this characteristic can be assumed to directly influence overall semantic activation. The results showed that at frontal sites words with dense orthographic or associative neighborhoods produced a more negative amplitude than words with sparse orthographic or associative neighborhoods in the N400 window. In addition, words with dense orthographic neighborhoods elicited an increased N400 at more posterior sites, whereas words with dense associative neighborhoods did not. We suggest that the common frontal ERP effect reflects increased overall semantic activation, a factor shared by the two neighborhood groups. We further argue that the additional posterior effect for orthographic neighborhood density derives from lexical competition between formally similar stimuli, since this process did not occur for neighbors by association, lacking orthographic overlap. In addition, this study is the first to report an ERP effect of the semantic variable number of associates.

E70

THE DORSAL AND VENTRAL PATHWAYS WERE MODULATED BY THE SPATIAL DEVIATION IN CONFIGURATION OF CHINESE CHARACTERS *Dan-ling Peng[1], Yan-lin Luo[1,2], Guo-sheng Ding[1], Yan-hui Yang[3], Wen-ping You[1]; [1]State Key Lab of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [2]Lab of*

Higher Function of Brain, Capital Medical University, Beijing, China, [3]MRI Center of Xuan Wu Hospital, Beijing, China – Previous studies have conformed that the ventral pathway was responsible for word form recognition. Recently, several researchers found that the dorsal pathway was also involved in the word processing with unfamiliar configuration such as mixed-case words or shifted words. However, more investigation needs to be done to reveal the role of the dorsal pathway in word form processing across different languages and methods. The present study aims to use fMRI to explore the function of the dorsal and ventral pathways in the processing of both normal Chinese characters and shifted ones (with radicals shifted). Twelve healthy undergraduate students participated in this study. 120 Chinese characters were divided into 3 groups, one of which were characters in normal forms, the other two were shifted characters with one of their radicals shifted 1/3 or 2/3 from its original position respectively. Activation was observed in bilateral fusiform gyri, the left precuneus gyrus and the right lingual gyrus in both shifted characters and normal characters, yet more activation was found in the processing of shifted characters compared to that of normal characters. As the degree of spatial-shift increased, the activation of the left precuneus gyrus and the right lingual gyrus became stronger accordingly. In conclusion, the left precuneus gyrus in the dorsal pathway and the right lingual gyrus in the vental pathway play important roles in spatial processing of word forms. It is suggested that the dorsal pathway and ventral pathway tend to work in a synergistic fashion.

E71

NEURAL ACTIVITY IN LANGUAGE AREAS REFLECTS VERB GENERATION PERFORMANCE IN CHILDREN *Jerod Rasmussen[1], Jennifer Vannest[1], Vincent J. Schmithorst[1], Prasanna Karunanayaka[1], Anna W. Byars[1], Scott K. Holland[1]; [1]Cincinnati Children's Hospital Medical Center* – Covert Verb Generation is a convenient functional MRI (fMRI) task for mapping language areas in pediatric neurosurgery patients. Because the covert responses are not monitored explicitly, the relationship between fMRI activation and task performance is unknown. Our study compared the activation from this task with a version of the Verb Generation task including overt responses. Fifteen children, ages 11-13, were presented with a series of concrete nouns and were prompted to respond with related verbs. The paradigm alternated between 30-second blocks of covert response, overt response, and control task of overt noun repetition. A clustered fMRI acquisition method allowed for recording of overt responses during quiescent scanner intervals. Individual covert generation versus noun repetition (covert-rep) and overt generation versus noun repetition (overt-rep) contrast t-maps were generated using the General Linear Model (GLM). GLM regression analysis determined correlations between contrasts and the mean number of verbs generated overtly per subject, modeling full-scale IQ as a confounding factor. For the covert-rep contrast, the left inferior frontal gyrus (LIFG, BA 44) and left posterior superior temporal gyrus (LSTG, BA 22) showed positive correlations with verb generation performance (LIFG: r-squared=.62, p<.001; LSTG: r-squared=.53, p<.003). Overt-rep contrast also showed positive correlations in both LIFG (r-squared=.31, p<.039) and LSTG (r-squared=.36, p<.023). These results suggest that increased verb generation performance leads to increased fMRI activation. In addition, overt performance may be used as an effective estimator of covert performance.

E72

DISENTANGLING FIBER TRACT AND CORTICAL CONTRIBUTIONS TO THE PROCESS OF NAMING VARIOUS CATEGORIES OF CONCRETE ENTITIES *David Rudrauf[1], Sonya Mehta[1], Carissa Philippi[1], Thomas Grabowski[1,2]; [1]Laboratory of Computational Neuroimaging, University of Iowa, [2]University of Iowa* – Lesion studies have identified regions of the cerebral cortex necessary for naming concrete entities, but these analyses have not been able to formally distinguish critical cortical damage from fiber tract damage. We developed a novel lesion analysis approach that incorporates probabilistic fiber tract information, to detect lesion-deficit associations related to damage to major association fiber tracts, and to reduce effects attributed to the cerebral cortex due to confounding fibers of passage. We re-analyzed a dataset of 129 brain damaged subjects (Damasio et al. 2004), tested for naming impairments in 5 categories of concrete entities. Using voxelwise logistic regressions, we incorporated covariates for probable damage to the inferior frontooccipital fasciculus (IFOF), superior longitudinal fasciculus (SLF), uncinate fasciculus (UNC), and inferior longitudinal fasciculus (ILF). Inclusion of tract information removed some cortical regions previously implicated in category-related deficits. The SLF explained many of the significant voxels associated with naming animals and tools, and the UNC and IFOF explained some of the voxels associated with naming famous faces. Some perisylvian and inferotemporal cortical regions remained associated with impaired naming, even after the effects of nearby association fiber tracts were modeled. For musical instruments and fruits/vegetables, tract effects and gray matter effects were statistically confounded. Supplementary tractwise analyses implicated the IFOF and UNC for naming famous faces, and the SLF for animals, tools and fruits/vegetables. The results suggest a possible distinction between cortical and fiber tract systems underlying naming unique versus non unique concrete entities.

E73

LEARNING TO READ SHAPES SPEECH RECOGNITION *Ulrike Schild[1], Brigitte Röder[1], Claudia K. Friedrich[1]; [1]Biological Psychology and Neuropsychology/ University of Hamburg* – Learning to read and write requires the knowledge that words consist of phonemes and that each phoneme has a corresponding grapheme. Using event-related potentials (ERPs) we investigated whether reading acquisition modifies neuronal speech recognition. We recorded ERPs in an unimodal auditory word fragment priming paradigm. Former research with adults suggests that the amplitude of the P350 deflection reflects neuronal word form activation as a function of the goodness-of-fit between the target words and their preceding fragments (Friedrich, 2005, BMC Neuroscience). In an Identity condition, fragments matched following target words (e.g., dra-Drache [engl. dragon]). In a Variation condition, fragments and targets differed in the initial place of articulation (PLACE, e.g., gra-Drache). In a Control condition, fragments and targets were completely unrelated (pul-Drache). Adults, beginning readers and preschoolers were tested. P350 amplitudes for adults replicate gradual activation of word form representations: Most positive amplitudes were found in the Control condition, medium amplitudes in the Variation condition, and weakest amplitudes in the Identity condition. Beginning readers did not tolerate the variation: P350 amplitudes in the Variation condition did not differ from P350 amplitudes in the Control condition. By contrast, preschoolers tolerate the variation in PLACE: Targets in the variation condition did not differ from identical targets. Thus, lexical representations appear to represent more detail after literacy acquisition. All groups showed a central negativity that was more negative for unrelated control words compared to the other two conditions. This negativity is associated with rapid phonological expectancies, which might not be altered by literacy acquisition.

E74

MONITORING OF SPEECH ERRORS: ELECTROPHYSIOLOGICAL EVIDENCE FROM DUTCH *Niels Schiller[1,2], Iemke Horemans[2], Dirk Koester[3,2]; [1]Leiden Institute for Brain and Cognition, Leiden University, The Netherlands, [2]Maastricht University, The Netherlands, [3]F. C. Donders Centre for Cognitive Neuroimaging, Nijmegen, The Netherlands* – When we perceive speech, our goal is to extract the meaning of the verbal message which includes semantic processing. However, how deeply do we process speech that we encounter while carrying out another task? In two experiments, native Dutch participants heard spoken sentences describing simultaneously presented pictures. Sentences either correctly described the pictures or contained an anomalous final word (i.e. a lexical substitution error or a phonemic perseveration error). In the first experiment, when spoken sentences were task-irrelevant, we found that the amplitude of a centro-parietal N400 was the same for both anomalous conditions as compared to the correct condition. In the second experiment, we ensured that participants processed the sentences and the pictures to a semantic level. In an early time window, we found similar phonological mismatch negativities in both anomalous conditions compared to the correct condition. These negativities were followed by an N400 that was larger for lexical than perseveration speech errors. These data suggest that we process speech, even if task-irrelevant, deeply enough to allow semantic processing. Furthermore, once we allocate more cognitive resources to the processing of speech, we try to predict upcoming words, presumably by means of the internal monitoring loop, to facilitate lexical access.

E75

WHEN 'UMKOMMEN' (PERISH) PRIMES 'KOMMEN' (COME): ELECTROPHYSIOLOGICAL EVIDENCE FOR STEM ACCESS IN SEMANTICALLY OPAQUE DERIVATIONS *Eva Smolka[1], Matthias Gondan[2], Frank Rösler[3]; [1]University of La Laguna, Spain, [2]University of Regensburg, Germany, [3]University of Marburg, Germany* – This study investigated whether semantically transparent and opaque derivations are accessed via their constituent units or as whole words. Reaction times (RTs) and event-related potentials (ERPs) were measured when verb targets (e.g. 'kommen', come) were preceded by a purely semantically related verb ('nahen', approach), by a morphologically and semantically related verb ('mitkommen', come along), by a purely morphologically related verb ('umkommen', perish), by an orthographically similar verb ('kämmen', comb), or by an unrelated verb ('schaden', harm). Morphological relatedness produced robust RT facilitation and N400 modulations regardless of semantic relatedness. These morphological effects were even stronger than pure semantic effects. Moreover, morphological derivations induced an early frontal negativity indicating prefix-stripping. Orthographic similarity produced RT interference and early frontal effects that differed from those of the morphological effects. Behavioral and ERP data favor a single system that accesses the stems of both semantically transparent and opaque derivations.

E76

EVIDENCE FOR EARLY MORPHOLOGICAL DECOMPOSITION IN VISUAL WORD RECOGNITION: A SINGLE TRIAL CORRELATIONAL MEG STUDY *Olla Solomyak[1], Alec Marantz[1]; [1]New York University* – We employ a single trial correlational MEG analysis to investigate early processing in the visual recognition of morphologically complex words. Three classes of affixed words were presented in a lexical decision task: free stems (e.g. taxable), bound roots (e.g. tolerable) and pseudo-affixed words (e.g. vulnerable, the root of which does not appear elsewhere). Analysis was focused on brain responses within 100-200ms post-stimulus onset, in the letter string and visual wordform areas. MEG data were analyzed using cortically constrained minimum-norm estimation. Correlations were computed between activity at functionally defined regions of interest and continuous measures of the words' morphological properties. ROIs were identified across subjects on a reference brain and then morphed back onto each subject's brain (N=9). We find evidence of decomposition for all three classes of affixed words. Peaks corresponding to letter-string (~130ms) and wordform (~170ms) components in the literature are shown to be sensitive to affix properties, such as affix frequency, for both bound roots and pseudo-affixed words. For free-stemmed affixed words, the M170 response is shown to be sensitive to the conditional probability of the word given the stem. These morphological properties are contrasted with orthographic form features (letter string frequency, transition probability from one string to the next). Effects of decomposition can in fact be attributed to morphological properties of complex words, rather than purely orthographic and form related properties. Our data support a model of word-recognition in which decomposition is attempted, and possibly utilized, for complex words of all three classes.

E77

EARLY COMPOUND CONSTITUENT PROCESSING BY RIGHT AND LEFT FUSIFORM GYRUS *Linnaea Stockall[1], Roberto de Almeida[1], Michael von Grunau[1]; [1]Concordia University* – Stockall et al (2008), investigate the lateralization of the early visual processing of morphological complexity with a lexical decision experiment. Compounds (teacup) and monomorphemic pseudocompounds (carpet) were presented briefly (74 ms) and centered on the screen, but with the point of visual convergence (fixation) falling either at the constituent boundary (e.g., TEA+CUP) or one character off the boundary (e.g., TE+ACUP). We obtained a main effect of word type (compounds faster than monomorphemics) and a main effect of morphological legality, with convergence at morphological boundary yielding faster RTs than at off-boundary, suggesting hemifield of presentation plays a role in early morphological processing. In an MEG experiment Zweig and Pylkkänen (2006) found that morphologically complex forms (teacher, refill) evoke increased activation from sources in the left and right fusiform gyrus (Visual Word Form Area; Cohen et al., 2000) peaking approximately 170 ms after stimulus onset (M170; Tarkiainen et al., 1999), as compared to matched monomorphemics (winter, resume). Our experiment combines the design of the lexical decision experiment (compound vs. monomorpheme, aligned vs. unaligned constituent boundary, short SOA) with the dependent measure of the MEG experiment: left and right fusiform gyrus activity. Preliminary results (N=18) show that participants exhibit a significant M170/VWFA response, which initial analyses confirm is sensitive to the morphological complexity of the stimuli. Many participants also show a second evoked posterior response 50-80ms after the M170. Further analysis will be required to determine the relationship of this second response component to the stimulus manipulations.

E78

THE FUNCTIONAL ACTIVATION AND NETWORK CHARACTERISTIC IN THE LEFT TEMPOROPARIETAL CORTEX *Xiaoyi Wang[1], Xia Wu[1], Haiyan Zhou[2], Jie Lu[3], Li Yao[1], Hua Shu[1]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [2]International WIC Institute, Beijing University of Technology, Beijing, China, [3]Xuanwu Hospital, Capital University of Medical Sciences, Beijing, China* – This fMRI study aimed to examine the functional activation and network characteristic in each part of the left temporoparietal cortex in Chinese. BOLD changes were recorded in thirteen healthy right-handed speakers in Mandarin Chinese during auditory Chinese word, visual Chinese word and picture dangerous judgment tasks. The results of functional activation and conjunction analysis showed the supramaginal gyrus(SMG) and angular gyrus(AG) were activated in all the three tasks and the superior parietal lobule(SPL) for two visual tasks, while the posterior superior temporal gyrus(pSTG) was for none, suggesting visual Chinese word approach to the picture in the activation feature. The further ROI analysis for the contrast between the AG and SMG of each judgment task showed that the AG were more activated than the SMG, indicating the AG was more sensitive to the semantic judgment than the SMG. The contrasts of among the different tasks in the same area showed that the activations of the AG, SMG and SPL were larger in the visual tasks than of in the auditory task and there were not significant between the two visual task. Furthermore, the structural equation modeling analysis to three areas for three tasks found the left temporoparietal cortex connected the left prefrontal cortex to be center at the AG in the word tasks (auditory or visual), while taking the SPL as the center for the picture task. This result implied the universal mechanism in the network of language processing in spite of the difference among the functional activation tasks.

E79

MODULATION OF BRAIN REGIONS INVOLVED IN OVERT PICTURE NAMING BY PARAMETRIC VARIATION IN WORD FREQUENCY, WORD LENGTH AND REACTION TIME *Stephen Wilson[1,2], Lisette Isenberg[1], Gregory Hickok[1]; [1]University of California, Irvine, [2]University of California, San Francisco* – Picture naming is a cognitive task commonly used to study lexical access. However it is a complex operation, entailing not only semantic and phonological stages of lexical access, but also ancillary processes including visual processing, articulation, self-monitoring and executive functions. Previous neuroimaging studies have revealed a wide range of brain areas which presumably support these various components of the task. In order to better delineate the functions of regions activated by picture naming, we used fMRI to identify brain areas where BOLD responses to picture naming were modulated by three different parametric variables: word frequency, word length and reaction time, each of which we hypothesized to be associated with different aspects of the task. Twelve subjects were scanned while they named 165 pictures in a rapid event-related design, and digital signal processing was used to extract vocal responses from background scanner noise. Lower frequency words were associated with greater BOLD responses in occipitotemporal cortex bilaterally. These regions are associated with visual and semantic processing. Longer words led to increased activity in speech motor areas as well as superior temporal cortex. Longer reaction times resulted in greater activity in several areas, including inferior frontal regions associated with both cognitive control and linguistic processes, and the pre-SMA. Of particular interest was a region in the left superior temporal sulcus where activity was correlated both with word length and reaction time (each independently of the other). We argue that such a pattern suggests a role for this region in retrieval of phonological form.

E80

THE INTERACTION OF MEANING AND COHORT SELECTION IN SPOKEN WORD RECOGNITION: AN FMRI STUDY *Jie Zhuang[1], William Marslen-Wilson[2], Billi Randall[1], Mike Ford[1], Emmanuel Stamatakis[3,1], Lorraine Tyler[1]; [1]Centre for Speech, Language and the Brain, University of Cambridge, UK, [2]MRC Cognition and Brain Sciences Unit, University of Cambridge, UK, [3]School of Psychological Sciences, The University of Manchester, UK* – Spoken word recognition involves the activation of multiple word candidates based on the initial speech input - the "cohort" - and selection amongst these competitors. Selection may be purely a sensory process or it may be facilitated by other aspects of lexical representation, such as a word's meaning (Marslen-Wilson, 1987). Here we tested this latter hypothesis in an fMRI study by presenting subjects with words and pseudo-words for lexical decision. In a factorial design we manipulated (a) cohort size (large cohorts where there is high competition amongst candidates and small cohorts where there is less competition), and (b) the word's meaning (high or low imageability). In a previous behavioural study (Tyler, et al 2000), we found that imageability facilitated word recognition but only for words with large cohorts and many competitors. In the imaging study, we found greater activity in left inferior parietal lobule with increased cohort competition, an imageability effect in right inferior parietal lobule and STG/MTG, and a significant interaction between imageability and cohort size in left STG/MTG including Wernicke's area. In words with large cohorts and high competition, highly imageable words generated stronger activity than low imageable words, whereas for words with small cohorts and low competition, there was no difference in the amount of activity generated by high or low imageable words. These results support the behavioural data in showing that selection processes do not rely solely on the sensory input but rather that the meaning of candidate words facilitates discrimination between competitors.

Perceptual processes: High-level vision

E81

CONCEPTUAL STRUCTURE MODULATES BEHAVIOURAL RESPONSES AND NEURAL ACTIVITY DURING OBJECT PROCESSING *Kadia Acres[1], Kirsten I Taylor[1], Billi Randall[1], Michael A Ford[1], Barry Devereux[1], Lorraine K Tyler[1]; [1]Centre for Speech, Language and the Brain, University of Cambridge, UK* – How are meaningful objects represented in the brain? Some distributed models of conceptual knowledge (e.g., Conceptual Structure Account, CSA) claim that the meanings of objects are represented in a distributed feature-based system where the statistical properties of concepts (e.g., distinctiveness, sharedness and co-occurrence of features) determine processing. Thus, distinctive features aid object identification, while features shared by many concepts aid category identification. Study 1 tested these claims; subjects named or made living/nonliving decisions to 412 object pictures. A principal components analysis on visual, psycholinguistic and conceptual structure variables resulted in eight components (including co-occurrence, sharedness, distinctiveness) which were entered into regression analyses. Consistent with the CSA, naming RTs were facilitated by feature distinctiveness, which is essential for unique identification, while domain decisions were facilitated by feature co-occurrence and sharedness, which allow domain identification. Study 2 investigated how the meanings of visual objects are processed in the brain by exploring how conceptual structure modulates ventral occipitotemporal activity during visual object identification using fMRI. Subjects covertly named the same object stimuli, and the aforementioned principal components were used as parametric modulators in the fMRI model. Object naming (compared to an orientation judgement baseline) resulted in bilateral ventral occipitotemporal activity, as expected. Significantly, although the sharedness and distinctiveness factors were orthogonal, both factors modulated activity in partially overlapping areas in the left fusiform and parahippocampal gyri with decreasing sharedness additionally activating more extensive and bilateral regions. These results demonstrate that the neural processing of meaning objects is modulated by their conceptual structure.

E82

EMBODIED COGNITION: CHANGING PERCEPTION THROUGH ONLINE EMULATION OF MOTOR ACTIONS *Sabine Blaesi[1], Margaret L. Wilson[1]; [1]University of California, Santa Cruz* – The theory of perceptual emulation proposes that motor representations are activated to simulate another person's action in real time in order to perceive and interpret the ongoing motor action (Wilson & Knoblich, 2005). While previous studies have shown that visual perception is influenced by previously learned motor skills (Casile & Giese, 2006), our present study will explore the influence of current, ongoing motor action on visual perception. We investigated if (1) an induced smile-like motor activation increases the likelihood of perceiving ambiguous facial expressions as "happy" and (2) an induced frown-like motor activation increases the likelihood of perceiving ambiguous facial expressions as "sad". Stimuli for facial expressions consist of a series of eleven photos of the same model on a continuum from smile to frown. Using previously tested methodology, participants were asked to rate the photos as either "happy" or "sad" while either holding a pen between the teeth without touching it with their lips (smile manipulation by Strack et al. 1988) or by asking participants to touch the tips of two golf tees applied to the brow region (frown manipulation by Larsen et al, 1992). Significantly greater "happy" responses were found for the smile condition than for the control condition. Results for the frown manipulation are thus far inconclusive. Further studies will examine whether the effect is mediated by emotion. These findings give partial support to the theory of perceptual emulation.

E83

THE TIME COURSE OF VISUAL OBJECT CATEGORIZATION FROM UNUSUAL AND CANONICAL VIEWS: EVIDENCE FROM EVENT-RELATED POTENTIALS *Meena Bolourchi[1], Lisa Lucia[1], Haline Schendan[1]; [1]Tufts University* – Rapid and accurate categorization of objects is necessary to interact appropriately with the visual environment. When does visual object categorization occur? Categorization depends upon object model selection processes to first evaluate whether the visual percept matches candidate models of known object categories in memory, and to then select the best match. Prior event-related potential (ERP) studies indicate that model selection is indexed by a frontopolar N350. Key evidence is that the N350 is the first ERP component to be modulated with the success of categorization, being smaller for correctly categorized than for unidentified fragmented line drawings of visual objects after 200 to 300 ms. In this experiment, ERP categorization effects were investigated using photographs of real known objects. Images of objects in unusual and canonical views were degraded by scrambling the phases of the spatial frequency spectrum to yield successful categorization half of the time. Participants rated their categorization success by key press, followed by naming. Performance and ERP results replicated known view-dependent effects: Performance was better for canonical than unusual views, and N350 amplitudes were larger for unusual relative to canonical views of categorized objects. Critically, for both unusual and canonical views, categorized and unidentified ERPs began to differ after 200 ms with unidentified waveforms being more negative throughout the N350. This provides further evidence that the frontopolar N350 directly measures model selection processes in the cerebral cortex, consistent with the two-state interactive account of visual object knowledge retrieval (Schendan & Kutas, 2007.)

E84

ASSOCIATION BETWEEN PERCEPTUAL ORGANIZATION AND HIGH-ORDER VISUAL COGNITION *Gabriella Brick[1,2], Csilla Antonovsky[1], Tahela Davidov[1], Daniel D. Kurylo[1,2]; [1]Brooklyn College CUNY, [2]The Graduate Center CUNY* – Perceptual organization represents a subordinate process to high-order visual functions. The present study investigated whether perceptual organization capacities correspond to measures of visual cognition that rely heavily on the organization of stimulus patterns. Subjects viewed dot patterns that progressively varied in intrinsic organization, and indicated the manner in which patterns were perceptually organized. Psychophysical measurements of grouping thresholds and critical stimulus durations were made across spatial and temporal domains. In addition, subjects received standardized tests associated with visual organization (WASI Block Design and Matrix Reasoning; DANVA2 Adult Faces 2). With one exception, measurements of perceptual organization did not correlate significantly with high-order vision tests. These results indicate that visual cognitive capacities measured here do not correspond to the efficiency of perceptual organization, emphasizing the role of non-perceptual cognitive function in high-order vision.

E85

NEURAL CORRELATES OF VISUAL PERCEPTION AND AESTHETIC PREFERENCE: EXPERTISE EFFECTS IN JUDGMENTS ABOUT DANCE MOVES *Beatriz Calvo-Merino[1], Patrick Haggard[1]; [1]Institute of Cognitive Neuroscience, University College London, UK* – Neuroimaging studies show that observation of familiar actions increases motor simulation in an observer. This neural mechanism might represent a link between the personal experience of one's own action system and the observed action. However, are the same perceptual processes engaged regardless of the observer's intentions during viewing? Here we investigated how brain mechanisms underlying aesthetic judgements about actions might differ from simple visual perception, and how these two ways of seeing interact with an observer's previous experience. 12 professional classical ballet dancers and 12 non-expert controls viewed point-light videos of ballet moves. Participants watched pairs of videos during two different tasks. On half the trials, participants performed a visual discrimination task (i.e. same / different judgement), while on the other half of trials they performed an aesthetic preference task (i.e. judge which move they preferred). This design allowed us to identify whether the brain circuits for aesthetic evaluation of dance moves differ from those merely engaged in seeing these moves, and also whether such circuits might be susceptible to the observer's expertise. Movements were presented in both their canonical and inverted orientation. Brain imaging data were analysed using SPM5. The results showed expertise-specific effects in medial and temporal regions for aesthetic judgements and in frontal and motor structures in the visual discrimination task. The results suggest engagement of different memory-related brain networks for aesthetic judgements. Funding: The Leverhulme Trust and Economical and Social Research Council (ESRC)

E86

SEMANTIC PRIMING DURING BINOCULAR SUPPRESSION *Patricia Costello[1], Jiang Yi[2]; [1]Gustavus Adolphus College, [2]University of Minnesota* – In general, stimuli that are familiar and recognizable dominate during binocular rivalry, and this is usually thought to be due to superior processing during the dominant phase. Recent research has demonstrated that familiar and recognizable stimuli such as upright faces and words presented in a native language also have an advantage of breaking suppression during binocular rivalry. In the current study, a visible prime was presented before either a semantically and conceptually related or unrelated word that was gradually introduced to one eye, competing against a standard high-contrast dynamic noise pattern presented to the other eye. We measured how long it took for semantically and conceptually related words to break out of suppression and compared the timing to a non-related word breaking from suppression. Preliminary results show that related words are faster to gain dominance. This suggests that words, even when suppressed and invisible, are processed faster when previously primed.

E87

CORTICAL UNDERCONNECTIVITY COUPLED WITH PRESERVED VISUOSPATIAL COGNITION IN AUTISM: EVIDENCE FROM A FUNCTIONAL MAGNETIC RESONANCE IMAGING STUDY OF AN EMBEDDED FIGURES TASK. *Saudamini Damarla[1,2], Timothy Keller[1,2], Marcel Just[1,2]; [1]Carnegie Mellon University, [2]Center for Cognitive Brain Imaging* – Individuals with high-functioning autism sometimes exhibit intact or superior performance on visuospatial tasks, which often contrasts with impaired functioning in other domains like language comprehension, executive tasks, and social functions. The goal of the current study was to investigate the neural bases of preserved visuospatial processing in high-functioning autism from the perspective of the cortical underconnectivity theory. We used a combination of behavioral, functional magnetic resonance imaging (fMRI), functional connectivity, and corpus callosum morphometric methodological tools. Thirteen participants with high-functioning autism and 13 controls (age-, IQ- and gender-matched) were scanned while performing an embedded figures task (EFT). No reliable behavioral differences were found between the groups, but the imaging results revealed several intriguing group differences. First, the autism group showed less activation in left frontal and inferior parietal areas and more activation in visual and spatial areas (bilateral superior parietal/intraparietal sulcus and right occipital). Second, the autism group demonstrated lower functional connectivity between language/verbal working memory areas and visuospatial areas (left frontal- right occipital).Third, the mean segment size of the corpus callosum, through which many of the bilateral cortical areas communicate, was reliably smaller in the autism group. Finally, the sizes of relevant regions of corpus callosum were positively correlated with left frontal-right occipital functional connectivity in the autism group, but not in controls. Thus, even in the visuospatial domain, where preserved performance among people with autism is observed, neuroimaging signatures of cortical underconnectivity can be found.

E88

TAKING A LONG, HARD LOOK IN THE MIRROR: INFLUENCE OF LEFT-RIGHT REVERSAL ON THE PROCESSING OF SELF AND FAMILIAR FACES *Sebastian Dieguez[1], Jakob Scherer[1], Olaf Blanke[1]; [1]Laboratory of Cognitive Neuroscience, Brain Mind Institute, Ecole Polytechnique Federale de Lausanne, Switzerland* – There is controversy as to the neural correlates subtending self-face recognition. Because one's own face is primarily known through our interactions with mirrors, part of the difficulties in this area might arise from insufficient consideration of the constraints of mirrored self-perception. Here we investigated the impact of two such constraints: compared to one's actual face, one's observed reflection is i) left-right reversed and ii) half as big. Subjects were asked to imagine they were looking into a mirror instead of a computer screen and shown normal or mirror reversed pictures of their own face varying in size. The task was a forced-choice size estimation of the shown face, i.e. whether the seen face was bigger or smaller than a real mirror reflection would be. In two different experiments, subjects were shown an actual mirror at screen distance prior to the experiment or did an additional size-estimation task with the face of a close friend, respectively. Psychometric thresholds of subjective size estimation of the reflection were obtained. The results confirmed previous findings that even with prior perception of a real mirror, subjects tended to overestimate the size of reflected faces. However, this overestimation was significantly reduced with mirror-reversed stimuli of one's own face, while increased for mirror-reversed stimuli of a friend's face. These results point out the importance of the left-right reversal of faces, which seems to influence differentially the processing of self and familiar faces. Future neuroimaging studies of self-face recognition should take this factor into account.

E89

REDUCED GAMMA-BAND ACTIVITY FOR REPRESENTATION OF FACES IN CONGENITAL PROSOPAGNOSIA *Christian Dobel[1], Markus Junghöfer[1], Thomas Gruber[2]; [1]Westfälische Wilhelms-Universität Münster, Münster, Germany, [2]Institute for Psychology I, University of Leipzig, Leipzig, Germany* – Electrophysiological correlates of face processing were investigates in seven subjects suffering from congenital prosopagnosia and seven matched controls using magneto¬encephalography. Pictures of familiar and unfamiliar persons were presented in upright and inverted orientation. Across all subjects, we found a peak of induced gamma band activity (iGBM) between 50 and 100 Hz and between 170 and 330 ms post stimulus onset. Differences between conditions and groups were analyzed in source space with VARETA (Variable Resolution Electromagnetic Tomography) estimations. Significant differences were depicted as statistical parametric maps (SPMs) constructed on the basis of the average Montreal Brain. In contrast to the evoked response in this time interval we found higher iGBR activity in response to upright compared to inverted faces. This was most pronounced in the left and right superior parietal lobes and occipital gyri. Unfamiliar faces compared to familiar faces induced significantly higher Gamma-Band oscillations in the right superior parietal lobe, the right middle temporal gyrus and the right lateral occipitotemporal gyrus. Finally, subjects with prosopagnosia revealed significantly reduced iGBR in the left lateral occipitotemporal gyrus and the left inferior temporal gyrus as opposed to the control participants. We conclude the iGBR reflect different processes than evoked brain activity and are most likely related to memory access. These processes seem to be disturbed in congenital prosopagnosia which can be seen in left-hemispheric areas. We will discuss these results with respect to recent fMRI and ERP studies on congenital prosopagnosia.

E90

ELECTROPHYSIOLOGICAL INVESTIGATION OF MASKED REPETITION PRIMING EFFECTS WITH OBJECTS ROTATED IN DEPTH *Marianna Eddy[1], Phillip Holcomb[1]; [1]Tufts University* – We have previously reported a series of ERP effects in masked repetition priming with pictures. One effect we observed, the N190/P190, appears to reflect processing of perceptual aspects of the stimuli. Another effect, the N300, has been show to reflect picture specific processing, while the N400 is a more a-modal effect, reflecting semantic processing. We were interested in investigating how changes in viewpoint (rotations in depth) would affect these previously observed ERP components. The current experiment investigated masked repetition priming effects with objects rotated in depth. Conventional views of target objects were primed with a 30, 60 or 150 degree rotation of that object in the repetition condition, whereas in the unrepeated condition 30, 60 or 150 degree rotation of an object primed a conventional unrelated target object. An early effect (N190/P190) was observed for all priming conditions. However, N300 and N400 effects were only observed for target objects that were primed with a 30 degree rotation of that object. Intact N190/P190 priming effects for all conditions possibly indicate that enough overlap between shape or features occurs between prime and target objects even when rotated in depth. We suggest lack of N300 and N400 effects in the 60 and 150 degree rotation conditions reflect a lack of overlap in the object representation activated by the prime and target, while for the 30 degree rotation, there is a sufficient amount of overlap, leading to a decrease in effort to process higher level semantic information about the conventional target object.

E91

THE TEMPORAL PROPERTIES OF OBJECT SEGREGATION AND RECOGNITION IN THE LATERAL OCCIPITAL COMPLEX *Stephen Emrich[1], Bernhard Ross[2], Douglas Cheyne[3], Susanne Ferber[1,2]; [1]University of Toronto, [2]Rotman Research Institute at Baycrest, [3]Hospital for Sick Children Research Institute* – Traditional models of visual object recognition argue that figure-ground segregation processes must operate on a visual scene before object recognition can take place. This means that figure segregation should be resolved in early visual cortical regions, with object processing emerging further up the ventral visual stream in the lateral occipital complex (LOC). However, recent evidence has called into question the theory that object recognition is preceded by figure segregation. We used magnetoencephalography (MEG) to investigate the temporal sequence of object processing steps. Participants observed images of moving line segments containing scrambled or intact objects moving in counter-phase, or simple coherent motion. While relative motion served as the cue to segregate both the scrambled and the intact objects from the background, only the intact objects had a recognizable form. An event-related beamformer was used to identify regions of maximal activation in response to the processing of intact objects, and source activity in these regions was estimated for each condition. Peak activations were first demonstrated in extrastriate regions and the motion sensitive MT. This activity was followed closely by peaks in the object sensitive LOC. Interestingly, source activity demonstrated that in the extrastriate, MT and LOC regions, responses to both intact and scrambled objects were similar at early latencies. Differences between the two conditions, however, were observed in the LOC at later latencies. Our results suggest that the LOC may initially perform figure segregation processes regardless of the presence or absence of a recognizable gestalt, followed later by object recognition processes.

E92

TIME COURSE OF THE PERCEPTION OF BIOLOGICAL MOTION: AN ERP STUDY *Jonathan Fawcett[1], Aaron Newman[1]; [1]Dalhousie University* – Humans appear to have developed specialized mechanisms for recognizing the movements of other humans, involving the posterior superior temporal sulcus as well as ventral temporal regions. One previous study (Jokisch et al., 2005. Behav. Brain Res., 117:195) reported event-related potentials sensitive to biological motion, including N170 and N300 components, but did not distinguish between the onset of visual stimuli depicting human forms and biological motion specifically. In the present study, we addressed the specificity of these components to biological motion by presenting static dot arrays that began to move after 200-400 msec as point-light videos depicting upright and inverted human actions. Adult participants had EEG recorded from 128 electrode sites. For both static and moving stimuli, differences between upright and inverted human forms were observed in the amplitude of a negativity peaking at ~230 msec and maximal over right ventral occipital-temporal electrodes. Therefore, this component may be sensitive to recognizing human forms rather than biological motion. On the other hand, a later negativity (N300) that differentiated upright and inverted forms was observed only following motion onset. This component was maximal at right parietal-occipital electrodes and inverted at ventral electrodes. These results suggest that the perception of biological motion involves an initial stage of human form recognition shared with the perception of non-moving forms, followed by a stage specific to moving biological forms. JMF supported by NSERC and the Killam Trusts; AJN supported by NSERC, CFI, and the Canada Research Chairs program.

E93

FUSIFORM FACE AREA SENSITIVITY TO FACIAL IDENTITY CATEGORIES IS MODULATED BY THE PERCEPTUAL TASK. *Christopher J Fox[1,2], Giuseppe Iaria[2], Jason J S Barton[2]; [1]Graduate Program in Neuroscience, University of British Columbia, [2]Division of Neurology, University of British Columbia* – The fusiform face area (FFA) has been identified as a cortical region involved in the perception of facial identity and shows categorical sensitivity to changes in identity. Using fMRI adaptation we examined categorical sensitivity within the FFA to changes in facial identity and facial expression, and the degree to which this sensitivity was modulated by perceptual task. Stimuli consisted of pairs of morphed faces that did or did not cross a categorical boundary between expressions or between identities. Fifteen subjects participated in the study and a right FFA was identified in twelve. Each subject participated in two adaptation runs during which they made same-different judgments on morph pairs. The same image pairs were presented on each of the two runs but the subject was required to judge identity and expression on separate runs. Behavioral data demonstrated categorical sensitivity to changes in both identity and expression, with greater detection of differences when pairs were located on either side of a category boundary. Analysis of the fMRI data showed: 1) No categorical sensitivity to expression during either perceptual task, suggesting that expression categories may not be encoded within the FFA. 2) Categorical sensitivity to identity, such that pairs which crossed a categorical boundary generated a larger response than pairs which did not. However, the latter result was found only when subjects were judging identity, not when judging expression. This task modulation of sensitivity to identity categories within the FFA shows the importance of considering task demands in fMRI experiments.

E94

VISUAL MENTAL IMAGERY AFFECTS NEURAL PROCESSES OF FACE PERCEPTION INDEXED BY THE P150/N170 COMPLEX *Giorgio Ganis[1,2,3], Stephen Maher[4], Lisa Lucia[4], Haline Schendan[4,2]; [1]Harvard Medical School, Boston, MA, [2]Massachusetts General Hospital, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, [3]Harvard University, Cambridge, MA, [4]Tufts University, Medford, MA* – Neuroimaging evidence indicates that visual mental imagery of faces can affect neural activation in face processing regions in the ventral stream. Consistent with these results, psychophysical studies have shown that visual mental imagery of faces can affect the subsequent perception of faces. However, the precise timing of these effects is unknown because of the limited temporal resolution of the techniques used. We addressed this issue by employing event-related potentials (ERPs). We asked whether visual mental imagery of faces affects processing of subsequently presented faces by modulating early face-sensitive neural processes in the ventral stream indexed by the P150/N170 complex. Seventeen subjects took part in the study. On each trial, subjects first visualized the face of a celebrity (e.g., Uma Thurman) or common objects (e.g., guitar) and then saw a picture of a face, after a brief delay. We predicted that the category of the visualized stimulus (face vs. object) would modulate the amplitude of the P150/N170 complex elicited by the following face. Results confirmed this prediction: The amplitude of a P150 with a centro-frontal scalp distribution and that of an N170 with an occipito-temporal distribution was modulated by the visualized category. This effect began by about 130 ms after stimulus onset.These findings suggest that one of the mechanisms by which visual mental imagery affects processing of subsequent visual stimuli is the modulation of neural processes in networks engaged during the early phases of bottom-up processing of these stimuli.

E95

THE ROLE OF THE LEFT FUSIFORM GYRUS IN READING: AN EXAMINATION OF CHINESE CHARACTER RECOGNITION *Yi Guo[1], E. Darcy Burgund[1]; [1]Rice University* – The left fusiform gyrus is hypothesized to be activated selectively during visual word processing. Nevertheless, the particular components of reading to which this area responds is the subject of much controversy. The purpose of the present study was to determine whether the left fusiform gyrus responds preferentially to the semantics or the phonology of visual words, and to examine the extent to which this region responds to word regularity. Accordingly, activity in the left fusiform gyrus was measured using functional magnetic resonance imaging (fMRI) while subjects performed semantic and phonological tasks with regular and irregular Chinese characters. In the semantic task, regular characters were those containing elements that provide semantic information for the whole character, and irregular characters were those without such semantic elements. In the phonological task, regular characters were those containing elements that provide phonological information for the whole character, and irregular characters were those without such phonological elements. fMRI results revealed greater activity in the left fusiform gyrus during the semantic task than during the phonological task and no effect of character regularity. Thus, the left fusiform gyrus responds to the semantics of visual words and is not sensitive to character regularity.

E96

BYPASSING THE BOTTLENECK: ENSEMBLE CODING HAPPENS AUTOMATICALLY EVEN WHEN CHANGE BLINDNESS OCCURS. *Jason Haberman[1,2], David Whitney[1,2]; [1]UC Davis Center for Mind and Brain, [2]UC Davis* – Change blindness suggests that, contrary to intuition, our representation of the visual world is sparse and limited to a few objects or features; observers cannot report salient changes between two successive images unless attention is directed to the region or object that changes. Here, we use a variation of the traditional change detection task to show that ensemble coding (i.e. statistical representation) still occurs even when subjects experience change blindness. Observers were exposed to two successively presented sets of 16 faces that varied in expression from neutral to disgusted. In the second interval, 4 of the 16 faces were changed from one emotional extreme to the other, thus shifting the emotional mean of the set. Observers performed two tasks in each trial: 1) indicate which of the sets (intervals) had a more neutral mean emotion and 2) indicate any one of the four faces that changed between the two sets. Mean discrimination performance was significantly better than change detection performance and significantly better than chance. Further, change detection performance did not improve even in the absence of the mean discrimination task. This suggests that observers could detect a change in the high-level scene statistics of each set (a gist or ensemble percept) without explicit knowledge of the items contributing to that change. Although change blindness for individual features and objects does exist, our results show that a great deal of additional information is simultaneously conveyed by summary statistics.

E97

EXPERIENCE WITH TEXT MODIFIES EARLY VISUAL EVOKED RESPONSES *Anthony Herdman[1,2], John Gaspar[1], Ross Stogryn[1], Alexander Moiseev[2]; [1]Simon Fraser University, [2]MEG Research Unit, Down Syndrome Research Foundation* – Because letters are frequently viewed visual objects, the neural network is likely reorganized for fast recognition of highly experienced visual objects as compared to inexperienced objects. This might manifest as increased neural firing synchrony. Thus we hypothesized that the early visual event-related fields should peak earlier and with greater amplitudes to letters (experienced objects) than to non-letters or symbols (inexperienced objects). To evaluate this hypothesis, we recorded behavioural and event-related fields using magnetoencephalography (MEG) from adults while they judged visual stimuli as letters, non-letters, or symbols. Stimuli consisted of either a single character or three characters. Accuracies were not different amongst the conditions or character length. Reaction times to letter stimuli were significantly faster by 59 ms than to non-letter and symbol stimuli ($p<.0001$). No differences were found between reaction times to non-letter and symbol stimuli. An event-related field that reached maximum amplitude around 130 ms peaked significantly earlier by 4 ms to letter and symbol stimuli than to non-letter stimuli ($p=.01$). We found no amplitude effects for stimulus type for this event-related field. The reaction time and latency effects demonstrate that early perceptual processing is faster for experienced than inexperienced characters. This is consistent with our previous findings which also indicate that the source of this event-related component is located in bilateral extrastriate visual areas. Source modeling results will also be presented for these data.

E98

PERCEPTION OF GLOBAL GESTALT BY TEMPORAL INTEGRATION IN SIMULTANAGNOSIA *Elisabeth Huberle[1,2], Paul Rupek[1], Markus Lappe[3], Hans-Otto Karnath[1]; [1]Section Neuropsychology, Center of Neurology, Hertie-Institute for Clinical Brain Research, University of Tübingen, Tübingen, Germany, [2]Center of Neurology, Hertie-Institute for Clinical Brain Research, University of Tübingen, Tübingen, Germany, [3]Psychological Institute II, University of Münster, Münster, Germany* – The coherent processing of our environment requires the integration of local elements into a global gestalt. Patients with bilateral parieto-occipital brain damage show intact processing of individual objects, while their simultaneous perception of multiple objects at the same time is disturbed. This deficit is termed simultanagnosia and has been discussed in the context of restricted visual working memory and impaired visuo-spatial attention. Recent observations indicated that the perception of global gestalt can be modulated by the spatial distance between individual objects in patients with simultanagnosia and thus is not an all-or-nothing phenomenon depending on spatial continuity. However, grouping mechanisms not only require the spatial integration of visual information, but also involve integration processes over time. The present study investigated motion defined integration mechanisms in patients with simultanagnosia. We applied hierarchical organized stimuli of global objects that consisted of coherently moving dots ('Shape-from-Motion'). In addition, we tested the patients' ability to recognize biological motion by presenting characteristic human movements ('Point-like Walker'). The data revealed largely preserved perception of biological motion, while the perception of motion defined shapes was impaired. These findings suggest separate mechanisms underlying the recognition of biological motion and shape-from-motion. They thus argue against a restriction in the overall capacity of visual working memory over time as a general explanation for the impaired global gestalt perception in patients with simultanagnosia.

E99

OSCILLATORY ELECTROENCEPHALOGRAM ACTIVITY ASSOCIATED WITH SUBJECTIVE AWARENESS OF A MASKED STIMULUS *Gethin Hughes[1], Max Velmans[1], Jan De Fockert[1]; [1]Goldsmiths, University of London, UK* – The aim of this investigation was to explore post-stimulus gamma oscillations associated with conscious perception of a target stimulus, as well as pre-stimulus differences that predict subsequent awareness. Participants were presented with arrow stimuli superimposed on a checkerboard pattern, which were masked using the alternative checkerboard such that they were at the threshold for conscious perception. Participants were asked to determine whether the arrow was pointing upwards or downwards, and to give a subjective rating of whether they could see the arrow. Post-stimulus gamma increases were observed for subjectively perceived arrows and were associated with an increased temporal separation of the two bursts of gamma activity associated with the target and the mask respectively. This suggests that successfully disentangling the stimulus from the mask is crucial for conscious awareness of the target. Importantly, in the pre-stimulus period we observed a negative relationship between gamma and beta power and later successful perception of the stimulus. We suggest that the increased gamma and beta activity reflects the building of a top-down representation of the upcoming stimulus, which interferes with perception of the stimulus itself. This finding suggests that the best method for successfully perceiving the stimulus is to passively allow perception of the target to be built from the visual stimulation.

E100

A COGNITIVE MODEL FOR FACE PERCEPTION *Alumit Ishai[1]; [1]Institute of Neuroradiology, University of Zurich, Switzerland* – Face perception elicits activation within a distributed cortical network in the human brain. The network includes visual ("core") regions, i.e., the inferior occipital gyrus, lateral fusiform gyrus (FG) and superior temporal sulcus (STS), which process invariant facial features, as well as limbic and prefrontal ("extended") regions, i.e., the amygdala, inferior frontal gyrus (IFG), insula and orbitoforntal cortex (OFC), which process changeable aspects of faces. Analysis of effective connectivity reveals that the major entry node in the 'face network' is the FG and that the functional coupling between the core and the extended systems is content-dependent. Thus, viewing emotional faces increases the neural coupling between the FG and the amygdala, whereas viewing famous faces results in increased effective connectivity between the FG and the OFC. A model for face perception is proposed, which postulates bidirectional connections between all face-responsive regions and further assumes that the flow of information through the network is stimulus- and task-dependent. Consequently, several new testable predictions are suggested: Focusing attention on gaze direction would increase the coupling between the STS and the FG; viewing animated faces would increase the effective connectivity between the STS and the IFG/OFC; viewing disgusted faces would increase the coupling between the FG and the insula; and an indeterminate facial input would increase the top-down connectivity from the OFC to the FG. Future studies will determine the extent to which various cognitive task demands are indeed associated with differential coupling among face-responsive regions.

E101

AGE-RELATED DIFFERENCES IN TASK-MODULATED GAZE PROCESSING AS MEASURED BY EYE MOVEMENTS *Roxane Itier[1], Tanya Brown[1], Christina Villate[1], Jennifer Ryan[1]; [1]Rotman Research Institute, University of Toronto* – Age effects on the explicit and implicit processing of gaze direction was studied using eye movement monitoring. Younger ($n=15$) and older ($n=20$) adults were compared on two tasks in which pictures of faces were presented with different head orientations and gaze directions. Subjects judged the direction of the gaze ("Gaze" task) or the head orientation ("Head" task). Looking at the eyes was task-irrelevant in the "Head" task. Measures of reaction times and d' revealed that, compared to younger adults, older adults had slower response times but similar accuracy, except for the incongruent conditions of the "Gaze" task (i.e. when the direction of head and gaze did not match) for which a marked decrease in accuracy was seen. In both groups, the proportion of viewing time and eye fixations were equivalent and similarly modulated by task; more viewing was directed to the eye region compared to the lower face area, but this difference was not as pronounced in the "Head" task. In contrast, the first saccade after stimulus onset showed marked group differences. While both groups had a similar number of first saccades that landed in the eye region in the "Gaze" task, older adults had more first saccades that landed in the eye region in the "Head" task. This suggests that although gaze processing is similar between groups, older adults are less able to suppress looking at the eyes when performing the head orientation judgment. This may reflect a general decrease of inhibitory control with increasing age.

E102

DISTORTIONS IN THE BRAIN? EVENT-RELATED POTENTIAL EFFECTS OF CARICATURING FAMILIAR AND UNFAMILIAR FACES *Juergen M. Kaufmann[1], Stefan R. Schweinberger[1]; [1]Institute of Psychology, Friedrich Schiller University Jena, Germany* – It has been suggested that caricatures are particularly incisive representations of familiar faces which can be recognized better than original portraits. We report two experiments in which participants performed speeded familiarity tasks and provided best-likeness ratings of photorealistic spatial caricatures and anti-caricatures (up to a distortion level of 30%) in comparison to veridical pictures of famous faces (Experiment 1) and personally familiar faces (Experiment 2). In Experiment 2, event-related potentials (ERPs) were recorded in addition to behavioural data. In both experiments there was no evidence for faster or more accurate recognition of caricatures. Furthermore, caricatures of famous and personally familiar faces at an exaggeration level of 30% were rated less representative than veridical pictures and anti-caricatures. In Experiment 2, ERPs for personally familiar faces were largely unaffected by spatial caricaturing. In contrast, caricaturing of unfamiliar faces elicited increased amplitudes of N170 and N250 components. Whereas N170 effects were limited to the first half of the experiment, differences in N250 amplitudes became prominent in the second half of the experiment. After three stimulus repetitions, N250 responses for caricatured unfamiliar faces were larger than for veridicals and anti-caricatures of unfamiliar faces, and became similar to N250 responses for familiar faces. These results imply that spatial information is of minor importance for the recognition of highly familiar faces. In contrast, spatial caricaturing of unfamiliar faces may increase a face's distinctiveness and thereby enhance face learning.

E103

NEURAL CORRELATES OF ADAPTATION TO FACE AND VOICE GENDER: IS THE N170 SENSITIVE TO GENDER ADAPTATION OR TO FACE DETECTION? *Nadine Kloth[1], Stefan R. Schweinberger[1], Gyula Kovács[2,3]; [1]Friedrich-Schiller-University of Jena, Germany, [2]Budapest University of Technology and Economics, Hungary, [3]University of Regensburg, Germany* – Recently, adaptation effects have been found for high-level processing of complex visual stimuli such as human faces. For example, adaptation to male faces caused participants to judge faces morphed along a male-female continuum as more feminine (Webster et al., 2004, Nature). In an event-related potential (ERP) study, Kovács et al. (2006, Cerebral Cortex) reported reduced N170 amplitudes and increased latencies for test stimuli following female gender adaptation as opposed to test stimuli following control stimulus (a phase randomized version of a face) adaptation. They concluded that these effects reflect mechanisms of shape-selective adaptation at higher levels of object processing. We examined whether N170 amplitude reduction to test faces was due to adaptation to gender-specific information in faces, or to adaptation to "faceness" per se. We compared N170 effects after adaptation to either female or androgynous faces - therefore providing face stimuli as adaptors in both gender-specific adaptation and gender-neutral control conditions. Additionally, crossmodal adaptation conditions, with either female or androgynous voice adaptors, were used to test for any cross-modal gender adaptation effects on the perception of test faces. We found behavioural gender adaptation effects from both face and voice adaptors, suggesting that gender adaptation modulates higher-level, modality-invariant gender representations. While N170 amplitudes were reduced for face-adapted test faces relative to voice-adapted test faces, no gender-specific adaptation effects were seen in the N170. We conclude that the present N170 amplitude reductions reflect adaptation of general face detection mechanisms, rather than adaptation to gender-specific facial information.

E104

REPRESENTATIONAL MOMENTUM: BIOMECHANICS AND THE EXPERTISE OF SIGNERS *Jessy Lancaster[1], Margaret Wilson[1], Karen Emmorey[2]; [1]University of California, Santa Cruz, [2]San Diego State University* – It has been shown that conceptual knowledge of inanimate objects affects representational momentum (RM). For this series of experiments, we first asked whether experience with a particular type of human body movement could affect how the movement is perceived. More specifically, we hypothesized that Deaf signers would perceive the motion of American Sign Language (ASL) signs differently than non-signers. Instead, the Deaf and hearing groups showed similar patterns of responding, with both groups showing greater RM for downward movements. This led us to believe that knowledge of biomechanics was influencing both groups. In a follow-up study using only hearing non-signers, we again found that RM is maximized for downward movements of the arm. It was also found that RM is maximized for movements shown as they were originally filmed, as opposed to being shown in reverse. Both of these findings suggest that viewers are sensitive to biomechanical factors. We further investigated the effects of biomechanical knowledge on RM by using movements that are easier and more natural to perform in one direction rather than another. For example, we compared moving the arm into a twisted posture versus moving it out of that posture. We found that RM is maximized for movements shown in a biomechanically easier and more natural direction. Taken together, these experiments show that RM is influenced by the viewer's own implicit knowledge of body movement, but is surprisingly unaffected by lifelong experience with a particular system of movement.

E105

WITHIN-CATEGORY OBJECT AGNOSIA WITHOUT PROSOPAGNOSIA: A DEVELOPMENTAL CASE *Laura Germine[1], Cashdollar Nathan[2], Duzel Emrah[2], Duchaine Brad[2]; [1]Harvard University, [2]University College London* – A number of papers have shown that individuals who have not suffered from brain damage can show deficits with face recognition coupled with normal object recognition. However, the opposite developmental condition has not been documented. We report the case of A.W., a neurologically healthy, 19 year old female with a deficit of within-category object recognition and normal face recognition. She performed outside the normal range on 7 tests of within-category object recognition memory while also scoring normally on 7 tests of face recognition memory. Testing confirmed that her impairment was not based on a general deficit in memory, basic-level recognition, or visual perception. Taken together with developmental prosopagnosia, A.W.'s pattern of impairment provides a functional and developmental double dissociation between face and object recognition memory.

E106

IS SELF-FACE RECOGNITION SPECIAL? EVIDENCE FROM LATERALIZED UPSIDE DOWN FACES *Yuan Hang Li[1], Eran Zaidel[1,2]; [1]UCLA, Los Angeles, CA, [2]Brain Research Institute, UCLA, Los Angeles, CA* – INTRODUCTION: Is self-face recognition an example of a more general process for recognizing familiar faces? We presented right-side-up and upside-down photos of self or familiar faces to the two hemispheres of normal participants. We hypothesize that self-face recognition is less lateralized (Uddin et al, 2005), and that it is more holistic, and thus more impaired by upside-down inversion than friend-face recognition. METHODS: Thirty four normal UCLA undergraduates were shown right-side-up or upside-down faces of themselves or of familiar friends in the left or right visual hemifield. They were required to identify the faces as 'self' or 'not self' with bimanual button presses. Data was analyzed using a repeated measures ANOVA: Face Type (Self-Face, Friend-Face) x Face Inversion (upside-down, right-side-up) x Visual Field (VF) (Left, Right). RESULTS: We found the expected advantage for right-side-up faces (latency and accuracy), and the expected overall Left VF (LVF) advantage (latency). There was a significant Face Type by Visual Field interaction, such that Self-Faces showed no asymmetry, whereas Friend-

Faces showed a strong LVF advantage (latency). Furthermore, Self-Faces suffered more from upside-down inversion than did Friend-Faces (accuracy). Upside-down face showed a Right VF (RVF) advantage (accuracy), whereas right-side-up faces showed no VF difference. CONCLUSION: As predicted, Self-Faces were more impaired by upside-down inversion, and Self-Faces also showed weaker lateralization than Friend-Faces. These findings echo split-brain data (Uddin et al., 2005), and suggest that the two hemispheres use similar, but special strategies for recognizing Self-Faces.

E107

NEUROPHYSIOLOGICAL INVESTIGATIONS OF THE TIME COURSE OF VISUAL OBJECT CATEGORIZATION: EFFECTS OF NAMING, RATINGS OF CATEGORIZATION SUCCESS, REPETITION, AND EXEMPLAR TYPICALITY *Stephen Maher[1], Haline Schendan[1]; [1]Tufts University* – Two event-related potential (ERP) experiments defined the timing of visual object categorization and long-term memory. Previously, a frontopolar N350 and posterior late positive complex (LPC) were modulated as a function of naming accuracy. Other experiments find N350 and LPC repetition effects on indirect memory tests. The N350 was proposed to index object model selection processes supporting categorization and implicit object memory, whereas the later LPC indexes post-categorization processes and recollection. The N350 and LPC are more positive for categorized than unidentified objects and for repeated than new objects. In experiment 1, participants saw novel and repeated fragmented line drawings of objects during an indirect memory test, rating each on the success of categorization from 1 to 4 followed by naming. Results demonstrated that naming and repetition modulate the same N350 and LPC components in the same individuals. Moreover, the N350 decreased linearly as categorization was rated to be more successful, while the LPC did not. In experiment 2, ERPs were compared to photographs of high versus low typicality exemplars of a basic level object category (e.g., cell- vs. rotary- phone). For high relative to low typicality exemplars, the N350 was larger, while the LPC was smaller. Altogether, findings further support the N350 and the LPC as indices of distinct visual object categorization and long-term memory processes, and the two-state interactive account of visual object knowledge, wherein the N350 reveals the functional properties of object model selection processes critical for categorization (Schendan & Kutas, 2007; Schendan & Stern, 2007).

E108

A BILATERAL OCCIPITOTEMPORAL NETWORK MEDIATES FACE PERCEPTION *Denise Minnebusch[1,2], Boris Suchan[1], Odo Köster[3], Irene Daum[1]; [1]Institute of Cognitive Neuroscience, Ruhr-University of Bochum, Germany, [2]Ruhr-University Research School, Bochum, Germany, [3]Institute for Diagnostic and Interventional Radiology and Nuclear Medicine, St Josef Hospital Bochum, Germany* – Exploring the neuronal mechanisms of face processing in healthy subjects may help to understand the difficulties experienced by prosopagnosia subjects. The aim of the present study was to further investigate FFA and OFA activation patterns associated with famous faces and caricatures in four DP individuals who differ considerably with respect to behavioural and electrophysiological indicators of face recognition (Minnebusch et al. 2007). A second goal of the study was to elucidate interactions between face processing areas in healthy subjects and their specific contributions to the processing of different representations of faces such as photographs and caricatures of famous people using fMRI and psychophysiological interaction analysis (PPI). Control subjects showed higher face related activations in the right compared to the left FFA, and right FFA activation correlated with right OFA activation. Caricatures of faces of famous people yielded higher percent signal changes in the OFA compared to photographs, which supports the face processing model by Haxby and colleagues (2000). DP subjects showed heterogeneous activation patterns. PPI analysis yielded evidence for a close relationship between activity in the right FFA and the left FFA and the OFA bilaterally. In summary, all four face related brain regions have to be activated for successful face processing. A disruption of processing in one part of this network may lead to prosopagnosia.

E109

THE DEVELOPMENT OF MEANING WITH INCREMENTAL OBJECT AWARENESS: AN EFMRI STUDY OF STAGES OF VISUAL OBJECT PROCESSING. *Lorina Naci[1], Richard N. A. Henson[2], Kirsten I. Taylor[1], Lorraine K. Tyler[1]; [1]Centre for Speech, Language and the Brain, University of Cambridge, [2]MRC Cognition and Brain Science Unit* – Visual objects are rapidly interpreted by the brain as meaningful objects. This research investigates the neural processes involved by contrasting two theoretical accounts of object recognition. Feedforward models postulate that increasingly complex visual features are processed in a hierarchically organized ventral object processing stream, where the meaning of a visual object is accessed at the last stage of object recognition, in antero-medial temporal cortex. In contrast, interactive accounts claim that object processing involves interacting and parallel feedforward and feedback processes, where visual meaning emerges gradually in a distributed network of regions. Crucially, we tested these competing accounts by measuring how an object's meaning (real vs abstract objects) modulates BOLD activity at early and later stages of object processing. To tap into incremental object processing, we used fast (17ms), repeated presentations (5), of double-masked visual objects. Subjects initially lacked object awareness, but later showed knowledge of shape and identity. Object meaning modulated occipito-parietal, temporal, and frontal activity in the 2nd and 3rd presentations. Within this broad network, activity was more anterior in the 3rd presentation, and was stronger for real than abstract objects, suggesting network modulation as a function of object meaningfulness. These data argue against feedforward models, suggesting instead that the neural signature of visual meaning emerges gradually, engaging increasingly more anterior regions in a wide anterior to posterior network. The dynamically changing activity patterns in this network suggest that interactions between functionally distinct, remote neural regions underpin the representation of visual object meaning.

E110

FROM LOW TO HIGH: DISTINCT BRAIN REGIONS ACTIVATED BY CONTRAST MODULATED 'NATURAL' AND 'UNNATURAL' VISUAL SCENES *Norberto Nawa[1,2], Hiroshi Ando[1,2]; [1]Multimodal Communication Group, NICT Universal Media Research Center, [2]ATR Cognitive Information Science Labs., Kyoto, Japan* – Innumerous studies have investigated the brain areas involved in the processing of physical attributes of visual stimuli such as color, luminance and contrast, but relatively little is known about how such attributes affect the perception of complex scenes as 'natural' looking, as opposed to 'unnatural' or 'artificial'. Using functional MRI, we examined whether distinct activity patterns are elicited by natural and unnatural visual stimuli. Stimuli were black and white pictures portraying various scenes (e.g., cities, country fields, objects in various environments); natural pictures had their contrast curves unaltered, while unnatural pictures were produced by reversing their contrast curves (negative images). Additional sets of low-contrast pictures (natural and unnatural) were used to find contrast-sensitive areas within the visual cortex. The luminance level of the pictures across sets was not significantly different. During scanning, participants viewed blocks of five pictures of the same type, interleaved with rest blocks, and performed a simple discrimination task. Although reaction time and classification accuracy were not affected by stimulus type, BOLD contrasts revealed that activity was greater in the right angular gyrus, right middle temporal gyrus, and cingulum for natural stimuli. In contrast, activity was greater in the fusiform gyrus bilaterally, right inferior temporal cortex, left middle occipital cortex, and left inferior frontal operculum for unnatural stimuli. The effect of the stimuli contrast level was limited to the calcarine cortex. These findings suggest that the perception of stimuli as natural or unnatural involves areas other than those known to take part in low-level visual processes.

E111

APPRAISAL-DRIVEN INTERACTION OF FACIAL EMOTION AND GAZE DIRECTION IN THE HUMAN AMYGDALA USING COMPUTER-GENERATED DYNAMIC FACES *Karim N'Diaye[1,2], David Sander[1], Patrik Vuilleumier[1,2]; [1]Swiss Center for Affective Sciences, Geneva, [2]Neurology and Imaging of Cognition, NeuroCenter, University of Geneva* – Recent behavioural evidence has shown a specific pattern of interaction between facial emotion and gaze-direction in the processing of facial displays. However, neuroimaging results on this topic have proved somewhat contradictory. These discrepancies could be due to differences in the nature of the tasks and in the material used which sometimes include mild-intensity blends of facial expressions. In the present experiment we addressed this issue using a highly-controlled set of computer-generated stimulus faces animated to produce emotional expressions of various intensities (fear, anger, happiness) with direct and averted gaze direction. Our prediction, based on appraisal theory of emotion, was that perceived emotion by healthy subjects would show a specific pattern of interaction driven by the self-relevance dimension of the facial displays, namely that averted fearful faces, which may signal a nearby danger would be more relevant than fearful faces gazing directly at the observer, while the converse would be true for angry faces -- for which direct gaze, signalling aggressiveness, may be more relevant. Confirming our hypothesis, this interaction pattern was observed both at the behavioural level in the ratings of perceived intensity and at the neural level in the left and right amygdala BOLD responses and only for low-intensity facial displays. These results underscore the role of expressed intensity as a possible source of discrepancy between studies and substantiate the involvement of human amygdala in the appraisal of affective stimuli, in particular with respect to their self-relevance dimension.

E112

PREDICTIVE CODING DURING DETECTION OF OBJECTS. *Spiro Pantazatos[1], Thomas Meitzler[2], Mary Bienkowski[2], Euijung Sohn[2], Joy Hirsch[1]; [1]fMRI Research Center, Columbia University, New York, [2]U.S. Army RDECOM TARDEC Visual Perception Laboratory, Warren, MI* – "Predictive coding" proposes that the brain resolves perceptual ambiguity by anticipating forthcoming visual stimuli and generating a template that enhances the match to incoming visual stimuli. Although predictive coding mechanisms have been demonstrated for detection of faces*, it is not known if these same mechanisms can be generalized to other visual stimuli. In the current fMRI study, 12 subjects were asked to search for an expected target in which task difficulty (target size) was parametrically modulated and related to detection performance. During the search phase of the task, activities of ROIs in medial frontal cortex (dmPFC and vmPFC, previously implicated in predictive coding using a "perceptual-set" paradigm*) were also observed to correlate with increasing task difficulty in the current study. A PPI analysis using activity in the vmPFC as the physiological factor and increasing task difficulty as the psychological factor identified clusters in the cuneus and lateral occipital cortex, higher visual regions known to be involved in visual searching and object identification, respectively. Whereas the prior study demonstrated upregulation of face-sensitive regions (FFA) by the vmPFC during a face-detection task*, the current work generalizes this observation to object detection. These findings extend the previous model of predictive coding to enhance detection of faces to detection of other target stimuli, and are consistent with a general model of top-down enhancement of visual perception. * Summerfield, C., T. Egner, et al. (2006). "Predictive codes for forthcoming perception in the frontal cortex." Science 314(5803): 1311-4.

E113

ELECTROPHYSIOLOGY OF OTHER RACE FACE RECOGNITION *Lara Pierce[1], James Tanaka[1]; [1]University of Victoria* – Although it is established that people are better at recognizing own- versus other-race faces, the neural mechanisms mediating this advantage are not well understood. In this study, Caucasian participants were trained to differentiate African (or Hispanic) faces at the subordinate individual level and classify Hispanic (or African) faces at the basic level of race. Training occurred during 5 sessions spaced over 10 days. During identical pre- and post-training assessments brain activity was recorded using scalp electrodes in order to investigate changes in posterior brain components that are involved in face processing, the N170 and the N250. The N170 is thought to index level of exposure, while the N250 is thought to be a marker of subordinate level representations. No differences were found in the N170 between conditions, supporting its role as indexing exposure alone (all conditions received identical exposure to all faces, only the depth of processing of the faces was varied between conditions). The main finding, however, was that faces from the race trained at the subordinate level elicited an enhanced N250 compared to faces trained at the basic level. These differences were mirrored in an old/new recognition task suggesting that participants learned to process other race faces at the subordinate level, and that the N250 component is a reliable marker of other-race face recognition.

E114

BISTABLE PERCEPTUAL REVERSALS: ERP COMPONENTS AND THEIR NEURAL GENERATORS *Michael Pitts[1], Antigona Martinez[1]; [1]University of California, San Diego* – Bistable figures are useful for investigating the neural basis of object perception because they allow an isolated examination of endogenous processes. Currently, debate exists over the neural mechanisms involved in bistable perceptual reversals. fMRI studies (e.g. Slotnick and Yantis, 2005) have reported increased activity in posterior parietal and inferior temporal areas during shifts in perception of the Necker cube. Event-related potentials (ERP) studies (e.g. Pitts, Nerger, and Davis, 2007; Kornmeier and Bach, 2004) have reported a reversal negativity (≈250msec) and a late positive component (≈400msec) associated with perceptual reversals. It is currently unclear how these ERP components relate to fMRI activations. The goal of the current study was to localize the neural generators of the reversal ERP components in order to evaluate their functional significance. A Necker-type stimulus was presented for 800msec with 500msec ISIs to allow time-locking of ERPs to stimulus onset. Observers pressed one of two response buttons after each trial to indicate how they perceived the cube. The reversal negativity and late positive component were identified, and dipole modeling (BESA) and statistical-based source analyses (LAURA) were conducted to estimate the locations of the neural generators. For the reversal negativity, both localization techniques suggested sources in the fusiform gyrus (with a right hemisphere lateralization). The generators of the late positive component were more anterior and medial, in middle/inferior temporal gyri. Localization of these sources allows comparisons between fMRI and ERP data, and provides converging evidence in support of top-down theories of bistable perception.

E115

NATURE VS. NURTURE IN VENTRAL VISUAL CORTEX: AN FMRI STUDY OF TWINS *Thad Polk[1], Joonkoo Park[1], Mason Smith[1], Denise Park[2]; [1]University of Michigan, [2]Beckman Institute, University of Illinois at Urbana-Champaign* – The patterns of neural activity in twins were estimated using functional magnetic resonance imaging in order to assess the role of genetics in the functional organization of human ventral visual cortex. METHODS: 13 pairs of monozygotic and 11 pairs of dizygotic twins performed visual one-back tasks with pictures from four experimental conditions (faces, houses, pseudowords, and chairs) and one control condition (phase-scrambled versions of the same pictures). There were three runs with 15 20-second blocks per run (three blocks of each condition in pseudorandom order) with a 20-second rest period preceding each run. Each block consisted of 10 items from the same category presented for 1500ms each, followed by a 500ms intertrial interval. Normalized statistical parametric maps of activity for each experimental condition vs. control in ventral visual cortex were computed. The activation maps from each participant were then compared with the maps from their twin using the Pearson correlation coefficient. RESULTS: The activation patterns in monozygotic twins were significantly more similar than in dizygotic twins for the face and house stimuli, but there was no effect of zygosity for pseudowords or chairs. The effect of zygosity on similarity was also significantly larger for the face and house conditions compared with the pseudoword and chair conditions. CONCLUSION: These results demonstrate that genetics play a significant role in determining the cortical response to faces and places, but play a significantly smaller role (if any) in the response to orthographic stimuli. [Supported by an NIH grant (R01AG060625) to D.C.P. and T.A.P.]

E116

A HOUSE IS NOT A FACE: THE EFFECTS OF EARLY VISUAL DEPRIVATION ON THE LATER DISCRIMINATION OF SPACING AND FEATURAL CHANGES IN A NON-FACE OBJECT *Rachel A. Robbins[1], Daphne Maurer[1], Catherine J. Mondloch[1,2], Mayu Nishimura[1], Terri L. Lewis[1,3,4]; [1]McMaster University, [2]Brock University, [3]The Hospital for Sick Children, [4]University of Toronto* – Patients deprived of patterned visual input during early infancy by dense bilateral cataracts later show deficits in discriminating spacing information in faces (e.g, distance between the eyes); however, they are normal at discriminating feature information (e.g., eye shape; Le Grand et al., 2001, 2003). Here, we tested whether this deficit is specific to faces by examining the ability of such patients to discriminate spacing changes and feature changes in a non-face object class (houses). We created two sets of 10 houses that were identical except for the position of windows and doors (spacing set), or the particular windows and doors (feature set). On each trial a single house was presented for 200 ms, followed by a pair of houses; participants indicated which house matched the original. The eight patients (10 to 23 years of age), all of whom had been treated for bilateral cataract during infancy, performed normally on both sets (patients means: spacing = 75.5%, feature = 83%; adult norms: spacing = 75.9%, feature = 84.1%), with every patient within 1 SD of adult norms for the spacing set. The sub-set of three adult patients tested on spacing in upright human faces on the same day confirmed a deficit on that task (patients = 62.2%, adult norms = 82.2%). Together, the results indicate that early visual input is necessary for the normal development of sensitivity to spacing in faces, but not in non-face objects.

E117

INDIVIDUAL DIFFERENCES IN GRAPHEME-COLOR SYNESTHESIA *Romke Rouw[1], Steven Scholte[1]; [1]University of Amsterdam, Amsterdam, The Netherlands* – Grapheme-color synesthetes experience specific colors with particular letters or numbers (e.g. 'the A is bright red). In this study, we examine the neurological basis of individual differences in the synesthetic experiences. DTI showed increased anisotropic diffusion when compared to matched controls. Increased anisotropic diffusion indicates more coherent white matter. Anisotropy furthermore differentiates subtypes of grapheme-color synesthesia. Increased connectivity in the inferior temporal cortex is particularly strong for synesthetes who see synesthetic color in the outside world ('projectors') as compared with synesthetes who see the color in their mind's eye only ('associators'). In contrast, increased connectivity (as compared with non-synesthetes) in the superior parietal or frontal cortex did not differentiate between subtypes of synesthesia. Furthermore, we present new data showing how individual differences in grapheme-color synesthesia are reflected in differences in the neurological mechanisms involved.

E118

INTERHEMISPHERIC TRANSFER OF PHOSPHENES INDUCED BY TMS OVER OCCIPITAL AND PARIETAL CORTE *Silvia Savazzi[1], Francesca Mancini[1], Carlo Marzi[1]; [1]University of Verona, Verona, Italy* – It is well established that one characteristic structural feature of the visual cortex is that it does not give rise or receive callosal connections beyond the central visual field representation. Therefore, peripheral visual stimuli lateralized to one hemisphere cannot be transferred from one visual cortex to the other via callosal connections. In contrast, the visual areas in the parietal lobes have widespread callosal connections that can ensure a direct interhemispheric transfer (IT) for the whole visual field representation. Thus, one could predict that phosphenes generated by applying TMS to V1 should show a slower IT than those obtained by stimulating areas with more widespread callosal connections such as the parietal cortex. To test these predictions we applied TMS over the occipital pole (O-TMS), or to the posterior parietal cortex (P-TMS) and we measured IT with the Poffenberger paradigm, by asking normal participants to respond to the onset of a phosphene with the hand ipsilateral or contralateral to the stimulated hemisphere. The difference between crossed and uncrossed conditions (CUD) is taken as an estimate of IT which in normals is around 4 ms. We found a dramatically lengthened CUD for RT to O-TMS-induced phosphenes (36-37 ms) while the CUD for RT to P-TMS-induced phosphenes and for visually presented stimuli was in the normal range (3-4 ms). The thrust of these results is twofold: they show that phosphenes transfer from one hemisphere to the other via callosal connections. Moreover, they provide novel evidence of phosphenes obtained by stimulation of posterior parietal cortex.

E119

NEURONAL TUNING TO WHOLE REAL WORDS IN THE VENTRAL VISUAL PATHWAY *Laurie Schwarz Glezer[1], Xiong Jiang[1], Maximilian Riesenhuber[1]; [1]Georgetown University Medical Center, Washington, D.C.* – Numerous studies have identified an area in the ventral visual pathway that responds preferentially to written real words (RW) and pseudowords (PW), termed the "visual word form area" (VWFA). It has been proposed that the VWFA is responsible for creating an abstract representation of visually perceived letter strings that is prelexical. In contrast, we hypothesized that the requirement to discriminate similar real words (i.e. "farm" and "form") leads to experience-driven refinement of neurons tuned to whole RWs. In contrast, response boundaries of these RW-tuned neurons to PWs are less sharp due to lack of refinement, causing low-level activation of a number of RW neurons to a particular PW. We used fMRI rapid adaptation to test these contrasting hypotheses. We compared two groups of 12 subjects presented with either RW pairs or PW pairs. We examined three conditions: 1) "same", in which the same stimulus was presented twice, 2) "1L", in which the two stimuli differed by one letter, and 3) "different", in which the two stimuli shared no letters. In both groups, we found significant adaptation for "same" vs. "different" and "1L". Interestingly, the RW pairs showed no difference between "1L" and "different" in the VWFA, showing that even though the two RWs in "1L" shared sublexical units, there was no adaptation. In contrast, the PW pairs showed a significant difference between "1L" and "different, suggesting broad tuning to PWs. These results suggest that VWFA neurons are tightly tuned to whole real words and not sublexical units as previously proposed.

E120

PERCEPTUAL LOAD AND EVENT-RELATED POTENTIAL (ERP) MEASURES OF HEMISPHERIC COOPERATION *Andrea Shafer[1], Barry Haimson[1]; [1]University of Massachusetts Dartmouth* – Prior research with behavioral methods has demonstrated that task complexity is a factor influencing within and across hemisphere processing. Previously, this laboratory obtained behavioral and ERP differences in hemispheric processing by manipulating the timing (delayed vs. simultaneous) of the target and probe. An across hemisphere advantage was obtained in the delayed condition, but was contingent on the visual field of the target. This finding could have resulted from differences either in perceptual load or task complexity. The purpose of the present study was to evaluate ERP correlates of hemispheric cooperation associated with perceptual load not confounded with task complexity. Subjects were randomly assigned to either a single probe or multiple probe condition. The target appeared in the left visual field (LVF) or the right visual field (RVF) while the matching probe (match-location) appeared in the same visual field as the target (within match) or the opposite visual field (across match). A matching probe appeared on half the trials. Participants indicated on a keypad whether one of the probes above a fixation point matched a letter target below it. Statistical analyses indicated match-location differences in RT associated with visual field but not perceptual load. The ERP peak amplitude data revealed greater positivity for the multiple condition and for the within condition in both the P200 and P300 time windows. Peak latency occurred earlier in the within condition for P200, but later for P300. These results suggest increasing perceptual load influences hemispheric cooperation differently from increasing task complexity.

E121

MODULATION OF FACIAL AFFECT PROCESSING BY VISUAL DESIGN: ERP EVIDENCE AT P1 AND N170 *Bernadette Sibuma[1], John Black[2], Karen Froud[2]; [1]SUNY Oswego, [2]Columbia University* – A continuing point of debate in the electrophysiology literature is whether the face-sensitive N170 event-related potential is modulated by facial affect (Batty & Taylor, 2003; Eimer & Holmes, 2007; Blau, Maurer, Tottenham, & McCandliss, 2007). However, little is known about the impact of the visual design on face processing. The initial P1 component is said to reflect feature-based processing, whereas the N170 reflects more structural and holistic processing (Latinus & Taylor, 2006). Using a perceptual decision-making task, we examined the P1 and N170 in the processing of cartoon, computer-agent, and photographs of faces with neutral and fearful expressions. Results indicated that the most realistic presentations elicited the largest P1 amplitudes. In addition, although there was no significant effect of facial affect on the N170 amplitude within cartoons and photos, fear significantly enhanced the N170 negativity in agents. Since variance in the amplitude of a component has often been associated with the degree to which the associated cognitive process is engaged (Donchin & Coles 1988; Otten & Rugg, 2005), we hypothesized that realistic faces significantly heighten neural engagement in early perceptual processing. These findings suggest that visual design modulates the time course of facial affect processing. Batty, M., & Taylor, M. J. (2003). Early processing of the six basic facial emotional expressions. Cognitive Brain Research, 17, 613-620. Blau, V. C., Maurer, U., Tottenham, N., & McCandliss, B. D. (2007). The face-specific n170 component is modulated by emotional facial expression. Behavioral and Brain Functions, 3(7), 1-13. Eimer, M., & Holmes, A. (2007). Event-related brain potential correlates of emotional face processing. Neuropsychologia, 45(1), 15-31. Donchin, E. & Coles, M.G.H. (1988). Is the P300 component a manifestation of context updating? Behavioral and Brain Sciences, 11, 355-372. Latinus, M., & Taylor, M. J. (2006). Face processing stages: Impact of difficulty and the separation of effects. Brain Research, 1123, 179-187. Otten, L.J. & Rugg, M.D. (2005). Interpreting event-related brain potentials. In Handy, T.C. (ed.) Event-related potentials: a methods handbook. Cambridge, MA: MIT Press. Pp. 3-16.

E122

TOP-DOWN PROCESSES OF MODEL VERIFICATION FACILITATE VISUAL OBJECT CATEGORIZATION UNDER IMPOVERISHED VIEWING CONDITIONS AFTER 200 MS *Emily Slocombe[1], Giorgio Ganis[2,3], Haline E. Schendan[1]; [1]Tufts University, [2]Harvard Medical School, Boston, MA, [3]Massachusetts General Hospital, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA* – While objects seen under optimal visual conditions are rapidly categorized, categorizing objects under impoverished viewing conditions (e.g., unusual views, in fog, occlusion) requires more time and may depend more on top-down processing, as hypothesized by object model verification theory. Object categorization involves matching the incoming perceptual information to a stored visuostructural representation in long-term memory. Functional magnetic resonance imaging (fMRI) work found evidence for model verification theory, and implicated ventrolateral prefrontal cortex (VLPFC) and parietal lobe in top-down modulation of posterior visual processes during the categorization of impoverished images of objects. We replicated the fMRI study with event-related potentials (ERPs) to time model verification processes. The two-state interactive account of visual object knowledge predicts that top-down processes of model verification modulate object model selection processes supporting categorization during a frontopolar N350, and later categorization processes during a parietal late positive complex (LPC), but not earlier feedforward processes of perceptual categorization during a P150-N170 complex. 24 participants categorized fragmented line drawings of known objects. Impoverishment was defined by a median split of response time with slower times defining more impoverished (MI) and faster times defining less impoverished (LI) objects. As predicted, after 200 ms, the N350 was larger for MI than LI objects, whereas the LPC was smaller for MI than LI objects. Consistent with the two-state interactive account, object model selection processes supporting categorization occur after 200 ms and can be modulated by top-down processes of model verification implemented in VLPFC-parietal networks to facilitate object constancy under impoverished viewing conditions.

E123

PERCEPTION OF HUMAN WALKING IN NEUROSURGICAL PATIENTS WITH LEFT CEREBELLAR LESIONS *Arseny A. Sokolov[1], Alireza Gharabaghi[1], Marcos Tatagiba[1], Marina A. Pavlova[2]; [1]University of Tuebingen Medical School, Tuebingen, Germany, [2]Children's Hospital, University of Tuebingen Medical School, Tuebingen, Germany, and MEG-Center, Institute of Medical Psychology and Behavioral Neurobiology, University of Tuebingen, Tuebingen, Germany* – The ability to perceive actions of others is essential for our daily-life behavior, e.g. for non-verbal communication or safe car driving. The cortical network for perception of body motion has been widely explored (Pavlova et al., Cereb Cortex 2006; Puce and Perrett, Phil Trans R Soc Lond B 2003; Pelphrey et al, Cereb Cortex 2005). Recent brain imaging data also suggest cerebellar involvement in perception of biological motion (Grossman et al., J Cogn Neurosci 2000; Calvo-Merino et al., Curr Biology 2007). However, there is still a lack of consensus as to cerebellar substructures engaged. By using point-light stimuli, we assessed the sensitivity to human locomotion in neurosurgical patients with lateral or medial lesions to the left cerebellum. Our psychophysical findings show that patients with left cerebellar lesions exhibit a lower sensitivity to human walking than healthy controls, and that lateral lesions account for more pronounced deficits than medial lesions. We also report a patient SLO with an extensive left cerebellar lesion. Her preoperative sensitivity to human walking was at a chance level. Eight months after neurosurgery, her sensitivity improved substantially and reached the level of healthy controls after 24 months. The findings point to the cerebellum as an important structure subserving perception of human walking and shed light on its plasticity. Brain imaging in combination with neuropsychological assessment is required to determine the role of the cerebellum in the neuronal network for body motion perception.

E124

AN OSCILLATORY SIGNATURE OF VISUAL FEATURE-BINDING IN OBJECT PERCEPTION *Kevin Spencer[1,2], Robert McCarley[1,2]; [1]VA Boston Healthcare System, [2]Harvard Medical School* – Single-unit recordings in animals have found evidence that neuronal synchronization in the gamma band (30-100 Hz) of the electroencephalogram (EEG) may underlie the linking of stimulus features into the perception of coherent objects. In humans, EEG/MEG studies have reported evidence that non-stimulus-locked gamma oscillations are related to object perception, but close links have not been established. Previously we observed a gamma oscillation at occipital electrodes in a Gestalt perception task that occurred prior to the overt response on shape-present but not shape-absent trials, and was phase-locked to reaction time, suggesting that it was closely related to the perceptual decision. Here we sought to determine whether this response-locked oscillation (RLO) could be elicited by both real and illusory shapes, as would be required by a mechanism involved in feature-binding. Fifteen subjects performed a task in which they indicated whether or not a diamond shape was present in a stimulus array. The shape could be formed by Real or Illusory contours. On No-Shape trials the inducer disks forming the Illusory contour were rotated outwards. On Real- and Illusory-Shape trials, an RLO was found at occipital electrodes prior to the overt response (48-64 Hz; Real: -198 to -172 ms; Illusory: -160 to -140 ms). The RLO was detected in the phase-locking but not the power data, and was not apparent on No-Shape trials. These findings suggest that the RLO may be the manifestation of an oscillatory mechanism for visual feature binding, which operates via modulation of the temporal precision of gamma activity.

E125

ANOREXIA NERVOSA IS ASSOCIATED WITH A REDUCTION OF GRAY MATTER DENSITY IN THE EXTRASTRIATE BODY AREA: A VOXEL BASED MORPHOMETRY STUDY. *Boris Suchan[1], Martin Busch[2], Dietmar Schulte[1], Dietrich Grönemeyer[2], Stephan Herpertz[3], Silja Vocks[1]; [1]Ruhr University Bochum, [2]Institute for Micro Therapy, [3]Westfälische Klinik Dortmund* – Anorexia nervosa (AN) is a widely distributed disease in the western society. One striking feature of subjects suffering AN is the disturbance of body size estimation. A plausible explanation for this phenomenon of body size disturbance is discussed controversially in the literature. The present study aimed at characterising the morphological changes in the brain of women suffering AN. Voxel based morphometry was applied to high resolution T1 weighted magnetic resonance images of 12 healthy controls and 12 women diagnosed with AN according to the criteria of the DSM IV. Contrasts of the segmented gray matter images of AN and healthy controls yielded evidence for a reduction of gray matter density in the left lateral occipital cortex covering the so called extrastriate body area (EBA) as well as the superior temporal sulcus in AN if compared to healthy controls. This finding suggest that structural alterations in parts of the visual cortex (EBA) which are sensitive for processing body specific information are responsible for the disturbance in body size estimation in AN.

E126

THE VENTROMEDIAL PREFRONTAL CORTEX DETECTS MATCHES BETWEEN EXPECTED AND OBSERVED EVENTS *Christopher Summerfield[1], Etienne Koechlin[1]; [1]Ecole Normale Supérieure, Paris, France* – Visual perception is shaped by 'top-down' information – foreknowledge about what is likely to be perceived. Prior information allows the brain to build an internal model (or 'template') of coming sensation, thereby reducing the problem of perceptual inference to assessing the match between this template and information in the external world. Which brain regions might participate in monitoring for this 'match' between expected and observed perceptual information? Here, we acquired functional magnetic resonance images (fMRI) whilst subjects performed a simple perceptual decision task that involved either forced-choice judgments with two alternatives (e.g. is the stimulus A or B?) or 'matching' decisions that involved the comparison between an external event and an internal template (e.g. is the stimulus A or not?). These two types of judgment, which we respectively call A-B and A-nA decisions, were presented in blocks, with an identical stimulus train, that were tailored not to differ in terms of overall task demand as indexed by either reaction times (RTs) or errors. Nevertheless, they led to strikingly different patterns of brain activity. A-nA decisions, which required the subjects to explicitly match each stimulus to an internal template, activated the ventromedial prefrontal cortex (vmPFC) and connected structures. We argue that matching expected and observed information may be a basic function of the vmPFC and other 'default network' structures, and that increased signal during an uneventful resting period may reflect the continuous fulfillment of sensory predictions.

E127

ALTRUISM AND FUNCTIONAL SPECIFICITY OF THE SUPERIOR TEMPORAL CORTEX *Dharol Tankersley[1,3], Chinchun Ooi[1], Scott A. Huettel[1,2]; [1]Brain Imaging and Analysis Center, [2]Psychiatry, Duke University Medical Center, [3]Philosophy Department* – Social perception requires the identification of agents and their goal-oriented behaviors, processes that preferentially evoke activation in the right superior temporal cortex (rSTC). Recent work suggests that a specific perceptual capacity -- the discrimination of movement contingency -- influences both the perception of agency and hemodynamic activity in the rSTC. In parallel, we have shown that pSTC activation predicts individual differences in prosocial behavior. Although the rSTC is activated by social perception tasks, this region is also reliably recruited in simple visual attention tasks, including oddball and target-detection tasks. The common activation across these disparate tasks poses challenges for understanding its functional organization and specificity. Indeed, the role of physical parameters such as movement contingency in inducing perception of animacy suggests that social percepts might be composed of simple, non-social computations. We conducted a functional magnetic resonance imaging study in which subjects performed a variety of tasks tapping visual attention and social perception. Our imaging results confirmed two previous findings. First, the rSTC was preferentially activated when watching apparently goal-oriented actions, compared to watching random movements. Second, the amplitude of this rSTC activation during social perception was predicted, across subjects, by individual differences in altruism, as measured by self-report surveys and a giving task. Furthermore, we found that individual differences in the ability to discriminate movement contingency were correlated with rSTC activation. Future analyses will investigate the degree to which neuronal activity associated with visual attention tasks predict trait-level social phenomena like altruism.

E128

EPISODIC REPRESENTATIONS OF OBJECT COLOR *Sarah Vollmer[1], Robert Gordon[1]; [1]North Dakota State University* – The episodic representation of colored letters was investigated within a transsaccadic preview paradigm. While participants fixated on a central cross, a preview was displayed consisting of two letters located above and below a peripheral cross. Participants initiated a saccade to the peripheral cross immediately upon the appearance of the preview display. During the saccade, the preview display was replaced by a target display, consisting of a single familiar letter in one of the previewed locations; the participant's task was to name the letter as quickly as possible after the eyes landed. The target's letter either matched or was different from its color in the preview display. The results revealed an object-specific priming effect: that is, participants named the letter more quickly when it appeared in its previewed location than when it appeared in the opposite location. This priming effect was unaffected by a change in the target's color; however, a follow-up study, in which the preview and target stimuli were colored objects, revealed a significant effect of color change on object-specific priming. The results suggest that whether or not color change affects object continuity depends on the extent to which it plays a role in defining the object's identity.

E129

THE AGE OF THE BEHOLDER: ERP EVIDENCE FOR AN OWN-AGE BIAS IN FACE MEMORY *Holger Wiese[1], Kerstin Hansen[1], Stefan R. Schweinberger[1]; [1]Friedrich Schiller University of Jena* – Unfamiliar faces from an observer's own ethnic group are more accurately memorized than other-race faces. This own-race bias has been explained in terms of relatively enhanced perceptual expertise with own- in comparison to other-race faces. Using behavioral and event-related potential (ERP) measures, the present study examined whether similar interactions between the age of stimulus faces and the participants' age occur. In study phases, young (M=22 years) and elderly participants (M=66 years) categorized old and young faces according to stimulus age. Recognition memory for the faces was subsequently tested. Whereas young participants demonstrated enhanced recognition for own-age faces, no corresponding effect was observed in elderly participants. ERPs in the test phases revealed enhanced N170 amplitudes for old in comparison to young faces, probably reflecting more configural processing of young faces. In the subsequent right posterior P2 (200-300 ms), an interaction of face age and participants' age was observed: Whereas young participants demonstrated more positive amplitudes for young in comparison to old faces, this effect was absent in the elderly. Finally, enhanced old/new effects (more positive ERPs to hits than correct rejections) to own-age in comparison to other-age faces were observed in the young participants' waveforms. These findings thus demonstrate an own-age bias to the recognition of unfamiliar faces in young, but not in elderly participants, which is in line with a perceptual learning account of the phenomenon. Asymmetric perceptual experience of young and elderly participants with faces from different age groups may underlie the current results.

E130

BINOCULAR RIVALRY: STRUCTURAL CONNECTIVITY AND A TRULY NONRIVALROUS COMPARISON CONDITION *Juliane C. Wilcke[1], Robert P. O'Shea[3], Richard Watts[1,3]; [1]University of Canterbury, New Zealand, [3]University of Otago, New Zealand, [3]Van der Veer Institute for Parkinson's and Brain Research, Christchurch, New Zealand* – Is there an anatomical network connecting those fronto-parietal areas that several reviews have suggested as necessary for conscious perception? To investigate this question, we used a phenomenon in which visual awareness changes randomly every few seconds without any change in the stimuli shown to the eyes: binocular rivalry. In one experiment, we induced binocular rivalry by showing a red grating to one eye and a green grating of different orientation to the other. Observers pressed keys to signal changes in the perceived colour of the display while undergoing functional magnetic resonance imaging (fMRI). To remove confounding brain activity due to motor reports, we asked observers not to press keys in a second experiment. Here, the rivalling stimuli were green gratings of different orientation, which alternated with blocks of identical stimuli presented to the two eyes, leading to binocular fusion. The fMRI results in our first experiment were consistent with the fronto-parietal activity reported in previous studies of binocular rivalry. Probabilistic tractography based on diffusion tensor imaging data of the same participants showed that most areas associated with perceptual switches during binocular rivalry had direct white matter connections to other activated areas. When we compared binocular rivalry without motor reports to binocular fusion, we found, as expected, no activity related to the key presses, but activity in frontal and parietal areas was again present. Taken together, these findings support the necessity of activity in a fronto-parietal network for changes in visual awareness during binocular rivalry.

E131

ACCUMULATING EVIDENCE FOR AN ACCUMULATOR: AN FMRI STUDY *Drew Erickson[1], Brad Buchsbaum[1], Andrew Kayser[1,2], Mark D'Esposito[1]; [1]University of California, Berkeley, [2]University of California, San Francisco* – How the brain might accumulate evidence for a decision, whether perceptual, mnemonic, or otherwise, has been the subject of a number of recent studies ranging from macaque single-unit recordings to human psychophysics. In many, if not most, of these cases, the data can be explained by a simple model in which evidence for a decision is integrated over time to a threshold, at which point a decision is generated. One brain region in particular, the intraparietal sulcus (IPS), has been implicated by Shadlen and colleagues as an important locus of such "accumulator" activity. In this study, we investigated the signal in the IPS in response to dot displays in which the coherence of dot motion was varied parametrically. We found that the BOLD response in the medial posterior bank of the IPS varied linearly with dot coherence, and that correct and incorrect trials could be differentiated by the magnitude of the IPS signal. In contrast, areas in dorsolateral prefrontal cortex showed an inverse relationship with dot coherence and subject accuracy, suggesting that these regions were required as the perceptual difficulty of the decision increased. Our data support the idea of an accumulator in the IPS, and provide further evidence for the role of more distributed brain areas in such perceptual decision-making tasks.

Poster Session F

Attentional processes: Visual

F1

ABNORMAL VISUAL-SPATIAL ATTENTION IN MIGRAINEURS *Marla J. S. Mickleborough[1], Todd C. Handy[1]; [1]University of British Columbia* – Migraineurs show consistent abnormalities in basic sensory-level visual processing. Specifically, migraineurs do not habituate to repeated innocuous visual stimuli , which means they do not show the normal gradual decrease in the strength of cortical visual sensory response. Given that one of the central roles of executive functioning is to modulate visual-sensory processing via attentional control signals, the specific goal of this project was to examine whether migraineurs show abnormal top-down control of sensory responses in visual cortex as measured via ERPs. We tested four participant cohorts in a canonical spatial cuing task: migraineurs with aura (i.e., visual or somatosensory warning signals that a migraine headache is impending), migraineurs without aura, tension type headache controls, and age-matched non-headache controls. Our data indicate that migraineurs do not show the normal ability to modulate sensory-evoked visual brain responses via spatial attention. In particular, we found that attention related changes in both foveal and parafoveal visual locations differed in migraineurs relative to both control groups, as measured via the P1, N1, and N2 ERP components. Not only does this research indicate that there may be significant neurocognitive abnormalities in migraineurs visual-attentional function, but also that we may need to begin thinking about controlling for migraine states in our "normal" populations.

F2

VISUAL ATTENTION AND PERCEPTION ORGANIZATION *Mariofanna Milanova[1], Tomasz Smolinski[1,2]; [1]University of Arkansas at Little Rock, [2]Emory University* – In recent years, it has become clear that many problems in perception organization are difficult to solve without introducing the contextual information of a visual scene. Subjects often searched for the component feature of a target rather that the target itself, even if the target is a simple geometric form. Another reason for features -driven attention is that this reflects the attempt of the eye to maximize the information it can gather at each fixation. Barlow's hypothesis is that the purpose of early visual processing is to transform the highly redundant sensory input into more efficient factorial code. A perceptual system should be organized to transmit maximum information. At the same time the human visual system has evolved multiple mechanisms for controlling gaze. Tracking can be formulated in a probabilistic framework in both the future- driven and intensity-driven settings. Among existing techniques which make probabilistic treatment possible are principal component analysis (PCA) and independent component analysis (ICA). These techniques do not allow noise to be modeled separately from the signal structure, and they do not permit overcomplete codes in which there are more basis functions than input dimensions. In our proposed model, a sequence of images is described as a linear superposition of space-time functions, each of which is convolved with a time varying coefficient signal. When a sparse, independent representation is sought over the coefficients, the basis functions that emerge are space-time inseparable functions that resemble the motion-selective receptive fields of cortical simple cells. Our approach utilizes a spatio-temporal generative model that can be viewed as an extension of the spatial generate model used by Olshausen and Field , Rao and Ballard .Contrary to previous computational models, results on static images, which gave only filters at the finest possible spatial scale, spatio-temporal analysis yields filters at a range of spatial and temporal scales. Filters centered at low spatial frequencies are generally tuned to faster movement than those at high spatial frequencies. It is shown that performing sparse learning codes on video sequences of natural scenes produces results with qualitatively similar spatio-temporal properties of simple receptive field of neurons. The proposed framework was tested using neurobiological (event related potentials ERP's) and behavioral (eye tracking) data. We also discuss some of the challenging directions for future research.

F3

ROLE OF ATTENTION IN PERCEPTUAL LEARNING *Ikuko Mukai[1], Olivia Wu[1], Leslie Ungerleider[1]; [1]National Institute of Mental Health, NIH, Laboratory of Brain and Cognition* – Results from our previous study (Mukai et al., 2007) suggested an important role for attention in perceptual learning, in that the responses of attention-related areas (IPS, FEF, and SEF): 1) were negatively correlated with behavioral improvement on the task; 2) were initially greater for subjects who subsequently learned compared to those who did not; and 3) showed stronger functional connectivity with early visual areas in subjects who learned. In the current study, we directly examined the relationship between attention and perceptual learning by using a dual task paradigm. In the main perceptual learning task, we used the same contrast discrimination task employed in Mukai et al. (2007), where subjects were trained to detect a fine difference in the contrast of two sine wave gratings. Each trial of this main task was preceded by a rapid serial visual presentation (RSVP) task in which subjects had to identify a white target letter in a temporal string of black letters. Behavioral data showed that subjects improved only by about 10% while performing the dual tasks, compared to the 20% improvement seen in our previous study of perceptual learning using a single task (Mukai et al., 2007). Our findings suggest that depleting attentional resources impedes perceptual learning of the contrast discrimination.

F4

PRIMING BY UNATTENDED FACES: ERP EVIDENCE *Markus F. Neumann[1], Stefan R. Schweinberger[1]; [1]Friedrich-Schiller-University of Jena, Germany* – It is a matter of considerable debate whether attention to initial stimulus presentations is required for repetition-related neural modulations to occur (e.g., Henson et al., 2007, NeuroImage). Recently, event-related potential (ERP) evidence for long-term repetition effects of unattended famous faces has been reported (Neumann et al., 2007, NeuroReport). This finding is in line with the assumption that faces are particularly hard to ignore and tend to capture attention. The present study investigated influences of attention to prime face stimuli on repetition effects in ERPs. We manipulated attention to first-presentations (S1) of task-irrelevant famous faces according to the perceptual load theory (Lavie, 1995, Journal of Experimental Psychology – Human Perception and Performance). Participants attended to letter strings superimposed on face images, and identified target letters "X" vs. "N" in letter strings consisting of either 6 different (high load, e.g. "HXZWMK") or 6 identical letters (low load, e.g. "NNNNNN"). Letter identification was followed (SOA=2000ms) by presentations (S2) of a) identical repetitions of S1 faces, b) new famous faces, or c) butterflies. Participants responded to infrequent butterfly images (~12%) by button press. Our behavioural results showed that S1 load was manipulated successfully (higher accuracies and shorter reaction times for low vs. high load conditions). ERPs to S2 faces, however, revealed comparable repetition effects from 220 ms (N250r) at occipito-temporal regions irrespective of whether S1 face presentation occurred under low or high load conditions. This finding provides further electrophysiological evidence for processing of task-irrelevant faces, even under high perceptual load which usually prevents distractor processing.

F5

ATTENTIONAL MODULATION OF STIMULUS APPEARANCE: ERP EVIDENCE FOR A POSTPERCEPTUAL PROCESS *Michael Niedeggen[1]; [1]Experimental Psychology and Neuropsychology, Free University Berlin, Germany* – Numerous psychophysical studies indicated that a transient visuospatial shift of attention induced by a salient peripheral cue increases the apparent contrast of a target stimulus. Here, a similar cuing paradigm was used to examine the effect of covert attention on the appearance of visual motion coherence: A short sequence of coherence (100 ms) was embedded in two dynamic random dot kinematograms (RDK) presented left and right of a fixation. Subjects had to decide which RDK was apparently defined by a higher level of coherence. The target was preceded by a short reduction in luminance in one RDK serving as a cue (SOA: 100 ms). Psychophysical data revealed that the apparent motion coherence was reduced by an invalid cue (higher coherence in the contralateral RDK), and attenuated by a valid one (higher coherence in the ipsilateral RDK). A corresponding modulation of the event-related brain potentials (ERPs) was obtained in the range of a late cognitive component (P300), but not within the negativity associated with sensory motion processing (N200). Here, invalid cues were found to prolong the time course of sensory processing. The results indicate that reflexive attention does not necessarily enhance a visual signal, and that the corresponding shift in stimulus appearance reflects the activation of a postperceptual process.

F6

A LOWER LOADED HEMISPHERE AIDS IRRELEVANT PROCESSING *Ritsuko Nishimura[1], Kazuhito Yoshizaki[1], Kimiko Kato[1], Takeshi Hatta[2]; [1]Aichi Shukutoku University, [2]Nagoya University* – Our study aimed to investigate whether or not a distractor was processed in the hemisphere which is loaded with the lower perceptual load. This question was motivated by the assumption that each hemisphere has an independent resource. Right-handed 16 participants were asked to discriminate a target letter in briefly presented five task-relevant letters, while ignoring a distractor presented in the periphery outside the task-relevant letters. We manipulated perceptual load of the target (high-load or low-load), presentation mode between a target and a distractor (within- or across-field), and compatibility of a target and a distractor (compatible or incompatible). In the high-load condition, a target and three non-target letters were presented in either left (LVF) or right visual-field (RVF) and a non-target letter was presented in the opposite visual-field. In the low-load condition, a target was presented in either LVF or RVF and four non-target letters were presented in the opposite visual-field. In the within-field condition, the target and the distractor were presented in the same visual-field. By contrast, in the across-field condition, they were presented in the divided visual-fields. Results showed that in the low-load condition the compatibility effect was larger in the within-field condition than in the across-field condition. On the contrary in the high-load condition, the compatibility effect was larger in the across-field than in the within-field condition. These results suggested that the distractor was processed in the hemisphere which was loaded with lower perceptual load, irrespective of the presentation mode.

F7

TEMPORAL EXPECTANCY INFLUENCES ORIENTING IN TIME BUT NOT THE TIME COURSE OF ORIENTING IN SPACE *Nathan Parks[1], Paul Corballis[1]; [1]Georgia Tech* – It has long been known that attention may be oriented to regions of visual space. More recently, it has been proposed that attention may also be directed to instants in time. That is, an endogenous cue of attention may carry information regarding the temporal validity of an upcoming target. In the case of both spatial and temporal orienting, endogenous cues must be informative and the cue-target validity of these cues must be learned. We wondered whether the time course of spatial orienting is learned and is dependent on the temporal validity of endogenous spatial cues. We examined interactions between temporal orienting and the time course of spatial attention by biasing cue-target stimulus onset asynchrony (SOA) in an endogenous spatial attention paradigm. Subjects (N=72) performed an endogenous spatial cuing task (75% validity) with cue-target SOAs 100, 200, 300, 400, 500, 600, or 700 ms. The temporal validity of spatial cues was manipulated between groups by weighting the occurrence of one SOA over the others. In the three groups (N=24), the validity of 100, 400, or 700 ms was manipulated by weighting the corresponding SOA to occur 40% of the time versus the 10% occurrence of each remaining SOA. Simple reaction time data were examined for interactions between spatial and temporal orienting. There were significant within-subjects effects of spatial orienting and significant between-subjects effects of temporal orienting, but no interaction between the two. Results are consistent with the idea that spatial and temporal orienting operate via separable mechanisms.

F8

BEHAVIORAL AND ELECTROPHYSIOLOGICAL LINKS BETWEEN DRD4 AND ATTENTION ORIENTING IN CHILDREN *Koraly Perez-Edgar[1], Nathan Fox[2], Louis Schmidt[3]; [1]George Mason University, [2]University of Maryland, College Park, [3]McMaster University* – Numerous studies have shown that the D4 dopamine receptors (DRD4s) play important roles in attentional and motivational processes. With children, much of the focus has been on Attention-Deficit/Hyperactivity Disorder (ADHD). Less work has focused on the role of DRD4 in normal development. In the current study, we examined the links between DRD4 allelic status and performance in a standard measure of attention orienting, the Posner cued-attention paradigm, in 7-year-old children. Building on previous work, the Posner task was modified to include a baseline, affect-neutral, condition and a second condition completed in an emotionally-charged environment. The impact of this manipulation on attention orienting was examined using behavioral (RT) and psychophysiological (ERP) measures. The children with the long-allele (LA) were significantly slower in the task than their peers in the short-allele (SA) group, $F(1, 47)=8.57$, $p<.01$. The LA group was particularly slow when presented with invalidly cued trials, $F(1, 47)=6.59$, $p=.01$, across both neutral and affective conditions. For the N1 component, children in the SA group showed the expected validity effect, which increased from the neutral to affective Posner condition. However, the LA group displayed a decrease in the validity effect across conditions, $F(1, 43)=4.85$, $p=.03$. For N2, the LA group had smaller peak amplitudes and failed to show the validity effect in the affective task, $F(1, 43)=7.61$, $p=.01$. The data indicate that children with the long allele have greater difficulty with basic attention-orienting processes, perhaps contributing to the link between DRD4 and attention problems, including ADHD.

F9

MENTAL IMAGERY AND VISUAL PERCEPTION OF THE MENTAL NUMBER LINE *Lorenzo Pia[1,2], Alessia Folegatti[1], Marco Neppi-Mòdona[1,2], Luigi Cremasco[3], Lucia Spinazzola[1,4], Patrizia Gindri[5]; [1]University of Turin, [2]Neuroscience Institute of Turin (NIT), University of Turin, [3]Fondazione Don Carlo e Centro Santa Maria ai Colli, Turin, [4]Hospital Company S. Antonio Abate, Gallarate, [5]San Camillo Hospital, Turin* – It has been suggested a relationship between spatial thinking and number representation, such that numbers are represented along a continuous, left-to-right mental number line with smaller quantities located to the left of larger ones. Some evidence comes from the joint deficits of space and numbers processing in left-neglect patients. These patients, when required to indicate which number is halfway between two orally presented numbers that define a numerical interval, may displace the midpoint progressively rightwards as the interval grows. This raises the question of whether shifting attention within a mental representation produces a corresponding attentional shift in the visual field, and vice-versa. To address this question, we selected 10 neglect patients with the aforementioned pattern of numerical error. The same numerical intervals were then employed in a "numerical-endpoint task" that consisted of two conditions: 1) Marking the midpoint of the empty space enclosed between two numerical extremes; 2) Same as 1), but now patients were asked to mark the midpoint by writing down the number that is numerically halfway between the two numerical extremes. The results indicate that the size of numerical intervals equally influenced the rightward numerical bias in the number bisection and in the "numerical-endpoint" tasks. The same was not true for spatial bias (defined as the position of the bisector number): in this case no modulation by the size of the numerical interval was present. These results suggest that attention shift across internal spatial representation and external space might be underpinned by (at least some) different mechanisms.

F10

THE INFLUENCE OF REWARD AND PUNISHMENT ON ATTENTION: EVIDENCE USING ERPS *Nikki Pratt[1], Dennis Molfese[1]; [1]University of Louisville* – Event-related potentials (ERPs) investigated the influence of motivation and expectation on the neural processes involved in selective visual attention. The research design was adapted from Derryberry & Reed's (1994) paradigm. Cues preceded target location in peripheral boxes that contained positive or negative incentives. Points were awarded for a fast response in the positive incentive box and subtracted for a slow response in the negative incentive box. The electrophysiological recordings utilized a 256-hydrocel electrode net to investigate valid and invalid targets in positive and negative boxes. The current analysis examined the ERP to targets with cues predicting target location in 80% of the trials. Preliminary results indicated that the P1 in the occipitotemporal region generated a larger response to trials with congruent cue and target locations. This was enhanced for targets that appeared in the negative incentive box. The N1 in the occipitotemporal region generated a larger response to incongruent cue and target locations. Specifically, a greater N1 response occurred to invalid targets in the negative incentive box. A cue presented in the positive incentive box followed by a target in the negative incentive box generated the largest N1. The results suggest that early selective attention in the occipital cortex is influenced by motivation as well as target validity.

F11

THE RIGHT TIME AND THE LEFT TIME: SPATIAL ASSOCIATIONS OF ENDOGENOUS TEMPORAL CUES AFFECT TARGET DETECTION IN RIGHT BRAIN-DAMAGED PATIENTS *Carson Pun[1], Maha Adamo[1], Ulrich W. Weger[2], Sandra E. Black[3], Susanne Ferber[1]; [1]University of Toronto, Canada, [2]Keynes College, University of Kent, Canterbury, United Kingdom., [3]L.C. Campbell Cognitive Neurology Research Unit, Neurosciences Research, Sunnybrook Health Sciences Centre, Canada* – Right brain-damaged patients have slowed reaction times in detecting visual targets presented on the contralesional (left) side of space when a prior cue is presented on the ipsilesional (right) side. Typically, the types of cues used to demonstrate this are sudden onsets in the periphery leading to exogenous shifts in attention. The role of endogenous cues, however, is still unclear. Some studies have shown that endogenous processes can be relatively intact after right brain damage, though generally slowed. We tested stroke patients with right hemisphere lesions on a spatio-temporal cueing task to see whether spatial associations of endogenous temporal cues would elicit the same cognitive deficits as do typical exogenous cues. An association between the representation of time and space has been found in healthy subjects using a spatio-temporal cueing task with centrally presented time words, such as "yesterday" or "future." Such time cues are mapped onto a mental timeline that holds temporally earlier events on the left side of space and temporally later events on the right side. We administered a spatio-temporal cueing task to right brain-damaged patients and manipulated the spatial validity of a target following the central presentation of a time word. Our patients demonstrated the greatest disengagement deficit for targets presented on the contralesional side of space when the centrally presented time word cued them to the ipsilesional side. Our results indicate that the deficit in disengaging from invalidly cued locations persists for endogenous cues that elicit spatial mental representations.

F12

ATTENTION PLAYS A ROLE IN SUBITIZING: AN INATTENTIONAL BLINDNESS STUDY *Henry Railo[1,2], Mika Koivisto[1,2], Antti Revonsuo[1,2,3] Minna M. Hannula[1,4]; [1]University of Turku, Finland, [2]Centre for Cognitive Neuroscience, University of Turku, Finland, [3]School of Humanities and Informatics, University of Skövde, Sweden, [4]Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University* – Subitizing refers to the effortless process of enumerating small numbers of items. Whether subitizing rests purely on parallel preattentive processeses, or, is actually an attention demanding process, has been debated previously. Previous studies that have examined the attentional requirements of subitizing have based their conclusions on conditions where the participants have explicitly attended on the task of enumeration and attention has been focused on the item location. Enumeration latencies have also been shown to increase already in the subitizing range, suggesting that some serial, attentional components may be involved. The present study is the first that directly contrasts the preattentive and the attentive models of subitizing. We used inattentional blindness paradigm to test whether enumeration is possible when the effects of attention are minimized by presenting the items unexpectedly while the participants were focusing on another task. Divided- and full-attention conditions were also included. The results showed that only numbers one and two could be enumerated under inattention, that is, when the effects of attention were minimized. Moreover, freeing attentional resources in the divided- and full-attention conditions increased the enumeration accuracies considerably, including for number two. Thus, the results suggest that even for enumerating small numbers, the attentional demands increase as the number of objects increases.

F13

EVENT-RELATED POTENTIAL INDICES OF ASYMMETRIES IN ATTENTIONAL GRADIENTS *John C. Richiedei[1], William Bush[1], Lisa D. Sanders[1], Kyle Cave[1]; [1]University of Massachusetts, Amherst* – Previous evidence suggests that if the possible locations of stimulus presentation are delineated, spatial attention affects processing in a graded manner. Specifically, stimuli presented close to cued regions elicit larger visual evoked potentials (VEPs) than those presented farther away. However, both position in the visual field and allocation of attention may contribute to the observed gradients. These relative contributions can be distinguished by comparing responses on physically identical trials when attention is directed to locations at various distances from the stimuli. In the current study, participants attended to one of 12 squares arranged in a circle around fixation. Letters appeared individually, each in one of the squares; 80% were O's (standards) and 20% were X's (deviants). Participants pressed a button when an X appeared at the attended location. VEPs elicited by standards showed evidence of asymmetric attentional gradients. Specifically, the largest amplitude N1s were observed when participants attended to the location where a standard was presented. Responses were also larger to standards when attention was directly above the stimulus compared to when it was directly below. However, all of these conditions resulted in larger amplitude N1s than when participants were attending to more distant locations. These results confirm that attention can be applied to visual processing in a spatial gradient and reveal its asymmetric distribution.

F14

DEFICITS IN EARLY DETECTION AND DISCRIMINATION PROCESSES OF ATTENTION DURING NICOTINE ABSTINENCE *Anthony Rissling[1], Dana Smith[1], Irene Yang[1], Michael Dawson[1], Anne Schell[2], Keith Nuechterlein[3]; [1]University of Southern California, [2]Occidental College, [3]University of California Los Angeles* – Impaired performance during continuous performance tasks (CPTs) has been reliably reported in smokers following nicotine abstinence when compared to nicotine intake. However, the specific processes of attention that account for the overall changes in performance are not well understood. Furthermore, it remains unresolved whether such changes are due to a withdrawal relief or a facilitation effect of nicotine. Signal detection indices were measured during three CPTs following both smoking and overnight abstinence among 29 student smokers to measure the effects of smoking on the early processes (detection, discrimination) and later process (vigilance). A group of 39 nonsmokers were tested twice without nicotine manipulation. Subjects responded whenever they saw the digit "0" in three CPTs: (1) with visually degraded stimuli and an SOA paced by the subject, (2) visually degraded stimuli with a fixed 1s SOA, (3) clear (non-degraded) stimuli with a 1s fixed SOA. Abstinence among smokers produced reliably lower vigilance performance compared to ad lib smoking in the two degraded tasks. However, there were no differences between smokers smoking and nonsmokers, suggesting a relief of withdrawal effect. The results indicate that smoking abstinence affects the early stages of stimulus processing (detection, discrimination) but not the maintenance of attention (vigilance) in tasks that put a heavy burden on early perceptual processing. However, nicotine abstinence does not affect either early or late processes in tasks with a low cognitive load.

F15

IN THE BLINK OF AN EYE: REFLEXIVE ORIENTING TRIGGERED BY NONPREDICTIVE EYE GAZE DIRECTION MODULATES THE ATTENTIONAL BLINK. *Jelena Ristic[1], Barry Giesbrecht[1]; [1]University of California Santa Barbara* – In the past decade several studies argued that nonpredictive eye direction elicits strongly reflexive attentional orienting. We tested this notion by examining the influence of a nonpredictive central gaze cue on the magnitude of the attentional blink (AB). The AB is a deficit in the report of a second target (T2) that follows a correctly identified first target (T1) within 200-500 ms. If orienting to gaze direction is reflexive, then the AB should be attenuated when T2 appears at a gazed-at location. Participants were asked to report the identity of two masked letters, presented randomly on either left or right side of a central fixation face, separated by 320 or 800 ms. The nonpredictive gaze cue, which looked equiprobably to the left, right or straight ahead, was presented between 0 and 160 ms before the onset of T2. The results indicated that there was an effect of lag, indicative of an AB. The results also indicated that both overall performance and the magnitude of the lag effect decreased as cue-T2 interval increased. Importantly, these effects were only present when T2 appeared at a gazed-at location. Together the combined effects of lag and gaze cue-T2 delay suggest that (i) in agreement with the notion that gaze direction elicits reflexive orienting, the AB is modulated by reflexive orienting to gaze direction, and/or (ii) the overall performance deficit reflects a difficulty in disengaging attention from the central gaze cue.

F16

ATTENTIONAL BIAS TO STIMULUS FEATURE MODULATES ATTENTIONAL ALLOCATION FOR BOTTOM-UP DEVIATION *Risa Sawaki[1,2], Jun'ichi Katayama[3]; [1]Graduate School of Education, Hokkaido University, [2]Japan Society for the Promotion of Science, [3]Faculty of Education, Hokkaido University* – Top-down direction of attention to a stimulus feature facilitates processing of not only the attended, but also the unattended features of the same object. However, it is unclear whether this attentional bias to stimulus features modulates processing of bottom-up deviations. We investigated this issue by using event-related brain potentials (ERPs). In this paradigm, target (50 %) and non-target (50 %) objects were defined by a stimulus feature (shape; circle or triangle) and they were serially presented at a central location in random order. In the change condition, stimulus color and size were infrequently changed in the target or non-target object. In the appearance condition, distractor objects appeared infrequently around either of the objects. Participants were asked to respond to the target object, regardless of task-irrelevant deviation. For both conditions, reaction time for the target and P3 ERP response for the target and non-target trials were increased by the change or appearance deviation. This deviant effect on P3 was larger for target than for non-target trials in the change condition. In contrast, it was smaller for target than for non-target trials in the appearance condition. These results demonstrated that the attentional bias to stimulus features of objects modulates processing of bottom-up deviations; attentional allocation for deviations was enhanced in objects with the attended stimulus feature whereas it was inhibited for distractors which appeared around the objects. This modulation suggests that the attentional bias to stimulus features of objects provides a competitive advantage for the objects in both bottom-up and top-down processing.

F17

IS SPATIAL ATTENTION NEEDED TO EXTRACT MEANING FROM WORDS? EVIDENCE FROM ELECTROPHYSIOLOGY *Amanda Scott[1], Mei-Ching Lien[1], Eric Ruthruff[2], Joel Lachter[3]; [1]Oregon State University, [2]University of New Mexico, [3]NASA Ames Research Center* – Do we need to attend visual words in order to identify them and extract meaning? Recent behavioral studies have shown that unattended prime words do not influence responses to a target (e.g., "dog" fails to prime "DOG"; Lachter, Forster & Ruthruff, 2004). This finding suggests that word identification does not occur without spatial attention. A viable alternative explanation, however, is that unattended words are fully identified, but somehow fail to influence response processes. To test this hypothesis, we used a more direct measure of word processing: the N400 component of the event-related potential (ERP). The N400 effect is the difference in ERPs between words that match and mismatch the current semantic context (known as mismatch negativity). Only identified words processed up to the semantic level can produce a significant N400 effect. This effect thus provides a highly specific, continuous index of semantic activation from a word. We used a spatial cuing paradigm, in which cued (attended) words and non-cued (non-attended) words could match or mismatch the semantic context. We found an N400 effect only for cued words, suggesting that spatial attention is critical for semantic activation from a visual word.

F18

THE EFFECT OF EMOTIONAL CONVERSATION ON VISUAL DETECTION DURING SIMULATED DRIVING: A BEHAVIORAL STUDY *Sean Seaman[1], Li Hsieh[1], Richard Young[2]; [1]Wayne State University, [2]School of Medicine, Wayne State University* – We present an investigation into multitask processing, using an ecologically valid task: a simulation of driving while engaging in a hands-free cellular conversation. We employed a validated event-detection paradigm with lane-tracking to measure driving performance. Specifically, we look at what factors influence multitasking performance; in this case, we investigated emotional prosody. We compared the RT differences among three conditions of multitasking situations: driving without cellular conversations, driving with cellular conversations spoken in a neutral tone, driving with cellular conversations spoken in an angry tone. 20 participants viewed a video recording of a driving scene while using a foot pedal to respond to visual events occurring in the periphery of the display. Lane-tracking, using a steering wheel, was employed to ensure participants were engaged with viewing the driving video. Behavioral analyses based on 20 subjects showed the expected pattern of events occurring during concurrent conversations while driving being associated with slightly longer RTs than those events during driving without conversation. One-way ANOVA analysis showed a significant condition effect at $p<0.05$. However, this effect was moderated by the emotional tone of the conversation; events occurring during angry conversations were responded to significantly faster than events occurring during neutral conversations, and were only marginally slower than events occurring in absence of conversation. Preliminary results in this study suggest that emotional conversation may have some influence on visual detection during simulated driving.

F19

SALIENCE ENCODING OVER TIME IN HEMISPATIAL NEGLECT *Victoria Singh-Curry[1,2], Masud Husain[1,2]; [1]Institute of Cognitive Neuroscience, University College London, [2]Institute of Neurology, University College London* – Evidence from functional imaging studies points to a crucial role for right inferior parietal and frontal structures in detecting salient items and sustaining attention. We hypothesized that impairments in detecting salient items over time may interact with spatial deficits in the neglect syndrome. Right-hemisphere neglect patients were compared to stroke controls and healthy individuals. Stimuli were presented either centrally, or just left or right of fixation. Participants responded to targets of high or low salience, but had to withhold responses to non-targets. We also evaluated the effect of alerting tones on performance. Neglect patients demonstrated reduced response sensitivity which deteriorated with time, even for central stimuli. Importantly, target salience and location interacted with the ability to sustain attention, such that low salience stimuli to the left were more likely to be missed over time. An alerting tone improved performance to central, as well as left-sided stimuli, particularly those of low salience. While deficits in encoding salience, sustaining attention and spatial attention were associated with lesioned fronto-parietal voxels, the greatest benefit from an alerting tone was associated with damage to frontal cortex. In summary, neglect patients have deficits in sustaining attention, with performance modulated by both target salience and location. These components of neglect are associated with damage to specific sub-regions of right parietal and frontal cortex. Alerting stimuli ameliorate some of these deficits, particularly in patients with right frontal lesions. Interacting fronto-parietal networks for salience encoding, sustaining and directing spatial attention underlie the cognitive deficits in the neglect syndrome.

F20

AGING, SUSTAINED ATTENTION, AND MIND WANDERING *Daniel Smilek[1], J. Allan Cheyne[1], Grayden J. F. Solman[1], Jonathan S. A. Carriere[1]; [1]University of Waterloo* – As individuals age they report less mind wandering. Consistent with these reports, older individuals make fewer errors than younger individuals on the Sustained Attention to Response Task (SART), known to be associated with mind wandering. Specifically, speeding of RTs on the SART is an index of mind wandering, which leads to SART errors. On this task, older individuals show slower RTs than younger individuals and the age difference in RTs completely explains age difference in errors. The present report examined RTs for trials immediately preceding and following SART errors in 504 subjects aged 14-63. A common SART finding is a slowing of RTs following errors, suggesting increased attention to task in response to errors. Consistent with this, we found a marked increase in RTs following SART errors, but only for older individuals (age 25 being the break-point), this slowing persisting until the early 60s. Adolescents and young adults showed no evidence of slowing following errors. Older subjects appear to have been brought on-task following an error, whereas younger subjects remain off-task. Older individuals may engage in less mind wandering because they are more readily brought back on task because of sensitivity to the quality of task performance. This is consistent with findings that, at equivalent SART performance levels, older adults show greater pre-SMA and ACC activation, the latter having been previously associated with greater post-error slowing, and interpreted as reflecting greater error monitoring. Such age difference may be related to late PFC white matter development and/or compensatory additional cortical recruitment.

F21

EFFECTS OF AGE AND FOCAL BRAIN INJURY ON VISUOSPATIAL ATTENTION IN CHILDREN *Sabrina Smith[1,2,3], Gray Vargas[1], Anjan Chatterjee[2,3]; [1]Division of Neurology, Children's Hospital of Philadelphia, [2]University of Pennsylvania School of Medicine, [3]Center for Cognitive Neuroscience* – Visuospatial neglect is well-characterized in adults and has been reported in children. While visuospatial attention becomes more developed during childhood, the effects of age on visuospatial neglect in children are not known. The purpose of this study was to evaluate how chronic focal brain injury affects visuospatial attention in children of different ages. Fifty children (2-18 years) with chronic unilateral focal brain injury (subjects) and 130 healthy children (controls) were assessed using line bisection, cancellation, pre-attentive visual search and attentive visual search. Brain-injured subjects with visuospatial deficits were identified using age-appropriate (2-4 y, 5-6 y, 7-8 y, 9-12 y, 13-18 y) Z-scores. 15/50 subjects showed neglect on line bisection (mean age 7.1 years), 4/45 on cancellation (mean age 8.0 years), 4/43 showed slower contralesional reaction times on pre-attentive visual search (mean age 10.0 years) and 8/42 on attentive visual search (mean age 12.6 years). There was no significant difference in frequency of neglect based on hemisphere of injury. Line bisection accuracy improved as subjects and controls got older. Brain-injured children ages 5-12 years were more variable on line bisection than controls. Older control and left brain-injured subjects were more likely to orient to the left of cancellation arrays than younger subjects, an effect not seen in right brain-injured subjects. In conclusion, line bisection tasks are relatively sensitive in assessing neglect in children. Even when taking account of normal variability in performance, detection of lateralized and non-lateralized deficits of attention in brain-injured children varies with age.

F22

EVENT-RELATED POTENTIAL CORRELATES OF ATTENTIONAL CAPTURE BY VISUAL MOTION *Matthew Tata[1], Aja Mason[2], Nazia Alam[1], Andrew Butcher[1], Gregory Christie[1]; [1]The University of Lethbridge, [2]The University of Victoria* – The human visual pathways include regions in extrastriate visual cortex that are sensitive to motion in the visual field. An onset, acceleration and/or change in direction of motion triggers activity in this area, and that activity can be modulated by the attentional set of the viewer. Motion can also reflexively change the viewer's attentional set, leading to complex interactions. In a recent study we investigated attentional modulation of the Event-Related Potential (ERP) elicited by reversals in the directions of coherently moving dots. We found that such reversals elicited a robust Event-Related Potential peak at 200 ms latency. Furthermore, attention directed to a field of interspersed stationary dots led to an unexpected enhancement of this peak. We hypothesized that this ERP component might reflect a reflexive perceptual re-segregation of the moving dots into a coherent sheet with each reversal. In the present study we tested this hypothesis by comparing reversal-evoked ERPs when the dots were 100% radially coherent (i.e. toward and away from fixation) and 0% coherent. We predicted that random motion should reduce the saliency of the moving dots and thus reduce or eliminate the 200 ms component. The data fit this prediction and support the hypothesis that the 200 ms peak is associated with the reflexive orienting of attention in response to salient visual motion.

F23

EVIDENCE SUGGESTING A FUNCTIONAL-ANATOMIC ORGANIZATION OF PARIETAL CORTEX DURING ATTENTIONAL CONTROL *Preston P. Thakral[1], Scott D. Slotnick[1]; [1]Boston College* – The control of spatial attention – shifting attention between visual field locations or sustaining attention at one location – involves the prefrontal cortex and parietal cortex. Within the parietal cortex, shifting attention has been linked to the superior parietal lobule, while the neural substrates associated with sustained attention are under active investigation. The present fMRI study aimed to identify the cortical regions associated with sustained attention during two different protocols (to obtain stimulus independent results). While maintaining central fixation, participants viewed a moving dot stimulus or a flickering checkerboard stimulus. Both protocols alternated between sustained periods of attention to motion/flicker (with a detection task), perception of motion/flicker, and perception of stationary stimuli. To confirm differential stimulus processing, a region-of-interest analysis was conducted to assess attention and perception effects in motion processing region MT+. A conjunction analysis was used to examine the neural regions associated with sustained attention (commonly active for both stimulus types). Supporting previous results, sustained attention was associated with activity in the middle frontal gyrus and intraparietal sulcus. The present and previous findings suggest a functional-anatomic organization of parietal cortex, where shifts in attention are mediated by superior regions and sustained attention is mediated by more lateral regions.

F24

INHIBITION OF RETURN AFTER DAMAGE TO THE FRONTAL EYE FIELDS *Michel Thiebaut de Schotten[1], Richard Levy[1], Hugues Duffau[2], Paolo Bartolomeo[1]; [1]INSERM-UPMC UMRS 610, Paris, [2]CHU Montpellier, France* – When two visual events appear consecutively in the same spatial location, normal subjects' response to the second event is slower than that to the first, an effect known as inhibition of return (IOR). Ro et al. [Exp. Brain Res. 150 (2003) 290-296], using transcranial magnetic stimulation (TMS) over the right frontal eye field (FEF), were able to decrease IOR for targets occurring on the stimulated side. Here we present evidence from 10 patients who underwent restricted resections of prefrontal cortex (including the FEF) for low-grade gliomas and six age-matched controls. Resections were in the right hemisphere for 4 patients, in the left hemisphere for 6 patients. We employed a cue-target detection task with non-predictive peripheral cues, and 150, 550 or 1,000-ms stimulus-onset asynchronies (SOAs). Trials in which an eye movement occurred and RTs below 150ms or above 1500ms were discarded from analysis. A repeated-measures analysis of variance with group as between subjects factors and cue validity, target side and SOA as within-subjects factors revealed an interaction between all the factors, $F(4, 26) = 4.53$; $P = 0.007$. As expected, controls showed IOR starting from 550-ms SOA. Patients, however, demonstrated no IOR at 550-ms SOA, consistent with the TMS results. IOR was present at longer SOAs for ipsilesional targets in right-brain damaged patients and for contralesional targets in left-brain damaged patients. These results suggest that both the right and the left FEF play an important role in the generation of an orienting component of IOR.

F25

USING FREQUENCY TAGGING TO INVESTIGATE THE NEUROCORRELATES OF DIVIDED ATTENTION *Paolo Toffanin[1], Sander Martens[1], Ritske de Jong[2], Addie Johnson[2]; [1]BCN-NeuroImaging Center, University Medical Center Groningen, Groningen, The Netherlands, [2]University of Groningen, Groningen, The Netherlands* – Frequency tagging is an EEG method to investigate the neural mechanisms of spatial attention and the competition for resources of simultaneously displayed stimuli. The method is based on the steady state evoked potentials (SSEPs) elicited from stimuli which flicker with different frequencies. The SSEP response changes according to the attentional condition (attend or ignore one of the stimuli). The attended stimuli elicit larger amplitudes SSEPs than do ignored stimuli. In other words, attention modulates the SSEP power, and the changes in SSEP reflect a mechanism of attentional switch to the relevant stimulation. In this experiment, resource competition between simultaneously displayed items was measured comparing a divided versus a focus attention condition. Two squares, at the left and right of fixation, were tagged with different frequencies while participants performed a detection task (respond to the digit 5 embedded in an alphanumeric stream of characters superimposed on each square). At the beginning of the trial a cue indicated which side to attend: left, right, or both. Behavioral results showed that the divided attention condition is more taxing then the focus attention condition. The electrophysiological response to the frequency tagging showed an enhanced SSEP during the focused attention condition and also during the divided attention condition. The dynamics of the enhanced neural processing during divided attention conditions reflect the competition for resources between stimuli. Future research will focus on the temporal and topographical dynamics of the resource competition, and investigate the possible role of frequency tagging in enhancing or reducing task performance.

F26

TOP-DOWN & BOTTOM-UP REGULATION OF FEATURE PRIORITIZATION IN COMPARATIVE VISUAL SEARCH *Michelle Umali[1], Marc Pomplun[1], Joy Hirsch[2]; [1]fMRI Research Center, Center for Neurobiology and Behavior, Columbia University, New York, [2]University of Massachusetts-Boston* – According to the Guided Search theory, pre-attentive parallel processes almost instantaneously guide search along the most informative stimulus dimension, making it difficult to observe the top-down and stimulus-driven mechanisms of feature prioritization,. In this fMRI and eye-tracking study, we employed the Comparative Visual Search task which requires repeated assessment of feature relevance based on local information content in the display. Healthy subjects (n=7, 4F) indicated whether two side-by-side distributions of assorted colors and shapes were identical or contained an item of discrepancy differing in either color or shape. Top-down attentional guidance was assessed by comparing a condition in which subjects were previously told the dimension of the mismatch (color or shape) to that in which they received no information. Prior knowledge had no beneficial behavioral effects in identifying shape mismatches, despite increased ventral stream activation. However, search for color mismatches led to longer fixations, fewer gaze switches between the display halves, and shorter response times. In addition, greater activation in the anterior cingulate, a region implicated in motivated attention and error detection was observed. This inequality suggests that top-down guidance is more effective in processing low rather than high-level features. Stimulus-driven guidance was studied by eliminating variation in the irrelevant dimension, i.e., by showing only objects of one color during shape search and vice versa. This manipulation had no behavioral or relevant neurophysiological effects for either color or shape mismatches, suggesting that bottom-up influences cannot further reduce perceptual interference of irrelevant features at any stage in the visual processing hierarchy.

F27

ATTENTIONAL SELECTION IN VISION: AN ERP STUDY ON HIERARCHY IN FEATURE SPACE *Vinod K. Unni[1], Kim M. W. Verhoef[1], Peter A. van der Helm[1]; [1]Radboud University Nijmegen* – The reverse hierarchy theory (RHT) postulates different functional roles for feedforward and feedback pathways in the human visual system. The feedforward pathway serves to encode stimulus properties in a hierarchy of receptive fields, going from V1 cells with small receptive fields to higher cortical cells with large receptive fields. Later, starting at the higher areas with coarse stimulus representations, the feedback pathway serves to direct attention back to lower areas to access individual stimulus properties. Hence, according to RHT, attention is deployed in a hierarchy defined in spatial terms. In this study we used the N2pc which has been shown to be especially sensitive to deployment of visualspatial attention to investigate the relevance of an alternative account of hierarchy, namely hierarchy in terms of features. ERPs were recorded when participants had to detect one of three features in a modified spatial cuing paradigm. Stimuli consisted of three nested features (shape: circle or square; color: red or green; and orientation: grating oriented left-oblique or right-oblique). The physical stimulus was the same across conditions but the deployment of attention differed for three feature conditions. For the orientation condition reaction times (RTs) were longer compared to the shape and color conditions. For the early N2pc with a latency of 180-240 ms a significant amplitude increase was found at P07/P08 for the orientation compared to the color and shape condition. Thus a similar pattern was observed for ERP and RT data. This suggests an attentional selection bias due to a hierarchy in feature space.

F28

DISTINCT AND COMMON NEURAL RESPONSES TO UNEXPECTED LOCATION AND FEATURE CHANGES IN THE LOCATION-CUEING PARADIGM *Simone Vossel[1,2], Ralph Weidner[1,2], Christiane M. Thiel[3], Gereon R. Fink[1,2,4]; [1]Institute of Neuroscience and Biophysics - Medicine, Research Centre Jülich, Jülich, Germany, [2]Brain Imaging*

Centre West, Research Centre, Jülich, Germany, [3]Institute of Biology and Environmental Sciences, University of Oldenburg, Germany, [4]University Hospital Cologne, Germany – Within parietal cortex the temporo-parietal junction (TPJ) and the intraparietal sulcus (IPS) seem to be involved in both spatial and non-spatial functions: Both areas are activated when misleading information is provided by invalid spatial cues in Posner's location-cueing paradigm, but also when infrequent deviant stimuli are presented within a series of standard events. In the present study elements of an oddball paradigm were included within the context of a location-cueing paradigm. Functional magnetic resonance imaging (fMRI) was used to dissociate the neural correlates of visuospatial attentional reorienting and visual oddball distraction as well as to reveal shared neural processes. Twenty subjects were investigated. The fMRI results are reported at $p<.05$ corrected at cluster-level. Both invalid spatial cueing and the occurrence of deviant targets resulted in a significant slowing of reaction times. Bilateral TPJ and right superior parietal lobe (SPL) activation was observed in response to invalidly as compared to validly cued targets. In contrast, bilateral inferior occipito-temporal cortex, left inferior parietal cortex, right frontal areas and the cerebellum showed stronger activation in response to deviant than to standard targets. Common activations were observed in the right angular gyrus along the IPS and the right inferior frontal gyrus. The data show that the superior parietal and temporo-parietal activations observed here as well as previously in location-cueing paradigms do not merely reflect the detection and processing of unexpected stimuli. Furthermore, the right IPS and inferior frontal gyrus are involved in attentional selection and distractor processing of both spatial and non-spatial features.

F29

ASYMMETRICAL TRAINING EFFECTS OF REPETITIVE STIMULI REPRESENTATION *Peng Wang[1], Tiangang Zhou[1], Siyuan Hu[1], Silu Fan[1], Xiaoming Du[1], Lin Chen[1], Yan Zhuo[1]; [1]Institute of Biophysics, Chinese Academy of Sciences* – When subjects were exposed to repeated stimuli, two possible consequences may be observed. One is that they became less sensitive to the stimuli, which was referred as adaptation. The other one is that they respond more efficiently, which was regarded as learning effects. It would be an interesting to investigate the relation of the two apparently contrary phenomena and the neural mechanism underlying them. In our study, both behavioral and EEG data were recorded when subjects were performing perceptual tasks for days. We found the performance keep improving either within days (between sessions) or between days, for the first several days. But in later days, the performance may still improve between days, but may remain or even became worse within days. This suggests possible isolation of adaptation and learning behaviorally. However, in the ERP data, the N1 components decreased with training even in the first training day, comparing with its increase between days in one task. Besides this "pattern asymmetry" of within-day and between-day, "task asymmetry" was also observed. The N1 component evoked by the target condition in another task did not have obvious decrease within the first day in the "triangle task", though the physical stimuli and training paradigm was totally identical. To give a satisfying interpretation and seek for the underlying neural substrates, further analysis is still going on.

F30

DYNAMICS OF THE LOCUS COERULEUS-NOREPINEPHRINE SYSTEM PREDICT EXTENDED SPARING IN THE ATTENTIONAL BLINK *Christopher Warren[1], Daniel Fiset[1], Caroline Blais[2], Justin Kantner[1], Andreas Breuer[1], Mike Masson[1]; [1]University of Victoria, [2]University of Montreal* – This research supports the theory that the locus coeruleus – norephinephrine system (LC-NE) is the neurophysiological basis of the attentional blink (AB). The AB refers to decreased accuracy for reporting the second of two targets (T1 and T2) inserted into a rapid serial visual presentation (RSVP). Findings that an AB is not observed when three targets are inserted consecutively in an RSVP have been held as evidence against the LC-NE theory. However, in these experiments, accuracy for identifying T1 is decreased. We demonstrate that when the difficulty of identifying T1 is manipulated, by shortening the time between T1 and the subsequent item or by lowering the contrast of T1, the ensuing period of attentional deficit is delayed. We describe how the effect of T1 difficulty on the AB is predicted by the LC-NE theory.

F31

OPPOSITE VERTICAL ASYMMETRIES FOR OVERT AND COVERT ORIENTING IN HUMANS *David Westwood[1], Kristin Greenlaw[2]; [1]School of Health and Human Performance, Dalhousie University, [2]Dalhousie University* – Visual stimuli can be selected for elaborated processing through overt (i.e., moving the eyes to the target) or covert (i.e., moving attention, but not the eyes) orienting. There has been considerable debate about the degree of overlap between overt and covert orienting, with convincing evidence in favor of opposing points of view. Building on past research on vertical asymmetries in visual processing, we used a cue-target task (SOA range: 150-450 ms) with cues and targets in the upper and lower visual fields to compare vertical asymmetries in overt and covert orienting. The location of the peripheral visual cue was not correlated with the location of the target (30% valid, 30% invalid, 30% neutral; 10% catch trials). In the covert task, participants pressed a single key in response to target onset and trials were excluded if the eyes moved away from central fixation. In the overt task, participants made a saccade to the target location. In the overt task, reaction time was smaller for targets in the upper (242 ms) versus lower field (269 ms), regardless of cue validity. In the covert task, reaction time was smaller for targets in the lower (346 ms) versus upper field (385 ms), regardless of cue validity. These results argue against the notion that overt and covert orienting engage common processing systems, supporting instead the hypothesis that overt and covert orienting mechanisms are distinct and evolved to support different behavioral functions.

F32

MINDFULNESS TRAINING REDUCES MIND WANDERING DURING A SUSTAINED ATTENTION TASK *Ling M. Wong[1], Marieke van Vugt[1], Jonathan Smallwood[2], Jane Carpenter-Cohn[3], Michael Baime[1], Amishi P. Jha[1]; [1]University of Pennsylvania, [2]University of Aberdeen, [3]Naropa University* – Attentional lapses can have deleterious consequences during task performance. Lapses are often associated with mind wandering, which is the tendency of one's attention to drift away from a task and toward task-irrelevant thoughts. The present study investigated the impact of mindfulness training on mind wandering. Participants (n = 16) were tested on a sustained attention to response task (SART) before (T1) and after (T2) participation in an intensive one-month mindfulness meditation retreat. The primary mindfulness practice required attending to present moment experience using the breath as the anchor of attention. The SART required responses to frequent "non-target" digits and response inhibition for an infrequent "target" digit. Mind wandering was assessed behaviorally, as failures to withhold responses to targets, and subjectively, via self-report responses to thought probes. At both T1 and T2, errors of commission to targets were greater during periods of self-reported mind wandering relative to periods of being on-task. In addition, response times to non-targets were reduced during both behaviorally- and subjectively-identified off-task periods. To better characterize the structure of response times to non-target events, principal components analysis (PCA) was performed (Smallwood et al., 2007). Two previously reported indices of mind wandering (Smallwood et al., 2007) were less prominent at T2 relative to T1. Finally, there were fewer errors of commission and increased self-report of being on-task and aware of present moment experience at T2 relative to T1. These results suggest that mindfulness meditation training may reduce the frequency of attentional lapses due to mind-wandering during task performance.

F33

AUTOMATIC AND CONTROLLED SPATIAL ORIENTING IN THE TWO CEREBRAL HEMISPHERES *Eran Zaidel[1,2], Yuan Hang Li[1], Deanna Greene[1], Anat Barnea[3]; [1]UCLA, Los Angeles, CA, [2]Brain Research Institute, UCLA, [3]Bio-Keshev Clinic, Kibbutz Givat-Chaim Ichud, Israel* –

INTRODUCTION: The Lateralized Attention Network Test (LANT) is a variation of the centrally presented Attention Network Test (ANT) that enables measurement of three attentional networks (Conflict resolution, spatial Orienting, and Alerting) in each hemisphere. Here we focus on results with spatial Orienting. We modified the LANT to include measures of both automatic and controlled spatial Orienting. Targets consisting of up- or down-pointing arrows were flashed randomly to one visual hemifield or the other for 150ms. These targets were preceded by valid, invalid, and central cues, which could be automatic (peripheral, non-predictive) or controlled (central, predictive). We asked whether automatic and controlled cues have different effects in the two hemifields of the normal brain. METHODS: Fifty normal college undergraduates were tested in two separate blocks, one including single peripheral cues (asterisks), the other including two central cues (hands pointing left, right, or center) presented simultaneously in both visual fields. Additionally, two Cue-to-Target Intervals (CTIs) were used: 150ms and 500ms. RESULTS: We found that automatic spatial Orienting was superior in the Left Visual Field, whereas controlled spatial Orienting was superior in the Right Visual Field. Furthermore, valid automatic cues facilitated target decision more at short CTIs (150ms) than at long CTIs (500ms) (Inhibition of Return). By contrast, valid controlled cues facilitated target decisions more at long CTIs than at short CTIs. CONCLUSION: This dissociation confirms that cognition in each normal hemisphere is orchestrated by a different set of attentional networks.

F34

DISTRIBUTED REPRESENTATIONS OF TASK-RELEVANT INFORMATION WITHIN HUMAN FRONTOPARIETAL CORTEX *Mark Stokes[1], Rhodri Cusack[2], John Duncan[2]; [1]University of Oxford, [2]MRC Cognition and Brain Sciences Unit, University of Cambridge* – Understanding executive processing within frontoparietal cortex (FPC) is of central importance to the neurobiological study of high-level human behaviour. Although recent functional magnetic resonance imaging (fMRI) studies have sought to segment FPC into distinct sub-regions associated with different sub-units of executive function, meta-analyses typically reveal a more generic processing space within the FPC (e.g., Cabeza and Nyberg, 2000; Duncan and Owen, 2000). Rather than dedicated sub-divisions, a distributed network within the FPC may rapidly adapt to code task-relevant information (e.g., Duncan, 2001; Miller and Cohen, 2001). Indeed, monkey neurophysiology studies reveal task-relevant neural representations that are distributed throughout the FPC with little or no overall spatial specificity (e.g., Freedman et al, 2003; Freedman and Assad, 2006). In human studies, however, evidence of adaptive neural coding has remained limited by the coarse resolution of standard neuroimaging analysis techniques because mean changes in brain activity cannot differentiate overlapping representations. In the present study, we applied a multivariate pattern analysis (MVPA) to resolve patterns of neural activity representing task-relevant activity in the human FPC. In a series of event-related fMRI studies, participants categorized visual stimuli according to variable task-contexts. Linear discriminant analysis of neural patterns within the FPC reliably predicted target categories within task-relevant, but not irrelevant, stimulus dimensions. This evidence supports the role of the FPC in high-level selection and task-relevant representations, and is consistent with an adaptive coding model of FPC in which functionally distinct, although spatially overlapping, neural representations flexibly code task-relevant information.

F35

TOWARDS AN INDEPENDENT BRAIN - COMPUTER INTERFACE: RELIABILITY ACROSS RECORDING SESSIONS *Allison Brendan[1], McFarland Dennis[2], Schalk Gerwin[2], Zheng Shi Dong[3], Moore Jackson Melody[3], Wolpaw Jonathan[2]; [1]Institute for Automation, University of Bremen, [2]Laboratory of Nervous System Disorders, Wadsworth Lab, NY State Department of Health, [3]School of Interactive Computing, Georgia Institute of Technology* – Different brain - computer interface (BCI) systems rely on different types of neural activity for control. The three most common approaches for non-invasive BCIs utilize the P300, SSVEP, or ERD/ERS activity (Birbaumer, 2006; Allison, Wolpaw, and Wolpaw, 2007). Although studies have explored the stability of P300 and ERD BCIs across several recording sessions over different days, this has not been well explored with SSVEP BCI systems. In this study, subjects focused attention on one of two oscillating stimuli that could be used in a BCI. Different conditions used displays that either did or did not rely on gaze shifting to explore the hypothesis that some SSVEP BCIs may not require gaze shifting, and thus could operate independent of any movement. Subjects participated in four recording sessions, each on different days, to explore how three key parameters varied across recording session and display type: optimal recording site(s); magnitude of EEG differences elicited by selective attention; and the frequency at which this difference was greatest. These parameters were used to estimate information throughput in an online BCI. Results showed that an independent SSVEP BCI is feasible. Further, the best recording sites and frequencies were consistent across sessions for most subjects. However, there was considerable inter - subject variability in both the best display type and the magnitudes of resulting EEG differences. This suggests that automated algorithms to identify parameters to optimize performance should be used with most subjects.

Cognitive and brain development

F36

INCREASING RECRUITMENT OF A PARTIALLY OVERLAPPING NETWORK DURING IMPLICIT LEARNING IN ASD AND TYPICAL DEVELOPMENT: AN FMRI STUDY *Kelly Anne Barnes[1], Anne Della Rosa[2], Philip S. Lee[1], James H. Howard, Jr.[1,3], Darlene V. Howard[1], Lauren E. Kenworthy[2], William D. Gaillard[1,2], Chandan J. Vaidya[1,2]; [1]Georgetown University, [2]Children's National Medical Center, Children's Research Institute, [3]Catholic University* – Symptoms of Autism Spectrum Disorders (ASD) suggest impairment in social, language, and motor skills, behaviors that are supported in typical development by implicit learning. Implicit probabilistic sequence learning enables the detection of regularities in the environment (e.g., where something is likely to occur). This type of learning depends upon dynamic changes in activation in adults but remains unstudied in childhood ASD. Thus, we performed event-related fMRI during a visual-motor task in 13, 7–12 year old children with high-functioning ASD and 13 matched control children. Children were presented with a display comprising three sequential stimuli, 2 cues and 1 target. Unbeknownst to participants, the location of the first cue predicted the target appearing in one location on 80% of trials (High Probability condition) and in another location on 20% of trials (Low Probability condition). Learning was defined as faster and more accurate performance on High relative to Low Probability trials. Overall, children demonstrated learning but magnitude of learning did not differ between groups. Using SPM2, we identified brain regions in which the difference between High and Low Probability trials increased linearly over the duration of the task. These changes were in frontal cortex (e.g., BA 6) and cerebellum for both groups. ASD children recruited additional regions including the insula and ventral striatum. Increasing recruitment of additional frontal and striatal regions in ASD suggests that intact implicit learning in ASD children requires additional neural resources.

F37

THE DEVELOPMENT OF THE FACE-SPECIFIC M170 RESPONSE *Jennifer N. Barrie[1], Anthony Herdman[1,2], Mario Liotti[1]; [1]Simon Fraser University, [2]Down Syndrome Research Foundation* — The goal of the current study was to use magnetoencephalography (MEG) to study the developmental trajectory of the M170 response and the development of holistic face processing, using faces and objects presented in different spatial frequencies, in children (9-12 years), adolescents (15-17 years), and adults (>19 years). It was hypothesized that all groups would have faster response times (RT) to Low Spatial Frequency (LSF) faces, and that LSF faces would elicit an M170 with a shorter latency and greater peak than High SF (HSF) faces. This would indicate that holistic face processing (supported by LSF) has developed by 9 years of age and remains stable thereafter. Also, this LSF advantage was expected to be specific to faces. Finally, it was hypothesized that the M170 latency would continue to shorten with increasing age. Results indicated that, in adults and adolescents, LSF faces elicited faster RTs, and earlier and smaller M170 responses than HSF faces. This effect was specific to faces, suggesting that LSF faces are processed faster and require less effort than HSF faces. Conversely, in children, results indicated no difference in RT or in the M170 elicited by faces and objects, and no effect of SF. This suggests that holistic face processing has not developed by late childhood, but rather develops during adolescence. Lastly, between-group comparisons revealed the adult M170 was elicited earlier than the adolescent and child M170, which were not significantly different. These findings suggest that face processing continues to develop until adulthood.

F38

READING, THE BRAIN, AND READING THE BRAIN: DOES WORKING MEMORY AFFECT N400 AMPLITUDE? *Erik Benau[2]; [1]Hampshire College/University of Pittsburgh* — The connection between working memory (WM), development, and N400 amplitude was explored using a Daneman and Carpenter (1980) complex-span task and a Kutas and Hillyard (1980) semantic priming task. The priming task used three types of sentence endings: congruous, moderately incongruous, and strongly incongruous. Children age 8-12 and adults age 18-24 completed both tasks. It was hypothesized that there would be a correlation between N400 amplitude and working memory scores in both ages. It was also hypothesized that strongly incongruous sentences would have larger N4's than moderate in both children and adults. The results show a moderate correlation between WM capacity and N400 amplitude in adults, but not in children. Additionally, adults' N4's at the strongly incongruous condition were significantly stronger than the moderately incongruous. This was not shown in children.

F39

NEUROPHYSIOLOGICAL CORRELATES OF VOCABULARY DEVELOPMENT IN PRESCHOOL-AGED CHILDREN *Jeannette E. Benson[1], Lindsay C. Bowman[1], Jennie M. B. Ito[1], Mark A. Sabbagh[1]; [1]Queen's University* — While much is known about the neurological systems associated with language in adult populations, comparatively less is known about the brain regions associated with vocabulary acquisition in children. An emerging body of work suggests that young children who incur damage to the right cerebral hemisphere have subsequent impairments in word learning (e.g. Bates & Roe, 2004). Although these findings suggest that neural systems within the right hemisphere are critical for vocabulary acquisition, no studies to date have directly tested the extent to which this is true in typically developing populations. Thus, the goal of this study was to investigate the neurophysiological correlates of vocabulary development in typically developing preschool-aged children. We obtained resting electrophysiological data (EEG) from 29 4-year-old children using a 128-channel Geodesic Sensor Net (EGI, Eugene, OR). To measure language skills, we administered the Peabody Picture Vocabulary Test (PPVT, Dunn & Duun, 1981). For each participant, cross-spectral power was computed within the alpha band, the results of which were submitted to sLORETA for source localization. The focal partial correlation analyses showed that PPVT scores were correlated with activation in the right posterior regions of the middle temporal gyrus and superior temporal gyrus (BAs 21, 22, & 39). Specifically, children with greater activation in these regions had higher PPVT scores. These findings confirm that right hemisphere development is important for vocabulary development in healthy, typically developing preschoolers. Further, these findings provide specific insight into to the neurocognitive processes that might support word learning in the first four years.

F40

THE RELATIONSHIP BETWEEN MATURATIONAL FACTORS AND AUDITORY CORTICAL PROCESSING: AN ERP STUDY *Patrizia Bisiacchi[1], Giovanni Mento[1], Agnese Suppiej[2]; [1]University of Padova, Italy, [2]Children's Hospital, University of Padova, Italy* — Introduction: Newborns of less than 30 weeks of gestational age show an immature cortical pathway; nevertheless they are more exposed to the extrauterine environment and therefore to a longer and richer sensorial stimulation, such as mother's voice, speech sounds and parental care. Therefore, they could be supposed to approximate cortical maturational delay before reaching the same post-conceptional age compared to the older ones. Auditory event-related potentials represent an useful and non-invasive tool to asses cortical functioning in non-collaborative subjects such as newborns. Aims: The purpose of this study was to investigate the effects of gestational age on the auditory event-related potentials (AERPs) in low-risk preterm newborns of extremely low (23-29 weeks, N=20) and low gestational age (30-34 weeks, N=19). Methods: All subjects were tested at the same post-conceptional age of 35 weeks. An auditory oddball paradigm was used with frequently occurring 'standard' tones at 1000 Hz and rarely occurring 'deviant' tones at 2000 Hz. Both exogenous and endogenous evoked responses were recorded. Results: Newborns of less than 30 gestational weeks showed smaller AERP responses (P1, N2 and Mismatch Negativity) than the older ones. Furthermore, Mismatch Negativity peak amplitude resulted significantly related to maturational indices such as weight, length and cranial circumference measured at birth Conclusion: Our results suggest the role of gestational age as the main factor in explaining cortical functioning at this early age: The longer environmental sensorial exposure doesn't seem to approximate the gestational development.

F41

HEMISPHERIC DOMINANCE FOR SPEECH IN PREVERBAL INFANTS *Heather Bortfeld[1], Eswen Fava[1], David Boas[2]; [1]Texas A&M University, [2]Martinos Imaging Center, Harvard Medical School* — By using various cues found in adult speech, infants gradually come to understand and use their native language. However, relatively little is known about the neural mechanisms that are responsible for this rapid gain in language processing abilities across the first year, in large part because there are a limited number of non-invasive neuroimaging techniques available for use with human infants. Using near-infrared spectroscopy (NIRS), an optical imaging technique that uses relative changes in the concentration of oxygenated (HbO2) and deoxygenated (HbR) blood as an indicator of neural activation, we currently are assessing the relation between language processing and brain function in infants. In earlier work, we demonstrated that this procedure is viable for use with awake, active infants (Bortfeld, Wruck, and Boas, 2007). Specifically, we established a dissociation of activity in the left temporal and primary visual regions in infants (aged 6- to 9- months; N = 35) during exposure to audiovisual and visual-only stimuli. In the current study, we examined bilateral temporal activation while 6- to 9-month-old infants (N = 21) were exposed to the same audiovisual and visual-only materials. Results revealed heightened activity in the left superior posterior temporal region relative to the right in the audiovisual condition but not in the visual-only condition, a finding that is consistent with brain-behavior models of language processing. These findings highlight the utility of NIRS for establishing neural correlates of language development in older infants, a task that is difficult to accomplish without the use of attention-getting visual stimuli.

F42

NEUROPHYSIOLOGICAL CORRELATES OF IMAGINARY COMPANION CREATION IN PRESCHOOLERS *Lindsay C Bowman[1], Jennie M Baxter Ito[1], Mark A Sabbagh[1]; [1]Queen's University* – During the preschool years, approximately 65% of children develop Imaginary Companions (ICs) -- invisible characters or personified objects that are named, directly referred to in children's conversation, and played with for at least several months (Svendsen, 1934). An interesting question concerns why ICs emerge for some but not all children. Previous research suggests that children who create ICs differ from those who do not on some aspects of social-cognitive development. However, there has been no investigation of whether the two groups might differ with respect to neurophysiological functioning. To address this question, we obtained resting electrophysiological data (EEG) from 29 typically developing 4-year-olds using a 128-channel Geodesic Sensor Net (EGI, Eugene, OR). The prevalence of ICs was measured via parent-report questionnaire where parents were given the definition of an IC, asked if their child had one, then asked to describe the IC as well as their child's interactions with it. For each participant, cross-spectral power was computed for the EEG within the alpha band (6 to 9 Hz) and submitted to sLORETA for source localization. Statistical analysis revealed that children with ICs (n = 10) showed less tonic alpha power in the inferior temporal and fusiform gyrus (BAs 37, 20), the precentral and middle frontal gyrus (BAs 4, 6), and the inferior frontal gyrus (BAs 45, 9), relative to children without ICs (n = 19). Findings are discussed with respect to implications for current theories of IC development, and the neurodevelopmental basis for fantasy play more generally.

F43

DIFFERENTIAL EFFECTS OF PRENATAL ALCOHOL EXPOSURE AND ADHD ON NUMBER PROCESSING *Matthew J. Burden[1], Sandra W. Jacobson[1], Charles A. Nelson[2], Alissa J. Westerlund[2], Malcolm J. Avison[3], Rafael Klorman[4], Leslie H. Lundahl[1], Stanislas Dehaene[5], Joseph L. Jacobson[1]; [1]Wayne State University School of Medicine, Detroit, MI, [2]Children's Hospital / Harvard Medical School, [3]Vanderbilt University, Nashville, TN, [4]University of Rochester, Rochester, NY, [5]INSERM-CEA, Orsay, France* – Fetal alcohol spectrum disorder (FASD) and attention deficit hyperactivity disorder (ADHD) are both associated with adverse effects on number processing (e.g., arithmetic), but distinct etiologies and abnormalities in brain function specific to each disorder suggest that the neural bases of these deficits are likely to differ. We examined event-related potentials (ERPs) during a number comparison task in 62 young adults (18-20 years) with documented histories of prenatal alcohol exposure and ADHD. Participants pressed a button to the larger of two presented numbers when numerically far apart ("easy") or close together ("difficult"); in the control condition ("letters"), they chose a letter rather than a symbol. Within a 2 (alcohol-exposed, non-exposed) x 2 (ADHD, non-ADHD) analysis design, the expected linear decrease in accuracy across the three conditions (letters, easy, difficult) was seen across groups, $F(1,58) = 15.15$, $p < .001$, as was the expected linear increase in RT, $F(1,58) = 119.41$, $p < .001$, but between-group comparisons showed no significant differences (all ps $> .05$). Average amplitude (μV) for a late positive component (600 – 1100 ms) also increased progressively across conditions, $F(1,58) = 25.59$, $p < .001$, and follow-up analyses showed disproportional increases associated with number problems for the alcohol-exposed group, $F(1,60) = 4.11$, $p < .05$, but no differences by ADHD group ($p = .85$). These results, which suggest increased cognitive effort for number comparison associated with prenatal alcohol exposure, are discussed in contrast to poorer performance associated with ADHD on a mathematics achievement test (WIAT-R) administered at 14 years.

F44

THE NEURAL CORRELATES OF SOCIAL EMOTION IN ADOLESCENTS AND ADULTS *Stephanie Burnett[1], Geoff Bird[2], Jorge Moll[3,4], Chris Frith[5,6]; [1]Institute of Cognitive Neuroscience, UCL, UK, [2]UCL, UK, [3]National Institutes of Health, Bethesda, Maryland, [4]LABS-D'Or Hospital Network, Rio de Janeiro, Brazil, [5]Wellcome Trust Centre for Neuroimaging, UCL, UK, [6]Centre of Functionally Integrated Neuroscience, University of Aarhus, Denmark* – In this fMRI study, we investigated the development during adolescence of the neural network underlying the understanding of social emotions. Social emotions, such as guilt and embarrassment, are emotions that require a representation of others' mental states. In contrast basic emotions, such as disgust and fear, require only the awareness of a somatic state. 19 adolescents (aged 10–18 years) and 10 adults (aged 22–32 years) were scanned using fMRI. A factorial design was employed with between-subjects factor Group and within-subjects factor Emotion (social or basic). In both adults and adolescents, medial prefrontal cortex (MPFC) was activated when imagining situations in which a social emotion (guilt or embarrassment) would be felt vs. imagining situations in which a basic emotion (disgust or fear) would be felt. In addition, there was a significant interaction between group and task in MPFC: during social relative to basic emotion, adolescents activated part of the MPFC more than did adults. In contrast, adults activated a region of the left temporal pole more than did adolescents. These results suggest that the neural strategy for social emotion processing changes between adolescence and adulthood. Activity moves from anterior (medial prefrontal) to more posterior (temporal) regions with age.

F45

DEVELOPMENTAL DIFFERENCES OF NEUROCOGNITIVE NETWORKS FOR PHONOLOGICAL AND SEMANTICS PROCESSING IN CHINESE WORD READING *Fan Cao[1], Danling Peng[2], Li Liu[2], Zhen Jin[3], Ning Fan[2], Yuan Deng[4], James Booth[1,5]; [1]Northwestern University, Evanston, IL, [2]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, P.R. China, [3]fMRI Center Hospital 306, Beijing, P.R. China, [4]Institute of Psychology, Chinese Academy of Sciences, Beijing, P.R. China, [5]Evanston Northwestern Healthcare, IL* – Developmental differences in the neurocognitive networks for phonological and semantic processing in Chinese word reading were examined in 13 adults and 13 children using functional magnetic resonance imaging (fMRI). Participants made rhyming and semantic association judgments to two-character words that were presented sequentially in the visual modality. These lexical tasks were compared to a nonlinguistic control task involving judgment of line patterns. The first main finding was that adults showed greater activation than children in right middle occipital gyrus on both the meaning and rhyming task, suggesting adults more effectively engage right hemisphere brain regions involved in the visual-spatial analysis of Chinese characters. The second main finding was that adults showed greater activation than children in left inferior parietal lobule for the rhyming as compared to the meaning task, suggesting greater specialization of phonological processing in adults. The third main finding was that children who had better performance in the rhyming task on characters with conflicting orthographic and phonological information relative to characters with non-conflicting information showed greater activation in left middle frontal gyrus, suggesting greater engagement of brain regions involved in the integration of orthography and phonology. We also found that children showed greater activation than adults in right pre/postcentral gyri for the rhyming task suggesting that children may rely on a compensatory strategy of articulation and phonological rehearsal.

F46

DEVELOPMENTAL DIFFERENCES IN THE FUNCTIONAL ORGANIZATION OF AUDITORY AND AUDIOVISUAL DISCOURSE NETWORKS. *Anthony Steven Dick[1], Steven L. Small[1]; [1]The University of Chicago* – We used functional magnetic resonance imaging (fMRI) to investigate the developmental biology of discourse comprehension. Using a cross-sectional design, we compared 13 typical children (8-13 years; M = 10.3 years; SD = 1.6 years) to 24 adults (M = 23.0 years; SD = 5.6 years) during two story comprehension conditions. In an audiovisual condition, participants viewed a storyteller narrating a story during which her mouth and hands were visible. In an auditory-only condition, participants listened to stories while viewing a fixation cross. Compared to baseline, both groups showed activation in bilateral inferior frontal, superior and middle temporal, and inferior parietal regions for both conditions, although the audiovisual condition evoked greater activity bilaterally in the posterior superior temporal gyrus and sulcus, and middle temporal gyrus and inferior parietal lobule. In a direct comparison between adults and children, both conditions showed greater activity for adults in the posterior superior temporal gyri bilaterally, and in the posterior superior temporal sulcus and inferior parietal lobule on the left. In the audiovisual condition, adults also showed greater activity in the left precentral gyrus. These results support the notion that over the course of development, neural activity during language processing tends to become less diffuse and more focused in posterior superior and middle temporal, and inferior parietal regions, with a relative bias toward the left. Further, the present findings suggest that development of this specialization continues into later childhood.

F47

NEURAL DEVELOPMENT OF PERSPECTIVE TAKING IN SCHOOL-AGED CHILDREN *Mengia Dosch[1], Peter Klaver[1,2], Ernst Martin[1], Loenneker Thomas[1,3]; [1]MR Center, Children's University Hospital, [2]University of Zurich, [3]Center for Integrative Human Physiology, University of Zurich, Switzerland* – Neuroimaging studies in adults have thoroughly investigated brain regions that are recruited when we put ourselves in another person's shoes. We know, however, little about the development of the neural network that yields cognitive perspective taking. Taking a third-person perspective (3PP) as opposed to a first-person perspective (1PP) has been associated with brain activation in the inferior parietal cortex, the medial posterior cortex and the medial prefrontal cortex. Yet, neurodevelopmental studies indicate that parietal and prefrontal areas are not fully mature until early adulthood. We hypothesize and confirm that perspective taking becomes increasingly efficient in children aged 8-13 years. Our data showed that children can correctly answer according to the other perspective but they are less efficient in processing a third-person perspective. The response latencies for 1PP and 3PP judgments both decrease with age, but the response latencies for 3PP judgments decrease significantly stronger with age than for the 1PP judgments. Whereas adults yielded neural activity in the posterior cingulate cortex, the precuneus and the left inferior parietal cortex, children additionally enhanced activity in the medial prefrontal cortex and the right inferior parietal cortex during 3PP as compared with 1PP judgments. We found a significant difference between groups in the right inferior parietal cortex with adults showing activity only in the left inferior parietal cortex, whereas children activated the inferior parietal cortex bilaterally. These results suggest that increasing efficacy in the self-other judgment during maturation accompanies a shift of activity from bilateral to unilateral inferior parietal cortex.

F48

THE AGE-RELATED EMERGENCE OF THE CORTICAL CONNECTIVITY UNDERLYING FACE PROCESSING REVEALED BY DIFFUSION TENSOR IMAGING. *Jaime L Doyle[1], K. Suzanne Scherf[1], Cibu Thomas[1], Marlene Behrmann[1]; [1]Carnegie Mellon University* – In adults, face processing is associated with a distributed circuit involving multiple cortical regions, some of which form the 'core', and others which form the 'extended' part of the face-related processing network (Fairhall & Ishai, 2007; Gobbini & Haxby, 2006). fMRI studies reveal reduced face-selectivity in both the core (the FFA, OFA, and STS in adults) and extended (associated anterior regions) network in children, whereas adolescents evince a more adult-like pattern in the core but not extended region (Scherf et al., 2007). To examine the developmental emergence of the structural circuitry of the face-processing network, we used diffusion tensor imaging to asses the integrity of the two major white matter tracts that pass through the fusiform gyrus, the pre-eminent face processing region (Kanwisher et al., 1997), which is effectively connected to other face-related regions. We quantified the macrostructural (density/volume) and microstructural (fractional anisotropy) properties of the two tracts, the inferior longitudinal fasciculus (ILF) and the inferior fronto-occipital fasciculus (IFOF) in children, adolescents, and adults. The findings suggest a significant improvement in the structural integrity of the right ILF as a function of age on all dependent measures. This gives new insight into the structural changes in the cortical regions mediating face perception and may explain the protracted course of acquisition of face selectivity over development.

F49

5-YEAR-OLD CHILDREN ALLOCATE SPATIAL ATTENTION TO RIGHT VISUAL FIELD EMOTIONAL FACES *Kit Elam[1], Josh Carlson[1], Karen Reinke Pressley[1], Lisabeth DiLalla[1]; [1]Southern Illinois University Carbondale, University of Illinois at Springfield* – Behavioral studies reveal an attentional bias to the location of threatening stimuli in both adults and children as young as 9 years old. Additionally, as early as age 4, children demonstrate an ability to discriminate between emotional faces, and this ability becomes increasingly automatic with age. However, it is unclear whether preschoolers' developing abilities to discriminate emotional faces may contribute to decreased spatial attention to emotional faces. The present project addressed this by studying 5-year-old participants who performed a modified dot probe task. Two faces (from Gur et al., 2002) were simultaneously presented (500 ms) to the left and right of fixation and were followed by a target cartoon character appearing in one of the two locations. The children's task was to indicate the location of the cartoon character as quickly as possible by pressing a button on the left or right side of the keyboard. Spatial attention trials consisted of one emotional face (fearful or positive) and one neutral face. Children produced faster reaction times for emotional congruent (target cartoon appearing on the same side as the emotional face) compared to incongruent trial types in the right visual field (RVF). This is the first such study of 5-year-olds. Most adult spatial attention studies have found congruency effects either bilaterally or in the left visual field. The presence of a RVF effect in preschoolers may represent an early developmental left-hemisphere mechanism that matures as processing becomes more automatic with age.

F50

DEVELOPMENTAL CHANGES IN PREFRONTAL AND HIPPOCAMPAL CONNECTIVITY DURING WORKING MEMORY: A LONGITUDINAL FMRI STUDY *Amy S. Finn[1], Margaret A. Sheridan[2,3], Stephen Hinshaw[1], Mark D'Esposito[1,4]; [1]University of California, Berkeley, [2]Harvard University School of Public Health, [3]Children's Hospital Boston, [4]Helen Wills Neuroscience Institute* – The human prefrontal cortex (PFC) matures well into adulthood, while the hippocampus reaches adult-like status before adolescence. Classically, PFC is proposed to support working memory (WM) whereas the hippocampus supports long-term memory (LTM). However, recent studies suggest this distinction is blurred since the PFC is involved in LTM processes and the hippocampus in WM processes. Developmental studies can help clarify this distinction. Given that PFC development is later, young adolescents may recruit compensatory areas for WM. In particular, they may recruit hippocampus. Young adolescents' performance on basic WM tasks is often indistinguishable from adults, making this an excellent cognitive domain to study compensation. We studied 10 female adolescents longitudinally—mean age 14 years for time 1 (T1) and 17 for time 2 (T2)—by administering a delayed match-to-sample task during fMRI scanning. During both scans, participants viewed either 2 or 6 upper-case letters for 2 seconds (encoding), followed by a 13.2 second delay period (maintenance), and responded as to whether a lower-case letter matched one of the encoding letters. Group analyses revealed that adolescents recruited the hippocampus at T1 not at T2 during encoding. Connectivity analyses reveal that at T1, hippocampal and PFC activity were correlated during encoding. At T2 no such correlation was detected; instead, PFC activity correlated with parietal areas more than at T1. The hippocampus therefore appears 1) to compensate for an underdeveloped PFC and 2) to be part of the PFC-parietal network only during early stages of development.

F51

THE RELATIONSHIP BETWEEN MUSIC AND LANGUAGE SKILLS IN NORMAL-READING AND DYSLEXIC CHILDREN *Marie Forgeard[1,2], Ellen Winner[1,2,3], Andrea Norton[1], Gottfried Schlaug[1]; [1]Beth Israel Deaconess Medical Center and Harvard Medical School, [2]Boston College, [3]Project Zero, Harvard Graduate School of Education* – Past research has shown that music and language skills appear to be related in normal as well as in impaired readers. Children suffering from dyslexia have been found to suffer from deficits in pitch and rhythm perception, and to have difficulty reading musical notation. It has also been reported that daily sessions of a rhythm-based intervention successfully remediated some of the language skills found to be deficient in children with dyslexia. Results from an ongoing longitudinal study with normal-reading children as well as from a pilot study with dyslexic children confirmed that a strong relationship exists between auditory musical discrimination abilities and language-related skills. In normal readers, melodic discrimination abilities predicted both phonological and reading skills, but rhythmic discrimination predicted only reading skills. These relationships were stronger in music-trained children than in controls, suggesting that musical training may help develop language-related skills. In children with dyslexia, melodic and rhythmic discrimination skills predicted phonological skills, which in turn predicted reading abilities. Phonological skills may therefore mediate the link between musical and reading abilities in children with language impairments. Furthermore, children with dyslexia appear to have both melodic and rhythmic discrimination deficits compared with a matched control group of normal readers. Normal-reading children with at least one year of musical training surpassed both the dyslexic and control groups on melodic discrimination. These results suggest that a music intervention aimed at improving dyslexic children's basic auditory musical perception skills might also have a beneficial effect at remediating some of their language deficits.

F52

CORPUS CALLOSUM MORPHOLOGY AND INTELLIGENCE *Amanda Hutchinson[1,2], Benjamin Jacobson[1], Luka Ruzik[1], Jane Mathias[2], Marie Banich[1]; [1]Institute of Cognitive Science, University of Colorado at Boulder, [2]School of Psychology, University of Adelaide, Australia* – The corpus callosum is the largest fibre tract in the human brain and connects homologous areas of the left and right cerebral hemispheres. The corpus callosum plays an important role in integrating information between the cerebral hemispheres, and is thought to contribute to the allocation of attention between the hemispheres and in maintaining hemispheric arousal. Recently, the size of posterior regions of the corpus callosum has been found to be related to intelligence in a group of healthy adults (Luders et al., 2007) with larger callosal area related to higher intelligence. The current study investigated the relationship between the morphology of the corpus callosum and IQ in a sample of individuals in their late teens and early 20s because recent evidence suggests that maturation of white matter tracts continues through the 20s (Barnea-Goraly et al., 2005; Sowell et al., 2003). Area measurements of seven sub-sections of the corpus callosum, as defined by Witelson (1989), were obtained at the midsagittal slice and correlated with Wechsler Abbreviated Scale of Intelligence scores, while controlling for overall brain volume. The relationship between IQ and callosal size held for individuals in this age range as well, providing further evidence for the relationship between callosal morphology and cognitive task performance.

F53

SOCIAL INPUT AND THE EVOLUTION OF PRIMATE INTELLIGENCE: THE INFLUENCE OF THE PRE-WEANING PERIOD *Jeffrey Hutsler[1], Oscar Ybarra[1]; [1]University of Nevada, Program in Neuroscience, University of Michigan* – Many animals, especially primates, require social contact and social bonds with mothers and caretakers in order to survive and develop properly. Such bonds allow for protection and nourishment, but may also be critical to cognitive development and the expression of complex cognitive skills to adapt to and exploit the environment. Greater levels of cognitive ability and intelligence in primates are often associated with larger brains and larger neocortices (Reader & Laland, 2003), but when survival and fitness depend on acquiring complex skills, the cognitive system should be predisposed to learning from others, especially caretakers. Here we show that the development of complex cognitive skills is associated not only with the expansion of neocortex, but also the early social input that is a central aspect of the environmental milieu in which the enlarged primate brain originally evolved. We examined the relationship between measures of intelligence and the length of the pre-weaning (birth to weaning) and gestation periods in 68 primate species. Controlling for phylogeny, these findings show that longer pre-weaning periods and, less consistently, shorter gestation lengths, predict higher frequencies of social learning, tool use, and innovation as reported in the primate literature. Additional analyses suggest that the rates of evolutionary change for both intelligent behaviors and the pre-weaning period are highest in apes as compared to other major primate sub-branches. This pattern of results indicates that the amount of social contact infants have with their caretakers may be related to both the expression and evolution of intelligent behaviors.

F54

IMPAIRED EYEBLINK CONDITIONING AS A BIOMARKER OF FETAL ALCOHOL SYNDROME *Sandra Jacobson[1], Mark Stanton[2], Christopher Molteno[3], Matthew Burden[1], Douglas Fuller[1], Joseph Jacobson[1]; [1]Wayne State University School of Medicine, [2]University of Delaware, [3]University of Cape Town* – Eyeblink conditioning (EBC) is a Pavlovian paradigm that involves contingent temporal pairing of a conditioned stimulus with an unconditioned stimulus. Animal studies have shown that binge consumption of alcohol during pregnancy impairs EBC and that this impairment is likely mediated by a loss of neurons in the inferior olive and the cerebellar cortex and deep nuclei, as well as a reduction in neural plasticity in the cerebellar deep nuclei. Short delay EBC was examined in 98 5-year-old children born to women from the Coloured (mixed ancestry) community in Cape Town, South Africa, who were recruited prenatally and are participating in the first prospective study of children with fetal alcohol syndrome (FAS). FAS status was assessed at 5 years by expert dysmorphologists. Two sessions of 50 trials each were administered to the children; a third session was administered the following day to those children who did not meet criterion of 40% conditioned responses in session 2. Not a single child with FAS met criterion for conditioning as contrasted with 75.0% of the nonexposed controls. Only 33.3% of the children with partial FAS and 37.9% of heavy exposed nonsyndromal children met criterion. These alcohol effects on EBC persisted after controlling for IQ. Three of four microcephalic children who were not exposed to alcohol were successfully conditioned. Successful EBC in a microcephalic group supports the inference that the eyeblink conditioning deficit is specific to prenatal alcohol exposure and a potential biomarker for diagnosis of exposed children lacking the distinctive FAS dysmorphology.

F55

PLASTICITY IN RIGHT LIMBIC STRUCTURES MEDIATES HARMONY INCONGRUITY PROCESSING IN MUSICAL EXPERTS *Clara James[1], Juliane Britz[1], Patrik Vuilleumier[1], Claude-Alain Hauert[1], Christoph Michel[1]; [1]FPSE, University of Geneva, Switzerland* – Western tonal music follows relational syntactical rules that regulate harmonic transitions. Although laymen of western culture can detect violations of musical syntax to a certain extent, refined syntactical transgressions may be distinctively apprehended by musical experts, who have incorporated the rule system more extensively due to intensive training. This differential sensitivity can best be observed at musical closure, where a very specific harmonic consequent is expected. We hypothesized that a subtle incongruity of standard closure should evoke a profound reaction in an expert, whereas an auditor lacking musical training may hardly detect it.

Using electrical source imaging, we identified the temporal dynamics of neuronal responses in highly trained pianists and musical laymen to syntactic harmonic incongruities in expressive music, that were easily detected by the experts, but not by the laymen. We demonstrate that, in musical experts only, a unique response in limbic areas encompassing the right amygdala and hippocampal complex is evoked by subtle musical closure incongruity. Its early onset (~200 ms) precedes a response of frontal areas that may reflect more conscious processing. No such differences between the two groups were found for compositions with correct endings or in early auditory processing. These results go beyond previous work demonstrating enhanced activity of primary sensory and motor areas in professional musicians, and suggest that plasticity in limbic structures also mediates the processing of fine harmonic incongruities in professional musicians.

F56

THE NEURAL MOSAICS OF FACE SENSITIVITY ACROSS DEVELOPMENT: LOOKING BEYOND PEAK ACTIVITY *Rebecca M. Jones[1], Jason D. Zevin[1], Jeremy Skipper[1], BJ Casey[1], Nim Tottenham[1]; [1]Sackler Institute, Weill Cornell Medical College, NY* – Functional Magnetic Resonance Imaging (fMRI) reports in children and adolescents that rely on univariate analyses suggest that the neural network for face processing continues to mature until young adulthood with a progressive focalization of neural activity (Aylward et al., 2005; Golarai et al., 2007; Passarotti et al., 2007). No imaging study, however, has quantified diffuse versus focal activity to faces versus non-face objects in the inferior temporal cortex as a function of age. Examining distributed information across a number of voxels throughout development can show more subtle changes in activity, by characterizing the landscape of neural representations rather than simply measuring the "peak" activity. Sixty-two participants (ages 5-35 years old) were shown pictures of faces and houses while fMRI scans were acquired. Our initial univariate analyses confirm that there was a positive correlation between age and the BOLD signal in both the bilateral fusiform gyrus (p<0.03) to faces relative to houses, and in the bilateral parahippocampal gyrus to houses relative to faces (p<0.03). In order to look beyond peak activity, we demonstrate a method to quantify the degree to which category-specific activity in the inferior temporal cortex changes from diffuse to focal as a function of age and performance. These results provide a better understanding of how the neural representation of faces changes across development.

F57

THE DEVELOPMENTAL PATTERN OF STIMULUS AND RESPONSE INTERFERENCE IN A STROOP TASK: AN ERP STUDY *Ellen Jongen[1], Lisa Jonkman[1]; [1]Maastricht University* – Event-related potentials (ERPs) were employed to investigate the temporal course and development of stimulus and response interference (SI; RI). A color-object version of the two-choice button-press Stroop task (de Houwer, 2003) was used. Twenty-one adults and fifty-four children, allocated to one of three age groups (6-7, 8-9, 10-12 year-olds), participated. Behavioral results showed no effect of SI in any of the groups. Regarding RI, children made more errors than adults. Reaction time results showed no developmental differences, but an effect of RI in every group. ERPs indicated there was SI, but only in the two youngest groups. More specifically, SI evoked (1) an early right-hemispheric occipital modulation (80-140 ms) in 6-7 year-olds, most likely indicating an early perceptual conflict caused by the incongruency of the presented object's color and it's canonical color; (2) a sustained negative modulation (400-560 ms) spread over the entire scalp in 6-7 year-olds and 8-9 year-olds. Given the absence of SI in behavioral data, the latter may be a reflection of interference control. RI evoked (1) a posterior negative modulation (440-540 ms), distributed over both hemispheres in 10-12 year-olds and lateralized over the left hemisphere in adults; (2) a sustained positive modulation (680-960 ms) in all groups at fronto-central and central sites, and additionally over centro-parietal and posterior sites in 8-9 year-olds. The implications of these results will be discussed.

F58

DIFFERENT DEVELOPMENTAL PATTERNS OF STIMULUS VERSUS RESPONSE INTERFERENCE CONTROL IN A FLANKER TASK; AN ERP STUDY. *Lisa Jonkman[1], Floortje Sniedt[1]; [1]Maastricht University, The Netherlands* – The present study investigated how much the development of the ability to suppress interfering information depends on whether conflict is present at stimulus level or at response level. Stimulus and response conflict was manipulated by presenting subjects with a letter flanker task in which subjects had to respond to 4 target letters with a left- (B,H) or a right-hand (F,T) response. The target letters were flanked by either 1) neutral flankers (NT: *F*), 2) congruent flankers (CO:FFF), 3) incongruent flankers mapped to the same hand (Stimulus-Interference(SI):BHB). In a fourth condition, additional response interference was manipulated (RI) by presenting flankers that were mapped on the opposite response hand (i.e.:BFB). Performance and 60-channel ERP data was collected from three groups of children; 6-7 yr-olds (n=19), 8-10 yr-olds (n=20), 10-12 yr-olds (n=17) and young adults (n=21). Behavioral analyses showed that SI only caused interference in the 6-7 year-old children by slowing RT and enhancing errors. Response interference (RIvsSI) only slowed responses in 10-12 year-olds and adults, but enhanced errors in all age groups. The P170 component at PO7 and PO8 was significantly enhanced in response to all stimuli flanked by letters (independent of congruency) compared to neutral stimuli, this effect was stronger in children than adults. Preliminary analyses showed no effect of SI or RI on fronto-central P2 and N2, but early centro-parietal positivity (P3) was significantly influenced by response interference in adults (reduced positivity to RI than SI), but not in children. These results will be discussed.

F59

ADOLESCENTS WHO WERE BORN VERY PRETERM HAVE DECREASED THALAMIC VOLUMES *Anastasia Kalpakidou[1], Tiago Marques[1], Larry Rifkin[1], Robin Murray[1], Chiara Nosarti[1]; [1]King's College London Institute of Psychiatry, UK* – Very preterm birth (VPT) is associated with structural and functional brain alterations and cognitive and behavioral deficits in adolescence. The thalamus has been found to be decreased in volume and to be implicated in language and response inhibition processing in VPT adolescents compared to controls. The aim of this study was to quantify thalamic volume in VPT adolescents and controls. As the thalamus has been found to modulate behavioral responsiveness and externalizing symptoms in humans, we further examined the association between thalamic volume and behavioral functioning. Structural MRI was performed in 70 adolescents who were born before 33 weeks of gestation (mean age 14 years), and 41 age and gender-matched controls. Thalamic volumes were calculated using a region of interest approach. The Rutter Behavioral Scale was administered, which assesses emotional, conduct problems and hyperactivity. A previous study with the same sample found that hyperactivity scores were higher in VPT adolescents compared to controls. After adjusting for whole brain volume and ventricular size, VPT adolescents had a 6.5% decrease in total thalamic volume compared to controls (F (109) =1.63, P = 0.013). No significant correlations between total thalamic volume and behavioral scores were observed in either group. We conclude that VPT adversely affects the development of the thalamus possibly due to the consequences of hypoxic-ischemic damage. Thalamic volume was however not significantly associated with the selective behavioral variables studied, possibly due to alterations in patterns of structure-function relationships following early brain injury, which will be further investigated with connectivity analysis.

F60

NEUROPLASTICITY-BASED COGNITIVE TRAINING IN SCHIZOPHRENIA NORMALIZES MAGNETOENCEPHALOGRAPHY AUDITORY DURATION MISMATCH RESPONSES IN CORTEX *Kasra Khatibi[1], Anne M. Findlay[1], R. Alison Adcock[3], Karuna Subramaniam[1,2], Stephanie Aldebot[1,2], Adelaide Hearst[1,2], Mary Vertinski[1,2],* *Elysa J. Marco[1], Srikantan Nagarajan[1], Sophia Vinogradov[1,2]; [1]UCSF, [2]San Francisco VA Medical Center, [3]Duke University* – Patients with schizophrenia show a number of abnormal cortical responses during early sensory processing, including an abnormal (reduced or absent) duration mismatch response (MMR) to auditory stimuli. We investigated whether intensive neuroplasticity-based cognitive training of auditory processes could normalize the MMR in schizophrenia subjects. Sixteen subjects were matched based on IQ, age, gender, and symptom severity, and then randomly assigned to receive either 40-60 hours of neuroplasticity-based targeted cognitive training (TCT) of auditory processing, or an equivalent number of hours of a computer games (CG) control condition. Eight healthy control (HC) subjects were also studied. Whole-head MEG responses were obtained before and after interventions, while subjects passively listened to auditory tones in noise (-7 dB signal to noise ratio). Stimuli consisted of frequently occurring complex tones (standards, 80 ms long) randomly interspersed with deviants (40 ms long) at a probability of 0.16. Using in-house noise and interference suppression algorithms, we extracted the average stimulus locked responses for deviant tones, and for the standards that immediately preceded deviants. At baseline, schizophrenia subjects showed an absence of the normal MMR at 200-250 ms post-deviant stimuli, compared to HCs. After training, TCT subjects (4 out of 5 of currently analyzed subjects) displayed an MMR at 200-250 ms, comparable to the response in the HCs, while the CG subjects did not. Thus, neuroplasticity-based training conferred normalization of early cortical responses to auditory stimuli, while computer games did not.

F61

THE ROLE OF SOCIAL CUES IN LONG-TERM MEMORY IN INFANTS *Franziska Kopp[1]; [1]Max Planck Institute for Human Development, Berlin, Germany* – Social cues have a facilitating effect on object processing in infants as was shown using event-related brain potentials (ERP). The aim of the present study was to test whether this facilitating effect could be observed for long-term memory processes as well. 4-month-old and 9-month-old infants were familiarized with visual stimuli: In the joint attention condition the experimenter alternated gaze between infant and object while expressing short vocalizations and positive affect. In the non-joint attention condition the experimenter looked constantly to the toy and not to the infant while vocalizations were presented via loudspeakers. The procedure was applied until infants had reached a cumulative looking time of 20 s per object. EEG was recorded in a recognition test phase where familiar items were presented with novel items in random order. This test phase was repeated after one week to test for long-term memory effects. Event-related potentials were calculated for familiar and novel objects. Results showed a novelty effect in both recognition phases. Furthermore, 9-month-olds' ERP responses differed between the joint attention and the non-joint attention condition. Differential effects were found for 4-month-olds and 9-month-olds for immediate recognition and recognition after one week. Results indicate the importance of social interactions for infant learning and long-term memory.

F62

WORKING MEMORY FOR NUMBERS, LETTERS AND FACES IN 8-YEAR-OLD CHILDREN AND ADULTS *Melissa Libertus[1,2], Elizabeth Brannon[1,2], Kevin Pelphrey[2,3]; [1]Center for Cognitive Neuroscience, Duke University, [2]Duke University, [3]Carnegie Mellon University* – According to Baddeley's model of working memory (WM), verbal WM relies on storage and rehearsal processes in the phonological loop. Neuroimaging studies typically find activation in the prefrontal and parietal cortices during verbal WM tasks. However, a recent study also reported stimulus-specific activation for a numerical WM task in the intraparietal sulcus, a brain area typically associated with semantic processing of numerical information (Knops et al., 2006). In the present study, we investigate whether letters and faces in addition to numbers elicit stimulus-specific activation in a WM task. Furthermore, we were interested in determining whether children who have less experience with numerical symbols and letters than adults also show automatic activation of these stimulus-specific brain regions. To this end, 8-year-old children (N=13) and adults (N=13) performed a 2-back WM task with three different stimulus conditions (numbers, letters and face images) while their brain activity was measured using functional magnetic resonance imaging (fMRI). Overall, children performed significantly slower and less accurate on all three working memory conditions; however, within each age group, performance between the three conditions was very similar. For adults, we found stimulus-specific activation in the intraparietal sulcus in the numerical WM condition, in the inferior temporal lobes in the letter condition, and in the fusiform gyrus in the face condition. In contrast, for children we only found stimulus-specific activation in the fusiform gyrus in the face condition. These results suggest that children do not yet automatically activate brain regions associated with semantic processing for numerical symbols and letters.

F63

HOW THE BRAIN REPRESENTS FULFILLED AND UNFULFILLED INTENTIONS *Jörg Meinhardt[1], Beate Sodian[1], Claudia Thoermer[1], Katrin Döhnel[2], Monika Sommer[2]; [1]University of Munich, [2]University of Regensburg* – The understanding of intentional action is one of the building blocks of a Theory of Mind (ToM), the ability to interpret and predict human behaviour by attributing inner states to the agent. Understanding intentions and desires are developmental precursors to belief-based reasoning. Studies seek to tap into neurophysiological distinct processes of these different abilities in adults. However, whereas several ERP studies investigated belief reasoning only little is known about the electrophysiological correlates of intention attribution. In the present ERP study we presented cartoon stories which only differ in their verbal vignette and realized three experimental conditions: intention fulfilled, intention not fulfilled and a non mentalizing reality condition. The task of the participants (N = 16 adults) was to indicate the emotional state of the protagonist in respect to the fulfilled or unfulfilled intention. In the non mentalizing condition participants have to judge the ongoing action. The ERP waveforms at anterior frontal sites (AF7) were affected by the experimental conditions in two epochs. Both intentional (mental) conditions (fulfilled and not fulfilled) showed more negative waveforms at 400 ms poststimulus in comparison to the reality condition. In addition, a late negative slow wave (500-800 ms poststimulus) was larger for fulfilled intentions than for not fulfilled intentions or the reality condition. The earlier waveform may reflect a matching process between intention and reality whereas the later waveform may indicate ongoing processing of fulfilled intentions. These results are discussed on the basis of distinct neurocognitive processes associated with intention processing and belief reasoning.

F64

ERPS TO PLACE OF ARTICULATION CUES IN PRESCHOOL-AGED CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT *Scott Miller[1], Jeanne Johnson[2], Paul Yoder[3], Dennis Molfese[4]; [1]University of Wisconsin – Madison, [2]Washington State University, [3]Vanderbilt University, [4]University of Louisville* – Efforts to test the hypothesis that deficits in temporal acuity account for specific language impairment (SLI) have tended to focus on children who are at least school-aged, because of difficulties in quantifying relevant perceptual abilities in infants, toddlers, and preschoolers. Event related potentials (ERPs) to speech place of articulation cues, which are carried by rapid changes in acoustic information, may offer a sensitive, developmentally appropriate measure for testing this theory across all age groups; but the only study to date that has examined ERPs to speech stimuli in this population sampled children who were 5 years old and older. The current study showed that early ERP components in response to an equal probability presentation of the synthesized syllables /da/ and /ga/ differentiated preschoolers with SLI from age-matched typically developing peers (n = 28, N = 56) to a significant but limited degree. Because variance accounted for and classification accuracy were low to moderate, a multi-factorial model of SLI may be most consistent with these results.

F65

RELATIONSHIPS BETWEEN BRAIN STRUCTURE AND BIMANUAL TASK PERFORMANCE IN HEALTHY ADOLESCENTS *Ryan Muetzel[1], Paul Collins[1], Kelvin Lim[1], Monica Luciana[1]; [1]University of Minnesota* – Adolescent development is characterized by dramatic behavioral changes in motor dexterity, executive functioning, and attention as well as changes in neural architecture. The structural brain changes associated with adolescent development have been studied primarily with conventional magnetic resonance imaging (MRI) and to a lesser extent, diffusion tensor imaging. With the exception of functional imaging, limited work has examined relationships between brain development and behavioral change. The current study incorporated a longitudinal design to examine the development of bimanual motor performance in relation to brain structure. Healthy adolescents (n=45) were scanned twice, with a two-year period between scans. Bimanual performance was assessed at both time-points. Automated tissue parcellation (FreeSurfer) was applied to T1-weighted images yielding cortical thickness, surface area, and gray and white matter volume for pre- and post-central gyri. Volumes for five regions of the corpus callosum (CC) were also computed. Changes in tissue over the two-year time span were assessed by computing difference scores for each region between sessions. The same approach was used for bimanual motor performance. Significant relationships were observed between bimanual task performance and posterior-CC volume changes, as well as white matter changes in the pre- and post-central gyri. Similarly, gray matter volume changes in pre- and post-central gyri were significantly related to improvements in task performance. These preliminary findings relate structural brain characteristics to behavioral performance using a longitudinal design. To our knowledge, this is the first study to examine bimanual task performance in relation to callosal and gyral structure in the developing adolescent brain.

F66

THE DEVELOPMENT OF BRAIN SYSTEMS FOR EPISODIC MEMORY RETRIEVAL *Noa Ofen[1], Xioaqian Jenny Chai[1], Karen D.I. Schuil[1], Ayesha Hameed[1], John D.E. Gabrieli[1]; [1]Brain and Cognitive Sciences, MIT, MA* – Multiple brain regions are involved in episodic memory retrieval in adults, but the brain regions that support episodic memory retrieval in younger children have not been identified. This study investigated the development of brain regions involved in episodic memory retrieval. Participants (age range 8-21, n = 24) studied 140 pictures of indoor and outdoor scenes and then were given a recognition test while being scanned with 3T MRI scanner. Participants made old/new decisions for the previously studied pictures and 140 new pictures. Participants correctly recognized 0.51 ± 0.13 of the studied pictures (Hit rate, mean ± SD) and correctly gave a 'new' response to 0.76 ± 0.10 of the new pictures (CR rate). Recognition accuracy (Hit + CR) increased with age (r = 0.53, p = 0.007). Frontal, parietal, and temporal cortical regions and basal ganglia regions were active for successful retrieval (Hits > Misses). Within these regions activations associated with successful retrieval increased with age in left anterior PFC (BA 10), left lateral parietal cortex (BA 7/40) and left medial PFC (BA 9/32). Activations for successful retrieval correlated with recognition accuracy, across participants, in left parietal cortex and medial PFC but not in anterior PFC. These results suggest that with age, frontal and parietal regions are progressively recruited to reach adult-like pattern of brain activation during episodic memory retrieval. Furthermore, these results suggest differential developmental trajectory for anterior PFC and lateral parietal cortical regions supporting episodic memory retrieval.

F67

LONGITUDINAL CHANGES IN DELAY DISCOUNTING RATE DURING ADOLESCENCE AND EFFECTS OF WHITE MATTER DEVELOPMENT *Elizabeth Olson[1], Paul Collins[1], Catalina Hooper[1], Ryan Muetzel[1,2], Kelvin Lim[1,2], Monica Luciana[1,3]; [1]University of Minnesota, [2]University of Minnesota/ Center for Magnetic Resonance Research, [3]University of Minnesota/ Institute of Child Development* – Discounting tasks assess the extent to which the subjective value of a reward decreases as the time until the delivery of the reward increases. This lab has previously demonstrated differences in discounting behavior across adolescent age groups (Olson et al., 2007). In this study, healthy adolescents ages 11-25 returned for a follow-up visit at which the delay discounting rate was assessed longitudinally after a 2-year interval. In addition, they completed a follow-up diffusion tensor imaging (DTI) brain scan using a 3T magnet. A voxelwise approach was used to analyze the data. We examine how within-subject developmental changes in white matter organization are associated with within-subject developmental changes in delay discounting behavior. These findings will be discussed relative to theories of adolescent brain development and the neural networks presumed to underlie discounting behavior.

F68

WORD READING IN BILINGUAL CHILDREN: AN FMRI STUDY *Elizabeth A. Owens[1], Noemí Aznar-Besé[1], Gayane Meschyan[1], Arturo E. Hernandez[1]; [1]University of Houston* – The purpose of the present study was to compare neural mechanisms in bilingual children and adults, and to determine the effects of language proficiency level on neural activity during a single word, reading task. All children (8 - 13 yrs.) and adults (18 - 40 yrs.) were right-handed, early Spanish-English bilinguals, having learned Spanish first, followed by English before the age of 7 years. A list was compiled of 30 Spanish and 30 English, early learned, high frequency words, which were controlled for age of acquisition (AoA), frequency, concreteness, and length. During the functional magnetic resonance imaging (fMRI) experiment, words were presented on a screen one at a time, in block design, and counterbalanced across participants. Participants were instructed to read the words silently and press a hand-held button after they had read each word. Children showed differences in English and Spanish. Increased neural activity for Spanish was found in the middle and superior temporal gyrus. In English, there was increased activity in the left anterior cingulate gyrus. Although adults showed similar differences between Spanish and English, the neural activity differences were much larger in magnitude. Taken together these results suggest that adults show larger differences between languages as proficiency changes across development.

F69

FMRI CONFIRMATION OF MEG EXPRESSIVE LANGUAGE LOCALIZATION IN A GROUP OF TEENAGERS *Elizabeth Pang[1,2], Frank Wang[1], Marion Malone[1], Darren Kadis[2], Elizabeth Donner[1,2]; [1]The Hospital for Sick Children, [2]The University of Toronto* – Functional MRI is the gold standard for the non-invasive localization of expressive and receptive language to Broca's and Wernicke's areas, respectively. Magnetoencephalography (MEG) is a newer neuroimaging technology that combines the spatial resolution of fMRI with high temporal resolution. While there are established MEG protocols for receptive language, there is a paucity of data regarding expressive language localization. In this study, we had a two-fold objective: to develop MEG expressive language tasks suitable for use in our clinical paediatric population, and to directly compare these new MEG tasks to homologous fMRI tests. Ten healthy, right-handed, English-speaking teenagers were tested with both fMRI and MEG. Three covert tasks were included: picture naming, picture verb generation (think of an action that corresponds to the presented object), and word verb generation (think of an action that corresponds to the presented word). fMRI acquisition and analysis followed our standard clinical protocols. MEG data were analysed with differential synthetic aperture magnetometry (SAM). As expected, the fMRI group averaged data demonstrated significant activation in left inferior frontal gyrus for all three tasks. The group averaged MEG results demonstrated significant beta band (13-30 Hz) desynchrony at 300-600 msec post-stimulus in left inferior frontal gyrus. Desynchrony in this frequency band has been found to correlate with fMRI localizations with other cognitive tasks. In summary, our three MEG expressive language tasks showed high localization concordance with traditional fMRI tasks. Furthermore, our use of picture-based stimuli makes this a promising candidate for localizing expressive language in the clinical paediatric setting.

F70

NEUROCOGNITIVE DEVELOPMENT OF MEMORY SUPPRESSION *Pedro M. Paz-Alonso[1], Simona Ghetti[2], Michael J. Souza[1], Michael C. Anderson[3], Silvia A. Bunge[1]; [1]Helen Wills Neuroscience Institute, University of California, Berkeley, [2]University of California, Davis, [3]University of Oregon, Eugene* – The Think/No-Think (TNT) paradigm has attracted substantial interest for the study of the intentional suppression of memories. Neuroimaging evidence with adults suggests that this suppression results from interactions between lateral prefrontal cortex and the hippocampus. Specifically, attempts to suppress memory retrieval were associated with increased lateral prefrontal activation and decreased hippocampal activation relative to unregulated memory retrieval. Our behavioral research indicates that children aged 8-9 have difficulty suppressing memories in the TNT paradigm, whereas children aged 11-12 perform similarly to adults. Thus, we hypothesize that children aged 8-9 exhibit weaker prefrontal control over hippocampal activation than older children or adults. The present fMRI study is aimed at investigating the neurodevelopmental underpinnings of memory suppression. A total of 54 healthy participants from three age groups (8-9-yr-olds, 11-12-yr-olds, and adults) will participate (current N = 12). After learning a series of word-pairs (e.g., Vacation-Palm), participants are presented with the first word (Vacation), and are asked to either remember (i.e., Think condition) or suppress (i.e., No-Think condition) the second word (Palm). fMRI data is acquired during this Think/No-Think phase. In the final recall phase, suppressed targets typically are remembered less than baseline items (Baseline condition). Preliminary fMRI data indicate that, in 11-12-year-olds but not 8-9-year-olds, hippocampal activation is reduced for No-Think trials that were subsequently forgotten relative to Think trials that were subsequently remembered. We predict that the negative correlation between prefrontal and hippocampal activation during memory suppression will increase with age, as a function of improved control over mnemonic processing.

F71

DEVELOPMENTAL DIFFERENCES IN PREFRONTAL AND SUBCORTICAL ACTIVATION DURING INHIBITION AS DETERMINED USING MAGNETOENCEPHALOGRAPHY (MEG) *Brendan Rich[1], Laura Onelio[1], Tom Holroyd[2], Frederick Carver[2], Richard Coppola[2], Daniel Pine[1], Ellen Leibenluft[1]; [1]Mood and Anxiety Program, National Institute of Mental Health, [2]MEG Core Facility, National Institute of Mental Health* – Introduction: The neural circuitry mediating inhibition varies developmentally, likely because frontal regions, central to inhibition, are among the last brain regions to mature. Magnetoencephalography (MEG), with excellent temporal resolution, allows for the measurement of distinct components of cognitive activity. We used MEG to differentiate neural activation that occurs before compared to after successful and failed inhibition, and thereby explore the neural developmental progression of the inhibitory process.Method: 15 youths (14.27 ± 2.25 years) and 15 adults (34.75 ± 10.18 years) completed the stop-signal task of behavioral inhibition. Neuromagnetic data were collected with a whole-head 275-channel SQUID sensor. We examined neural activation in the theta, alpha, beta, and gamma bands. Results: Whole-sample MEG analyses identified a fronto-thalamic-parietal network active prior to successful inhibition, and a temporal-occipital network active following successful inhibition. Developmental comparisons found that before successful inhibition, youths compared to adults had greater alpha desynchronization of the right superior frontal gyrus (SFG), while adults compared to youths had greater gamma synchronization in the left thalamus. Whereas alpha desynchronization in the left anterior cingulate cortex (ACC) preceded successful inhibition in youths, it preceded failed inhibition in adults. Discussion: Whereas youths may rely on working memory and planning mediated by the SFG for successful inhibition, adults may rely more on automatic processing mediated by thalamo-cortical circuitry. These MEG results both agree with and contrast recent fMRI studies of inhibition, supporting the utility of MEG as an important neuroimaging technique for improving our understanding of neural maturation.

F72

TRAINING EXECUTIVE ATTENTION: LASTING EFFECTS AND TRANSFER TO AFFECTIVE SELF-REGULATION *M Rosario Rueda[1], Purificacion Checa[1], Milagros Santonja[1]; [1]University of Granada, Spain* – Executive attention development appears to be subject to important constitutionally-based individual differences such as those rooted in genetic and temperamental variability. However, we have shown in the past that the efficiency of the executive attention network also seems to be influenced by experience. We have developed a series of computer exercises designed to train children's executive attention. Data from several studies show that both normal children and children suffering from attention-related deficits (e.g. autism) show signs of greater attentional efficiency after training as measured by both behavioral assessments and patterns of brain activation. In the current study, we have tested the lasting effects of a 10 session program of training attention in a group of 37 five-year olds. In addition, we have explored the transferring effects of attention training to aspects of intelligence and affective regulation. Data replicated beneficial effects of training in cognitive and brain measures of attentional control. In addition, the trained group still showed significant benefits on attention and reasoning abilities in two months follow up. Our data also showed a modest transfer of attention training to performance of affectively-relevant control tasks.

F73

TEMPORAL REWARD DISCOUNTING IN CHILDREN AND ADOLESCENTS WITH ADHD: EFFECT OF REWARD MAGNITUDE *Anouk Scheres[1], Allison Lee[1], Chandra Tontsch[1], Antonia Kaczkurkin[1]; [1]University of Arizona* – Background - Attention-Deficit/Hyperactivity Disorder (ADHD) is a common child psychiatric condition, of which the underlying neuropsychological mechanisms remain largely unclear. Theories have proposed that ADHD is associated with relatively strong preferences for small immediate rewards over large delayed rewards, also termed "delay aversion". However, paradigms in previous research were not optimized for measuring the trade-off between reward magnitude and delay durations. Methods – We used a temporal reward discounting paradigm that was optimally designed to measure this trade-off. Participants were between 6 and 17 years of age, and had ADHD (n= 15), or were healthy controls (n=20). Participants were presented with choices between a small immediate reward and a large delayed reward. Rewards were small amounts of money. The large reward was delayed between 5 and 60 seconds, and was either 10 or 5 cents. The small immediate reward varied in magnitude, and was between 1 and 4 cents when the large reward was 5 cents. It was between 2 and 8 cents when the large reward was 10 cents. Results – Preliminary data suggest that the ADHD group had a stronger preference for small immediate rewards than controls when the large delayed reward was 5 cents, but not when it was 10 cents. Conclusions - These findings suggest that delay aversion in ADHD may not be a robust finding, but rather one that is highly sensitive to specific task manipulations. Reward magnitude appears to be an important factor that determines whether or not delay aversion is observed in ADHD.

F74

FIFTEEN MONTHS OF MUSICAL TRAINING INCREASES THE SIZE OF THE CORPUS CALLOSUM IN YOUNG CHILDREN *Gottfried Schlaug[1], Marie Forgeard[1,2], Andrew Norton[1], Andrea Norton[1], Justin Bachorik[1], Udita Iyengar[1], Ellen Winner[2]; [1]Beth Israel Deaconess Medical Center and Harvard Medical School, [2]Boston College and Project Zero, Harvard Graduate School of Education* – As the main interhemispheric fiber tract, the corpus callosum (CC) is of particular importance for musicians who simultaneously engage parts of both hemispheres to process and play music. Past research has shown that professional musicians who began musical training before age seven have larger anterior CC areas than nonmusicians. These results suggest that plastic changes due to musical training may occur in the CC during early childhood. However, no study to this date has demonstrated that the increased CC area found in musicians is due to musical training rather than to preexisting differences. We tested the hypothesis that fifteen months of instrumental musical training would cause a significant increase in total CC area (corrected for total brain volume) in a group of six-year-old children compared with a matched control group. The two groups did not differ at baseline in total CC area. After fifteen months, children who practiced their instrument at least 1.5 hour per week showed significantly larger proportional increases in total CC area than controls did. Furthermore, the average number of minutes per week children practiced their instrument predicted the amount of proportional change in CC area, thus showing that there is a dose-response relationship between instrumental training and increase in CC size. Our results confirm that musical experience, and not preexisting differences, are responsible for the larger CC area found in adult professional musicians

F75

AFFECT REGULATION AFTER SOCIAL EXCLUSION IS STILL DEVELOPING DURING ADOLESCENCE *Catherine Sebastian[1], Essi Viding[1], Kipling Williams[2], Tony Charman[1], Sarah-Jayne Blakemore[1]; [1]University College London, [2]Purdue University* – Adolescents are particularly susceptible to peer pressure, and sensitivity to social exclusion may be a contributory factor. This is a powerful social tool; with Williams et al. (2000) showing that sensitivity to social exclusion predicts later conformity levels. Regulation of the distress resulting from social exclusion depends on ventrolateral prefrontal regions (Eisenberger et al., 2003), which are still developing during adolescence (Gogtay et al., 2004). The current study looked at affective and cognitive reactions to an experimental social exclusion manipulation (Cyberball) in two groups of adolescent girls (aged 11-13 and 14-15) and adult women. Exclusion led all groups to report that key psychological needs were threatened (belonging, control and meaningful existence) relative to baseline. Despite levels of need threat being equivalent across groups, the affective consequences were stronger in the adolescents, with greater anxiety, lower self esteem and lower mood reported after exclusion than in adults. The findings suggest that the ability to regulate distress associated with social exclusion develops between adolescence and adulthood. This may depend on the maturation of the relevant neural structures.

F76

ESTABLISHING A RELATIONSHIP BETWEEN PREFRONTAL CORTEX FUNCTION, SOCIOECONOMIC STATUS, AND CORTISOL REACTIVITY IN CHILDREN *Margaret Sheridan[1,2], Sarsour Khaled[3], D'Esposito Mark[4,5], Boyce W. Thomas[6]; [1]School of Public Health, Harvard University, [2]Children's Hospital Boston, [3]Eli illy & Company, [4]University of California, Berkeley, [5]Helen Wills Neuroscience Institute, [6]College for Interdisciplinary Studies and Faculty of Medicine, University of British Columbia* – Population health research has consistently demonstrated that children who grow up in low socioeconomic status (SES) environments experience poor health outcomes in childhood and adulthood. Environmental conditions associated with poverty such as crowded and noisy environments are associated with increased stress reactivity and decreased cardiovascular health in childhood. Animal studies confirm that exposure to stressful experience early in development results in increased stress reactivity in adulthood. Stress exposure is associated with a peripheral and central increase in catecholamines and glucocorticoids, hormones known to have short and long term effects on neural structure and function. Poverty could modify neural function in at least two ways, by early modification of stress reactivity, or by continuous exposure to stress hormones directly modifying neural structures. In the current study we measure prefrontal function in 18 children (aged 8-11) from either high or low SES backgrounds. We measured cortisol reactivity to fMRI scanning, a moderately stressful and novel experience. During scanning, participants performed two rule-based previously learned arbitrary stimulus response (SR) mappings and learned two novel SR mappings. While performance on the previously learned SR mappings was not different between groups, children from low SES backgrounds learned the novel SR mappings less quickly than children from high SES backgrounds. Performance on this task was significantly correlated with a measure of income to needs ratio and cortisol reactivity during scanning. These results replicate and extend previous studies demonstrating a relationship between SES and performance on tasks requiring prefrontal function.

F77

THE PROCEDURAL LEARNING OF ACTION ORDER AND TIMING IN YOUNG CHILDREN IN A SERIAL REACTION TIME TASK *Jacqueline Shin[1]; [1]Indiana State University* – The procedural learning of timed movement sequences was investigated in elementary school children grades 1-3 and adults. A version of the serial reaction time task was used in which spatial information that specified the order of manual responses and timing information (response-to-stimulus intervals) varied from trial to trial. Response order and timing were presented in repeating sequences simultaneously in a phase-matched manner. Learning for either sequence was probed by observing performance costs associated with randomizing one dimension while maintaining the sequenced presentation of the other. Similarly, a phase shift between the initially correlated response and timing sequences was introduced to evaluate whether the two sequences had become integrated into a common sequence representation. The main results were that in both children and adults, learning for the response sequence as well as integrative learning were significant. The current finding that the pattern of learning was similar in both age groups suggests that the neural mechanisms for acquiring temporal coordination in sequenced actions may already be mature by early childhood.

F78

EFFECT OF DOPAMINE TRANSPORTER GENOTYPE ON WORKING MEMORY MAINTENANCE IN CHILDREN *Devon Shook[1], Jennifer Foss-Feig[1], Colin Brady[1], Edwin Cook[2], Mark Stein[2], Laura Kenealy[3], Chandan Vaidya[1]; [1]Georgetown University, [2]University of Illinois Chicago, [3]Children's National Medical Center* – Neuroimaging studies of adults have shown that prefrontal contribution to executive function differs by the polymorphism of the dopamine transporter genotype (DAT1). In typically developing children, studies of individual differences by DAT1 have focused upon behavioral differences in inhibitory function. It is unknown whether prefrontal contribution to working memory differs by DAT1 in typically developing children. We performed functional magnetic resonance imaging during the Sternberg working memory task with loads 5 and 3 letters (relative to 1 letter) in 8-12 year old children with either two copies (10/10) or 1 copy (9/10) of the 10 repeat allele of DAT1. Performance accuracy did not differ between groups but was reduced for memory load of 5 than 3 letters relative to 1 letter. Accuracy was marginally reduced for load 5 than 3 letters. Thus, behaviorally, both groups had a similar response to working memory load. In the brain, response to memory load, i.e., regions that were more activated for memory set of 5 vs. 1 letter relative to 3 vs. 1 letter, was mediated by bilateral ventrolateral prefrontal cortex in the 10/10 children but by right dorsolateral prefrontal cortex in the 9/10 children. Differences in prefrontal engagement based upon DAT1 in childhood suggests that genotypic modulation of dopaminergic function is evident early in maturation. Funded by NIMH MH065395

F79

DECREASED FUNCTIONAL CONNECTIVITY OF MOTOR CIRCUITS IN AUTISM *Daniel J. Simmonds[1], James J. Pekar[1,2], Stewart H. Mostofsky[1,2]; [1]Kennedy Krieger Institute, Baltimore, [2]Johns Hopkins University School of Medicine* – Recent studies using functional magnetic resonance imaging (fMRI) have demonstrated decreased functional connectivity in autism across a wide range of brain regions and tasks. Abnormalities in motor development are common in children with autism and may also be associated with poor connectivity between regions important for motor skill learning and execution. To address this, we investigated functional connectivity differences in autism during performance of a motor task. Thirteen children with high functioning autism (HFA) ages 8-13 and thirteen age- and gender-matched typically-developing (TD) controls completed a simple finger-sequencing task during fMRI, alternating between 30s periods of rest, right-handed finger-sequencing (RHFS) and left-handed finger-sequencing (LHFS). Functional connectivity between seven task-relevant regions (bilateral primary motor, bilateral anterior cerebellum, bilateral thalamus and supplementary motor area) was measured as the correlation between fMRI time courses for each pair of regions (21 pairs) during each condition (rest, RHFS, LHFS). Repeated measures ANOVA revealed decreased connectivity across all region-pairs for each condition (rest:$F=9.0, p=.007$; RHFS:$F=11.0, p=.003$; LHFS:$F=10.5, p=.004$), particularly notable for ROI's involving the cerebellum ($F=15.2, p<.001$). Additionally, during finger-sequencing, differences were more pronounced in motor circuits for the hand not in use (RHFS:$F=15.6, p<.001$ vs. $F=8.6, p=.007$; LHFS:$F=16.2, p<.001$ vs. $F=8.7, p=.007$). Decreased functional connectivity of motor circuits in autism is consistent with findings of motor impairment in the disorder; moreover, decreased connectivity in circuits for the hand not in use may reflect poor bilateral motor regulation and may contribute to impaired acquisition and execution of motor skills in children with autism.

F80

A POSSIBLE COMMON NEUROCOGNITIVE BASIS FOR AT LEAST THREE DEVELOPMENTAL DISORDERS *Tony J. Simon[1], Hui Zhang[2], Brian Avants[2], James Gee[2], Elliott Beaton[1], Michele Mazzocco[4], Randi Hagerman[1], Juidth Ross[3]; [1]M.I.N.D. Institute, University of California Davis, [2]School of Medicine, University of Pennsylvania, [3]School of Medicine, Thomas Jefferson University, [4]Kennedy Krieger Institute, Johns Hopkins University* – Chromosome 22q11.2 deletion, Turner and fragile X syndromes share some phenotypic but not genotypic characteristics. Individuals from each population show relative strength in verbal and weakness in visuospatial, visuomotor and numerical cognition domains and some impairments of executive function. This overlap was the basis for our detailed neurocognitive investigation into possible common biological and functional bases for the shared impairments. We studied children aged 7 to 14 years using Magnetic Resonance Imaging to measure brain structure, function and connectivity and a set of experimental cognitive tests to examine the performance of neural circuits, particularly frontoparietal networks that subserve the operation of attentional and numerical functions. Despite intergroup differences in IQ measures, all three developmental disorder groups produced a strikingly similar performance pattern on the experimental tests that was significantly different to the one produced by typical controls. There was also a clear overlap in neural changes relative to controls. At least one common region of anomalous connectivity in the right parietal lobe was detected. Also neural activation in response to a multiple object tracking task, measured using fMRI, was significantly different in each developmental disability group to the pattern produced by controls. Results suggest the first evidence of similarities in the neurodevelopmental trajectory of these distinct disorders. We will discuss the patterns of similarity and difference that we have found and discuss some implications for future plans involving the design of therapeutic interventions.

F81

CHILDHOOD POVERTY AND LEARNING: MEDIAL TEMPORAL VERSUS STRIATAL LEARNING SYSTEMS *Elizabeth Smith[1], Martha Farah[1]; [1]University of Pennsylvania* – Memory performance on two implicit learning tasks was assessed in adolescents from low and middle socioeconomic status (SES) families. Prior work with these and other participants has demonstrated an SES disparity in declarative memory performance. Declarative memory relies on the medial temporal lobe, including the hippocampus, and is sensitive to stress hormone levels. Chronic stress exposure is associated with lower SES and could explain differences in hippocampal declarative memory performance, but what about other learning systems? Current computational memory models describe multiple interacting memory systems. Animal, patient, and neuroimaging studies corroborate these models and suggest hippocampal declarative memory is distinct from, and may even inhibit, striatal habit learning. If SES effects on declarative memory performance are driven by stress-related impairment of the hippocampus, then the SES disparity in neurocognitive performance should not extend to striatally-mediated learning. We assessed performance on two classic striatal habit learning tasks, a serial reaction time task and a probabilistic category learning task. As predicted, SES was not related to performance. We are in the process of replicating these findings and the earlier findings with declarative memory to more explicitly contrast non-declarative and declarative memory performance.

F82

REPETITION SUPPRESSION OF INDUCED GAMMA ACTIVITY PREDICTS ENHANCED ORIENTING TOWARD A NOVEL STIMULUS IN 6-MONTH-OLD INFANTS *Kelly Snyder[1], Andreas Keil[2]; [1]University of Denver, [2]University of Florida* – Habituation refers to a decline in orienting to a repeated stimulus, and can be inferred to reflect learning about the properties of the repeated stimulus when followed by increased orienting to a novel stimulus (i.e., novelty detection). Habituation and novelty detection paradigms have been used for over 40 years to study perceptual and mnemonic processes in the human infant, yet important questions remain about the nature of these processes in infants. The aim of the present study was to examine the neural mechanisms underlying habituation and novelty detection in infants. Specifically, we investigated changes in induced alpha, beta, and gamma activity in 6-month-old infants during repeated presentations of either a face or an object, and examined whether these changes predicted behavioral responses to novelty at test. We found that induced gamma activity to faces decreased with stimulus repetition ($t(25) = 2.98, p < .01$), and that greater decreases in the gamma-band were associated with enhanced orienting to a novel face at test ($r(17) = -0.52, p = .03$). In contrast, increases in induced alpha activity ($t(25) = -2.66, p = .013$) and decreases in induced beta activity (paired $t(25) = 2.20, p = .04$) with stimulus repetition were not associated with infants' behavioral responses to novelty. These findings suggests that gamma activity may play a role in encoding featural information about faces in infants, and that encoding in infant habituation paradigms may reflect a form of perceptual learning.

F83

NATURALLY-BIASED AND LEARNED INFLUENCES ON THE DEVELOPMENT OF SENSORY ASSOCIATIONS: THE COLORS OF THE ALPHABET *Ferrinne Spector[1], Daphne Maurer[1]; [1]McMaster University* – Many letters of the alphabet are consistently mapped to specific colors in English-speaking adults, both in the general population and individuals with grapheme-color synaesthesia who perceive letters in color (e.g., Simner et al., 2005). Such associations may be naturally-biased by intrinsic sensory cortical organization, or based in literacy (e.g., "A" is for "apple", apples are red, therefore A is red). To distinguish these hypotheses, we tested pre-literate children (aged 2.5-3), literate children (aged 7-9), and adults. For two letters (I/white, B/black), all three age groups (n= 20/age) made consistent mappings (all ps <.05). A follow-up study with toddlers (n= 40) indicated that the mapping was based on the shape of the letter (p<.05). and not its sound (ns). This is similar to the pattern we found previously for O(white) and X(black) and suggests that some color/letter mappings may be naturally-biased by sensory organization (Spector & Maurer, in press). In contrast, B and Y were mapped to blue and yellow by the literate groups (ps< .05) but not the toddlers (ns). This is similar to the pattern we found previously for A(red) and G(green), and suggests that some color/letter mappings are based in literacy. The results provide evidence that sensory cortical organization initially binds color to some shapes and that learning to read can induce additional associations, likely through the influence of higher order networks as letters take on meaning. In ongoing work, we are investigating the characteristics of shape and color that underlie these naturally-biased mappings.

F84

DEVELOPMENT OF REASONING AND EXECUTIVE CONTROL IN CHILDREN WITH AND WITHOUT ADHD *Melanie Stollstorff[1], Stephanie Bean[1], Christopher Tsang[1], Laura Kenealy[2], Ericka Ruiz[1], Michael Billington[1], Devon Shook[1], Chandan Vaidya[1,2]; [1]Georgetown University, [2]Children's National Medical Center* – Logical reasoning is an important process that develops throughout childhood and has been shown to rely critically on working memory and inhibitory control in normal control populations. The present study investigates logical reasoning, both abstract (content-free and belief-neutral) and concrete (belief-laden), in children with ADHD and age and IQ matched Controls. For Controls, overall reasoning ability and abstract reasoning increased linearly with age. Belief bias (the inability to suppress beliefs in favor of logic) significantly declined with age. Working memory correlated positively with overall reasoning ability, while inhibitory control correlated positively with belief bias suppression. The ADHD group had impaired logical reasoning relative to controls. In contrast to Controls, overall reasoning and belief bias did not correlate with age in the ADHD group. This group showed impairment in both working memory and inhibitory control relative to Controls and these measures did not relate to reasoning or belief bias. Therefore, different components of executive control related to different components of logical reasoning in Controls. In contrast, there was considerable variance in the development of reasoning in children with ADHD.

F85

LATERAL PREFRONTAL CORTEX ACTIVATION DURING MEDIA-RELATED AGGRESSION IN MALE ADOLESCENTS *Maren Strenziok[1,3], Frank Krueger[1], Rhoshel Lenroot[2], Elke van der Meer[3], Jordan Grafman[1]; [1]National Institute of Neurological Disorders and Stroke, National Institutes of Health, MD, [2]National Institute of Mental Health, National Institutes of Health, MD, [3]Humboldt University, Berlin, Germany* – Although clinical observations indicate that the prefrontal cortex modulates aggressive behavior in adults, little is known about the neural mechanisms of media-related aggression in male adolescents - a population that is exposed to media violence on a daily basis and bears a high risk for aggressive behavior. In an event-related fMRI experiment, 17 healthy male adolescents (mean age = 15.9, SD = 1.03 years, range 14 to 17) viewed three runs of realistic video scenes displaying different degrees of age-appropriate aggressive behavior. In a prestudy, videos were rated for aggression and excitement by a different group of age-matched males. Based on these ratings, we established three sets of videos that differed in aggression levels (low, mild, moderate), but not in excitement. First, we found deactivations in the lateral orbitofrontal cortex (lOFC) and dorsolateral prefrontal cortex (dlPFC) with increasing aggression levels in the scenes. Activation changes in both regions correlated with self-reported use of violent video games; the more violent the games subjects played, the stronger the deactivation. In addition, the dlPFC deactivation correlated with the personal distress scale of the Interpersonal Reactivity Index indicating a stronger deactivation corresponding to lower levels of personal distress. Second, comparing activation changes across runs, we found progressively reduced lOFC engagement over the course of the experiment. In conclusion, our results demonstrate that brain responses to aggressive media in the lateral prefrontal cortex are shaped by the strength of aggressive stimuli, continued exposure to violence, and the use of violent video games.

F86

THE ROLE OF CONTRAST POLARITY AND SUBCORTICAL VISUAL PATHWAYS IN RAPID ORIENTING TO FACE-LIKE STIMULI *Przemyslaw Tomalski[1], Gergely Csibra[1], Mark Henry Johnson[1]; [1]Centre for Brain and Cognitive Development, School of Psychology, Birkbeck, University of London* – Preferential orienting towards upright schematic face (white oval with three black dots) is present in newborns, indicating an innate bias in directing gaze towards faces. We investigated whether adults orient towards an upright schematic face faster than an inverted face and whether such effect is dependent on the contrast polarity of the stimuli. Participants were instructed to make speeded saccades to peripheral targets flashed briefly on the left or right side of the screen while their saccadic reaction times were measured by electrooculography. In Experiment 1, they made significantly faster saccades to upright than to inverted schematic faces with normal contrast polarity (black elements on white background), while failed to do so with reversed contrast polarity (white elements on black background). Restoring normal contrast properties within the eye region (black pupils within the white eyes) restored the orienting effect. In Experiment 2, the contribution of retinotectal pathway to this effect was assessed by presenting the normal contrast polarity stimuli to either the temporal or the nasal visual field. We found that saccades were faster to upright than inverted schematic faces predominantly in the temporal but not in the nasal visual field of each eye. Our results are consistent with the existence of a low-level, subcortical, face-biasing mechanism that is active in humans from birth through adulthood, allowing automatic and rapid detection and orienting towards face-like stimuli. In addition, the contrast polarity sensitivity of this effect suggests that preferential orienting is especially tuned to stimuli with gaze-relevant information.

F87

BRAIN RESPONSE TO OVERT AND MASKED HAPPY AND NEUTRAL FACES: AN FMRI STUDY WITH ADULTS AND CHILDREN *Angela Tseng[1], Kathleen M. Thomas[1]; [1]Institute of Child Development, University of Minnesota* – The amygdala has been consistently identified as a critical neural substrate for processing affective facial expressions, even when emotions are not consciously perceived. Prior research in children has suggested a neutral greater than fearful response that is opposite to the adult pattern, perhaps indicating a heightened sensitivity to neutral expressions in childhood. However, this developmental sensitivity to neutral faces has yet to be examined beyond the context of fearful faces. The present study utilized fMRI and a backward masking paradigm to examine the amygdala response to overt and covert presentations of happy and neutral faces. Eighteen children (8-9 years) and 12 adults completed 3 runs: 1) alternating blocks of fixation and neutral faces; 2) fixation and overt happy and neutral faces; and 3) fixation and masked (covert) happy and neutral faces. In the covert condition, participants viewed a brief (26ms) face stimulus (neutral or happy) masked immediately by a neutral face (169ms). Data from adults replicated previous reports of increased but equivalent amygdala activity to overt happy and neutral faces. Children showed amygdala activity to neutral greater than happy in both overt and masked conditions. Adults showed this same pattern with covert presentations. Notably, signal change to masked faces was significantly higher in children than adults. Additional analyses are underway to examine activity in other brain areas. Initial results indicate regions consistent with previous studies, including nucleus accumbens and cingulated gyrus. Results will be discussed in terms of developmental differences in the amygdala response to facial emotion.

F88

ADOLESCENT RISKY DECISION MAKING; THE RELATIVE CONTRIBUTIONS OF MOTIVATIONAL AND CONTROL CIRCUITRY *Linda Van Leijenhorst[1,2], Bregtje Gunther Moor[1,2,3], Zdenja op de Macks[1], P. Michiel Westenberg[1,2], Serge A.R.B. Rombouts[1,2,4], Eveline A Crone[1,2]; [1]Leiden University- Institute for Psychological Research, the Netherlands, [2]Leiden Institute for Brain and Cognition, the Netherlands, [3]University of Amsterdam, the Netherlands, [4]Leiden University Medical Center, the Netherlands* – Adolescence is often characterized as a period of increased risky behavior. It has been suggested in previous studies that immature decision-making abilities are related to the protracted development of prefrontal relative to limbic brain regions (Ernst, Pine & Hardin, 2006; Galvan et al., 2006). An imbalance between relatively mature motivational circuitry and immature cognitive control circuitry could bias adolescents to focus on potential rewards and engage in risky behavior. Our approach to studying decision-making under risk is to use tasks that require participant to choose between actions associated with uncertain rewards and punishments. To test the relative contributions of prefrontal and limbic regions in adolescent and adult risky decision-making, adolescents (10-12, and 14-15 years of age) and young adults (19-25 years of age) participate in an event related fMRI study using a child friendly version of a gambling task (Rogers et al., 1999). Participants choose between two gambles; a safe gamble, gambling with 50 cents and a 67% chance of winning, or a risky gamble, gambling with 2, 4, 6 or 8 euros and a 33% chance of winning. Feedback is presented on each trial, allowing us to dissociate brain activation related to risky decision-making and outcome processing. Behavioral results have shown an increase in risk-taking with an increase in the potential monetary reward (Van Leijenhorst, Westenberg & Crone, in press). We expect increased responsivity of motivational brain circuitry related to rewards for adolescents compared to adults, and decreased lateral prefrontal cortex activation related to negative outcomes.

F89

THE NEURAL BASIS OF PHONETIC PROCESSING SEEN THROUGH THE NEW LIGHT OF FNIRS *Katherine White[1], Ioulia Kovelman[3], Mark Shalinsky[4], Douglas McKenney[5], Matthew Dubins[2], Melody Berens[2], Laura-Ann Petitto[2]; [1]University of Rochester, [2]University of Toronto Scarborough, [3]MIT, [4]MGH, [5]Jerusalem University* – K. White2, I. Kovelman3, M. Shalinsky4, D. McKenney5, M. Dubins1, M. Berens1, and *L-A. Petitto11-University of Toronto Scarborough, 2-University of Rochester, 3-MIT, 4-MGH, 5-Jerusalem University. * = Corresponding Author. All infants discover the set of phonetic units that comprise their native language by 10-12 months. Is this capacity mediated by brain regions devoted to language processing or general auditory processing? We use Near-infrared Spectroscopy (fNIRS), which, like fMRI, measures hemodynamic change. But fNIRS is quiet, small, tolerates subtle movement and has good spatial and temporal resolution. In our pilot work, three-month-olds were presented with non-native (visual) phonetic units, Infant-Directed Speech (IDS), and a visual checkerboard control. With non-native phonetic units and IDS, neural activation increased robustly in Left STG, but not in the RH homologue (checkerboard stimulation did not cause increased STG activation)—suggesting that infants recruit classic LH areas when processing language. Here we tested young (2-6-months) and older (12-14-months) infants, and adults. Participants heard native and non-native phonetic units, and non-speech (tones), while neural activity was assessed with Hitachi fNIRS ETG-4000 (24- & 48-channel). Results will reveal whether (i) speech processing in 2-4 month-olds is initially mediated by the lateralized "language networks" (left Broca's, LSTG) observed in adults or by general auditory areas (bilateral STG), and (ii) how the processing of different types of phonetic units changes over development as a function of native language exposure/experience. The results will provide new clarity into long-standing debate about our capacity to discriminate, categorize, and process the linguistic stream when acquiring language. Funding-Petitto (PI): NIH R21HD05055802 and R01HD04582203.

F90

RELATIONSHIP OF VERBAL FLUENCY PERFORMANCE TO BRAIN VOLUMES DURING CHILDHOOD AND ADOLESCENCE *Samantha White[1], Rhoshel Lenroot[1], Gregory Wallace[1], Mark Celano[1], April Timberlake[1], Liv Clasen[1], Kristin Taylor[1], Jay Giedd[1]; [1]Child Psychiatry Branch, NIMH, NIH* – BACKGROUND: Phonemic and semantic verbal fluency (VF) tasks are frequently used measures of neuropsychological functioning. Previous work has shown that the number of words generated (whether phonemic or semantic) increases with age from childhood into young adulthood (White 2007). To explore the neuroanatomical substrate of VF ability we examined the relationship between changes in VF performance and changes in brain morphometry in a large cohort of typically developing children, adolescents, and young adults. METHODS: Participants were 209 screened typically developing subjects ranging in age from 7 to 28 years. Subjects generated word lists under time constraints (60 seconds) after being cued with a source letter (phonemic fluency: F, A, or S) or category (semantic fluency: animals or foods). Structural MRI scans were acquired and analyzed using a previously described algorithm (Zijdenbos 1994) yielding gray and white matter volumes of left and right frontal, parietal, and temporal lobes. The relationship between VF and brain measures was examined cross-sectionally using regression analysis with and without covariation for age. RESULTS: VF was significantly related to brain volumes (ps<.05). After co-varying for age, phonemic VF was associated with volumes of the frontal and temporal lobe (ps<.05), but semantic VF did not show relationships to any brain region. CONCLUSION: These results demonstrate a relationship between anatomic brain development and VF performance, and suggest that phonemic and semantic VF performance are associated with brain volumes in different ways.

F91

DECONSTRUCTING VISUAL-SPATIAL COGNITION IN EARLY CHILDHOOD *Meagan Williamson[1], Kim Cornish[1], Gerry Stefanatos[1]; [1]McGill University, Temple University* – Objective: A critical component of human cognition is the ability to efficiently perceive and process visual information. This ability is often termed 'visual-spatial cognition'. Relatively little is known about how this aspect of cognition develops in early childhood, or how performance across the varying sub-domains change as a function of task complexity, age, IQ and gender. This research seeks to demonstrate that 'visual-spatial cognition' does not present a unified construct but rather an array of specific sub processes that interact across other cognitive domains and across developmental time. Methods: 40 children aged between 4 and 7 years of age completed a novel battery of cognitive tasks that tapped core components of visual-spatial functioning: visual-spatial memory and learning, visual-spatial reconstruction and organization, visual-spatial mental manipulation, and visuo-perceptual processing. Results: Preliminary analyzes demonstrate that task complexity and age interact across all visual-spatial sub-domains. Additionally, gender differentially impacts across performance with the greatest difference on skills involving mental rotation. Conclusions: The findings clearly demonstrate age-related trajectories across visual-spatial domains confirming the necessity of teasing apart cognitive domains into their component parts and systematically investigating profiles across age and gender. These findings will guide future research that seeks to understand the pattern of visual-spatial performance in atypical populations known to have visual-spatial deficits.

F92

CHANGES IN CORTICAL ACTIVATIONS DURING VISUAL LETTER PROCESSING ACROSS THE KINDERGARTEN YEAR: A LONGITUDINAL FMRI STUDY *Yoshiko Yamada[1], Courtney Stevens[1], Laura Sabourin[1], Scott Klein[1], Mark Dow[1], Beth Harn[2], David Chard[2],* *Danielle Parisi[2], Helen Neville[1]; [1]University of Oregon, [2]College of Education, University of Oregon* – Neuroimaging studies of reading have revealed a recruitment of a left-hemisphere network (frontal, temporo-parietal, and occipito-temporal regions) in skilled, adult readers. However, very little is known about the development of these reading-related cortical regions in young children who have just begun to develop reading skills. In this study, hemodynamic responses to visually presented letters were examined in five-year-old kindergarteners at three different sessions - at the beginning of the kindergarten year, after the fall term, and at the end of the kindergarten year. Children were either typically developing (TD) or at risk for later reading difficulty (RD). During image acquisition, children were asked to respond when the same letter or false font, presented in separate blocks, was repeated in two successive trials. In the TD group, increases in the BOLD signals to letters relative to false fonts were observed in the temporo-parietal region at all three sessions while activations in the inferior temporal region to letters were not observed until the second session. These regions were close to cortical areas activated in adults performing the same task. In contrast, the RD group showed no significant increase in temporo-parietal activations to letters until the third session, and no robust activations were found in the inferior temporal region at any of the sessions. These results suggested that, when processing visually presented letters, typically-developing children begin to develop adult-like reading networks during the first year of reading instruction, whereas children at-risk for reading failure are delayed in recruitment of the same systems.

Memory: Memory systems

F93

TEMPORAL LOBE ACTIVITY DURING COMPLEX DISCRIMINATIONS OF FAMILIAR AND NOVEL OBJECTS AND FACES *Morgan Barense[1], Richard Henson[1], Kim Graham[2]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK, [2]Wales Institute of Cognitive Neuroscience, University of Cardiff, UK* – Recent studies indicate that structures in the medial temporal lobe (MTL) support processes beyond long-term declarative memory, including complex visual discrimination. In addition, there appears to be an influence of stimulus familiarity on visual discrimination ability in patients with temporal lobe damage. For example, discrimination performance in patients with focal lesions to the MTL (e.g., from herpes viral encephalitis) was improved by the use of meaningful stimuli. By contrast, patients with semantic dementia, a neurodegenerative condition characterized by progressive deterioration of conceptual knowledge and atrophy to the anterolateral temporal lobes, showed no benefit from the use of meaningful stimuli. To further investigate these findings, healthy volunteers were scanned while they performed oddity discriminations involving familiar and unfamiliar objects and faces using a dual echo EPI sequence (spin and gradient echo) to minimize MTL susceptibility artefacts. A baseline task of size oddity was employed. Outside the scanner, subjects' memory for the stimuli was assessed. Across the different conditions, different patterns of temporal lobe activation were observed. Discriminations involving familiar stimuli were associated with activity in the perirhinal cortex, anterior hippocampus, amygdala and temporal pole when compared to oddity judgements for unfamiliar stimuli. When compared to object discriminations, face oddity judgements were associated with activity in anterior temporal lobe structures, including the anterior hippocampus, perirhinal cortex, amygdala and temporal pole. These observations support previous patient and imaging findings and provide further evidence that the MTL is recruited during complex visual discriminations which place minimal demand on mnemonic processes.

F94

DELAYED DISCRIMINATION OF SPATIAL FREQUENCY FOR GRATINGS OF DIFFERENT ORIENTATION: BEHAVIORAL AND FMRI EVIDENCE FOR LOW-LEVEL PERCEPTUAL MEMORY STORES IN EARLY VISUAL CORTEX *Oliver Baumann[1,2,3], Tor Endestad[3], Svein Magnussen[3], Mark W. Greenlee[2]; [1]Queensland Brain Institute/University of Queensland, [2]Institute for Experimental Psychology/ Regensburg University, [3]Center for the Study of Human Cognition, University of Oslo* – The concept of perceptual memory refers to the neural and cognitive processes underlying the storage of specific stimulus features such as spatial frequency, orientation, shape, contrast, and colour. Using 3 T fMRI we examined the pattern of neural activation evoked when subjects discriminated the spatial frequency (SF) of Gabors presented with the same or orthogonal orientation (Magnussen et al, 1998 Journal of Experimental Psychology: Human Perception and Performance 24 707 - 718). On each trial, subjects viewed a ±45° Gabor followed by a delay period (8 s) and a test Gabor with either the same or orthogonal orientation. They responded whether the SF of test and reference were the same or different. RTs were shorter for Gabors sharing the same orientation. Blood-oxygen level dependent (BOLD) fMRI revealed significantly elevated bilateral activity in visual areas (V1, V2) when the gratings to be compared had an orthogonal orientation, compared to when they had the same orientation. These findings suggest that a change in an irrelevant stimulus dimension requires additional processing in primary and secondary visual areas. The finding that the task-irrelevant stimulus property (orientation) had no significant effect on the prefrontal and intraparietal cortex supports a model of working memory which consists of high level components that extract task relevant information from low level resources for dimensions like spatial frequency and orientation. Accessing different stores requires time and has metabolic costs.

F95

WHITE MATTER INTEGRITY AND IMPLICIT SEQUENCE LEARNING IN YOUNGER AND OLDER ADULTS *Ilana J. Bennett[1], Chandan J. Vaidya[1], David J. Madden[2], Darlene V. Howard[1], James H. Howard Jr.[3,4]; [1]Georgetown University, [2]Center for the Study of Aging and Human Development, Duke University Medical Center, [3]The Catholic University of America, [4]Georgetown University Medical Center* – Implicit sequence learning (ISL) describes non-conscious sensitivity to sequential regularities. Functional imaging and patient studies have shown that ISL relies on frontal, striatal, and cerebellar gray matter regions. However, white matter correlates of ISL and age differences in these brain-behavior relationships have not been examined. In the present study, 14 younger (18.9 ± 0.7 years; 9 female) and 13 older (67.8 ± 3.2 years; 10 female) adults completed the Alternating Serial Reaction Time task (ASRT) and underwent diffusion tensor imaging (DTI). The ASRT measured ISL by comparing response times on alternating trials in which targets occurred at predictable locations based on a repeating sequence versus randomly determined locations. DTI measured fractional anisotropy (FA), the degree of directionally restricted water movement. Behavioral analyses revealed no group differences in learning. A between-group t-test showed that older adults had lower FA in anterior callosal and association white matter. Whole brain voxel-wise positive correlations in younger adults revealed that ASRT learning was related to FA in frontal (anterior coronal radiata, corticospinal tract), cerebellar, parietal, and corpus callosum regions, primarily in the left hemisphere. In older adults, these ASRT learning x FA correlations were seen in similar cortical white matter in both hemispheres. These findings are consistent with ISL relying on a lateralized frontal-cerebellar network in younger adults, and suggestive of age-related compensation in that learning was related to similar, but bilateral cortical white matter in older adults who learn as well as younger adults despite age differences in underlying white matter.

F96

DIRECT FMRI EVIDENCE FOR PRESERVED HIPPOCAMPUS FUNCTIONING AFTER PARTIAL REMOVAL OF ANTERIOR TEMPORAL-LOBE INPUT STRUCTURES. *Ben Bowles[1], Ed O'Neil[1], Jordan Poppenk[1,3], Seyed M. Mirsattari[2], Stefan Köhler[1,3]; [1]University of Western Ontario, ON, [2]Clinical Neurological Sciences, University of Western Ontario, London Health Sciences Centre, ON, [3]University of Toronto, ON* – In a recent single-case study, we demonstrated that NB, an individual who underwent resection of the left anterior temporal lobe for treatment of intractable epilepsy, exhibits a selective impairment in the familiarity component of recognition memory with intact recollection. The surgery included partial removal of medial temporal-lobe (MTL) structures previously implicated in familiarity, the perirhinal and entorhinal cortex, but spared the hippocampus, an area known to support recollection. Because NB displays intact performance on memory tasks that require the integrity of the left hippocampus, this behavioral evidence suggests that NB's spared left hippocampus operates normally. Neuroanatomically, this finding is somewhat surprising as perirhinal and entorhinal cortex also provide much of the input to the hippocampus. Therefore we sought more direct functional neuroimaging support for our interpretation and examined whether NB's surgically spared left hippocampus does indeed show normal activation under task conditions that typically involve this structure. We compared NB's fMRI response to novel auditory sentences with that of controls in a task that engages associative encoding processes and that has previously been shown to elicit hippocampus activation. NB exhibited a normal left anterior hippocampus novelty response in a region that was comparable to that observed in the controls. This evidence indicates that the hippocampus can indeed function normally even when input from adjacent anterior MTL structures is partially compromised. The remaining input from more posterior aspects of perirhinal and entorhinal cortex and/or from parahippocampal cortex appear to be sufficient to support its functional integrity.

F97

LESION TYPE DETERMINES MEMORY DEFICITS IN HUMANS WITH HIPPOCAMPAL DAMAGE *Mischa Braun[1], Carsten Finke[1], Florian Ostendorf[1], Thomas-Nicolas Lehmann[1], Karl-Titus Hoffmann[1], Christoph J. Ploner[1]; [1]Charite University Medicine Berlin* – The pivotal role of the medial temporal lobe (MTL) for memory is undisputed in neuroscience. Based on behavioral findings in subjects with discrete cerebral lesions of various etiologies, several competing theories have been advanced to further explain why MTL damage affects some memory domains and leaves others unimpaired. Here, we chose a new approach and investigated whether lesion type affects memory performance in humans with MTL damage. Patients with selective lesions of the right MTL following surgical treatment of hippocampal sclerosis (n = 9) or benign brain tumors (n = 5) were tested for short-term memory of colors, locations and color-location associations. The basic clinical variables in both patient groups were similar, except for the duration of preoperative symptoms (hippocampal scleroses: 16.8 yrs; tumors: 1.8 yrs). Compared to controls, tumor patients showed a significant delay-dependent decrease in memory of color-location associations. No such decrease was observed in hippocampal sclerosis patients, although both patient groups received comparable resection of MTL structures. Obviously, hippocampal sclerosis patients benefited from a compensatory process that was absent or inefficient in tumor patients. Consistent with recent findings in monkeys, we propose that early hippocampal pathology allows for significant recovery of memory functions in the human brain. This implicates that preserved memory domains in patients with early hippocampal damage might not solely be due to a division of labor within the MTL, but could at least partly result from brain reorganization processes. Consequently, developmental disorders may represent unsuitable models for inferences on normal MTL function.

F98

NEURAL OSCILLATIONS IN SEMANTIC OBJECT RETRIEVAL *Matthew Brier[1], Thomas Ferree[2], Gail Tillman[1], Mandy Maguire[1], Clifford Calley[1], Priya Xavier[2], Mary Kathryn Reagor[1], John Hart[1,2], Michael Kraut[3]; [1]Center for BrainHealth, University of Texas at Dallas, [2]University of Texas Southwestern Medical Center, [3]The Johns Hopkins University School of Medicine* – Previous fMRI studies of the retrieval process in semantic memory have implicated the medial pre-SMA bilaterally, bilateral temporo-occipital regions, and left thalamus. To investigate the time course of these activations, we studied 19 healthy young adults with the Semantic Object Retrieval Test (SORT) where they were asked to determine if two features (e.g. "desert" and "humps") resulted in retrieving an object memory (e.g. "camel") as opposed to non-retrieval pairs, while continuous EEG data were recorded. These data were transformed to the average reference and a moving window Fourier analysis (500ms window, 100ms step) was performed to compute power. A series of Principle Components Analyses was performed to reduce these results in the frequency, spatial, and temporal domains, respectively. Significant differences between retrieval and non-retrievals were investigated and isolated in two frequency bands of interest high alpha (10-15 Hz) and gamma (25-40 Hz). At ~400 msec, there were alpha differences in the superior frontal and right parietal-occipital regions, and gamma differences in the left parietal-occipital area. At ~1100ms, there were alpha differences in the temporal regions bilaterally and gamma differences at the left temporal pole. There were also later gamma differences in the left posterior temporal region. Several other frequency bands will be investigated. These EEG power findings are generally consistent with previous fMRI findings, but with the added feature of temporal resolution. The EEG and fMRI studies begin to provide a neural mechanistic account for object memory retrieval as well as markers of the retrieval process.

F99

ANTICIPATORY PREFRONTAL CORTEX (PFC) ACTIVITY DURING CONTEXTUAL REMEMBERING *Norbou Buchler[1], Roberto Cabeza[1], Ian Dobbins[2]; [1]Duke University, [2]Washington University in St. Louis* – Neuroimaging studies contrasting memory for context and item memory have found relatively increased activation of a highly left lateralized network for context retrieval, particularly in the left prefrontal cortex (PFC). Additionally, recent work using a jittered cue-test paradigm suggests that the increased PFC recruitment for context trials is initiated early, perhaps as soon as subjects formulate retrieval plans in response to a context task-cue (Dobbins & Han, 2006). Here we further examine memory cue processing and whether this preparatory activation reflects context memory specific processes, or instead reflects proactive recruitment in anticipation of general retrieval demands, regardless of its contextual specificity. The current study crossed retrieval demands with type of memory retrieval to critically examine whether these PFC regions are also recruited early in anticipation of increased retrieval-difficulty as well as increased retrieval-specificity (item versus context). Retrieval difficulty was manipulated by varying the retention interval. Before each test-probe, a cue (easy, hard, context) signaled upcoming retrieval difficulty and whether the upcoming memory question required discrimination of old/new words or the specific prior context of a studied word. Anticipatory or cue-dependent processing was isolated using cue-only catch trials. Our results found PFC activation in a number of specialized regions involved in the early engagement of a contextual memory retrieval orientation as this activation was independent of anticipated retrieval difficulty. These results suggest that functionally specialized PFC regions (left precentral, medial-frontal, right frontopolar) underlie a contextual retrieval orientation and contribute to our understanding of key anticipatory and self-initiated context memory specific processes.

F100

CUEING AND DETECTING MEMORY: THE ROLE OF THE PARIETAL CORTEX *Elisa Ciaramelli[1], Cheryl Grady[1,2], Morris Moscovitch[1,2]; [1]Rotman Research Institute, [2]University of Toronto* – Based on a review of the fMRI literature (Ciaramelli et al., 2007), we hypothesized that superior parietal lobe (SPL) is activated during memory search and inferior parietal lobe (IPL) during target detection (i.e. retrieval success). To test this hypothesis, we devised a paradigm that isolates the search and recovery components of memory retrieval. Participants studied pairs of words. During each test trial, a CUE stimulus, that could be either a studied word, a new word, or a meaningless stimulus, appeared first. The cue was followed by a TARGET word, that could be either studied or new, and participants were required to make an old/new recognition judgement on this word. Healthy individuals were faster at recognizing the target word if it was preceded by the word with which it was paired at study (intact condition) relative to another studied word (rearranged condition), a new word, or a meaningless stimulus (no-search conditions). These results suggest that cueing can aid memory search and this facilitates memory detection. In a neuropsychological investigation, we found that cueing effects were abolished in 2 patients with lesions in SPL, who did not show a memory advantage under intact relative to recombined or no-search conditions. By contrast, they were preserved in a patient with IPL lesions. This evidence is in line with our hypothesis that SPL supports memory cueing signals. Preliminary findings from an fMRI study using the same paradigm will be presented to determine whether SPL and IPL activity is preferentially associated to memory search and detection.

F101

DIFFERENCES IN PREFRONTAL CONNECTIVITY DURING TEMPORAL AND SPATIAL CONTEXT MEMORY TASKS *David Crane[1], M.N. Rajah[2]; [1]Graduate Program in Neuroscience, McGill University, [2]Geriatric Psychiatry Division, Douglas Hospital, McGill University* – Functional neuroimaging and neuropsychological studies show frontal-parietal network involvement during retrieval of contextual information. Recent neuroimaging studies report differential regions of PFC activity during the retrieval of spatial versus temporal context information, compared to item recognition. However, little consideration is given to the spatial patterns of brain activity engaged during these tasks. This study uses a multivariate approach to investigate the relation between acquired fMRI images and behavior during contextual retrieval tasks. Sixteen healthy adults participated in an event-related fMRI study in which they performed temporal and spatial context memory tasks for faces. The number of responses was parametrically manipulated to control for response selection processing. We performed a multivariate analysis of the data using Spatial-Temporal Partial Least Squares to identify networks that covary with task type and response selection. Preliminary results show differential engagement of the frontal-parietal network during retrieval versus encoding tasks, especially in the dorsal-lateral PFC (DLPFC). The response selection manipulation correlates with early reduction in frontopolar activity followed by increased activity in bilateral PFC. Differences in spatial versus temporal context tasks will be investigated by examining differences in functional connectivity amongst frontopolar, lateral PFC and parietal cortices.

F102

SOURCE-MEMORY JUDGEMENTS AND THE LATE FRONTAL ERP OLD/NEW EFFECT *Damian Cruse[1], Edward Wilding[1]; [1]Cardiff University, School of Psychology* – Event-related potential (ERP) correlates of successful source (contextual) retrieval include a greater relative positivity for items attracting correct source judgments than for those attracting correct new judgments. This old/new effect is largest at frontal electrodes, onsets 500-600 ms post-stimulus, and lasts up to 1500ms. In some experiments, but not others, this frontal ERP old/new effect has varied according to whether source judgments were correct or incorrect. One possibility is that the disparities across studies arise because of the stimulus types employed at test: visually presented words in studies where the effect predicts source accuracy, spoken words or pictures in those where it does not. The effects reported in this experiment rule out this possibility, however. Participants studied words shown in two colours (red/green). ERPs were acquired time-locked to the onset of test words, and participants made old/new judgments, followed by a red/green source judgment for words judged to be old. Old/new recognition and source accuracy were off ceiling, and the frontal old/new effects were right-lateralised and equivalent for old words attracting correct or incorrect source judgments. These findings suggest that test format is not a critical determinant of the conditions under which frontal old/new effects predict source accuracy, and they also rule out the presence of physically identical stimuli (copy) cues at study and at test as an important feature: copy cues were present in all previous studies where the effect did not predict source accuracy. The functional significance of late frontal ERP old/new effects remains to be established.

F103

MEDIAL TEMPORAL LOBE ACTIVATION DURING SOURCE MEMORY RETRIEVAL: EFFECTS OF UNITIZED VS. NONUNITIZED ENCODING *Rachel Diana[1], Andrew Yonelinas[1], Charan Ranganath[1]; [1]University of California, Davis* – The hippocampus, which is critical for episodic memory, receives inputs from perirhinal cortex (PRc) and parahippocampal cortex (PHc). The binding of item and context model of memory (Diana et al., 2007) proposes that PRc encodes item representations that can contribute to familiarity-based memory, whereas PHc encodes context representations that typically contribute to recollection-based memory. The hippocampus binds item and context information as an episode. Source memory tasks require retrieval of specific contextual details and successful source retrieval is typically associated with hippocampal and PHc activation (Diana et al., 2007; Eichenbaum et al., 2007). However, recent studies suggest that successful source encoding may sometimes be associated with PRc activation (Staresina & Davachi, 2006). Diana et al. (in press) demonstrated that when participants unitize item and source information (i.e. encode source information as a feature of the item), source memory can be based on familiarity rather than recollection. Thus, we predict that retrieval of unitized source information is associated with PRc activation while retrieval of non-unitized source information is associated PHc and hippocampal activation. We used an encoding task that encouraged unitization and a task that did not encourage unitization but was matched for imagery and depth of encoding. Behavioral results indicated that source memory ROCs are more curvilinear and familiarity estimates are higher for unitized stimuli, as compared with nonunitized stimuli. Preliminary fMRI analyses suggest that medial temporal lobe activation during retrieval was correlated with the accuracy of source memory decisions. Further analyses will contrast activation between unitized and non-unitized trials.

F104

INDIVIDUAL VARIABILITY IN BRAIN ACTIVITY DURING EPISODIC ENCODING AND RETRIEVAL: HOW IT RELATES TO ANATOMY, STRATEGY, VISUAL/VERBAL TRAITS AND PERSONALITY. *Christa-Lynn Donovan[1], Rachel Segal[1], Michael Miller[1]; [1]University of California Santa Barbara* – We have previously shown extensive individual variability in brain activity during episodic retrieval. The purpose of this study was to identify factors that can account for the observed variability in brain activity underlying episodic encoding and retrieval. Fifty participants were scanned with functional MRI while they intentionally encoded lists of highly and lowly imageable words and completed subsequent recognition memory tests. After scanning, subjects were asked to report their strategy for each study/test session and to complete a Visualizer-Verbalizer test battery. They also completed a personality questionnaire. Our results replicated our previous work showing extensive variability of individual brain activity during episodic memory. Further, we show how this variability relates to anatomical differences (as measured by DTI and high resolution MPRAGE anatomical scans), reported strategy differences, visualizing/verbalizing trait differences and personality differences. Our results demonstrate that individuals can recruit widely dispersed brain regions during an episodic memory task, that recruitment of any particular region can be related to a number of factors including anatomical features of the individual's brain, the individual's unique mnemonic strategy as well as trait factors such as visualizing/verbalizing ability and personality. This demonstrates that a wealth of information can be gained by the combined use of traditional group analysis, analysis of individual variability in topography of whole brain activity patterns as well as individual variability in modulations of discrete brain regions.

F105

AGE- AND PERFORMANCE-RELATED DIFFERENCES IN THE NEURAL CORRELATES OF SUCCESSFUL MEMORY ENCODING *S. Duverne[1,2], S. Motamedinia[1,2], M.D. Rugg[1,2]; [1]Center for the Neurobiology of Learning and Memory, UC Irvine, [2]UC Irvine* – Previous studies of age-related differences in the neural correlates of successful memory encoding have reported a more bilateral pattern encoding-related activity in older adults than in the young. Such findings might reflect a compensatory response to age-related decline in the functional integrity of regions that are functionally lateralized in younger adults. The present fMRI study characterized the relationship between age-related differences in the lateralization of subsequent memory effects and memory performance by comparing effects in young and older subjects (Ns of 16 and 32 respectively). At study, participants made animacy decisions on a series of visual words. At test, they performed old/new recognition decisions with an associated confidence judgment. Older adults were segregated into two groups according to a median split on a composite score of episodic memory subtests (Californian Verbal Learning Test). Performance in the experimental task did not differ in the high- and low-performing group from that of the young. A voxel-of-interest analysis was conducted on activity in left prefrontal voxels identified in another study that used similar experimental design (Otten et al.; Brain 2001; 124: 399-412), and on activity in homotopic right prefrontal voxels. Crucially, lateralization of prefrontal subsequent memory effects was similar in the high-performing group and the young group. Only low-performing older subjects had a more bilateral subsequent memory effect than young adults. These findings suggest that relative preservation of memory performance with increasing age does not depend upon right prefrontal 'over-recruitment'.

F106

RULE-BASED CATEGORIZATION DEFICITS IN PATIENTS WITH PARKINSON'S DISEASE ARE NOT DEPENDENT UPON DOPAMINERGIC MEDICATION *S. W. Ell[1], A. Weinstein[2], R. B. Ivry[3]; [1]University of Maine, [2]San Francisco VA Medical Center - NCIRE, [3]University of California, Berkeley* – The role of the basal ganglia in category learning has been the subject of considerable study recently. In particular, patients with basal ganglia pathology are impaired on rule-based category learning tasks – i.e., categorization tasks where learning is thought to depend upon the use of an explicit, hypothesis-guided strategy. However, while patients with Parkinson's disease (PD) are impaired on rule-based tasks with high selective attention demands, patients with focal basal ganglia lesions are impaired on rule-based tasks with minimal selective attention demands. The goal of the present study was to re-examine the specificity of the rule-based categorization impairment in patients with PD and to investigate the extent to which performance is dependent upon dopaminergic medication. Specifically, we compared a high selective-attention condition in which participants learn to attend to the relevant stimulus dimension while ignoring an irrelevant dimension, and a low selective-attention condition in which participants learn to attend to both dimensions. In contrast to previous work, the PD patients were impaired on both tasks. A subset of patients was also tested after abstaining from dopaminergic medication. Accuracy rates did not differ between on- and off-medication states. These results suggest that the PD-related impairment on rule-based categorization tasks is neither sensitive to dopaminergic medication nor restricted to tasks that require selective attention. When considered in tandem with results from patients with focal basal ganglia lesions, the results reinforce the importance of considering multiple models of basal ganglia dysfunction.

F107

HUMAN RELATIONAL MEMORY: GIVE IT TIME, AND SLEEP. *Jeffrey Ellenbogen[1], Peter Hu[2], Jessica Payne[1], Matthew Walker[2]; [1]Harvard Medical School, [2]University of California, Berkeley* – Introduction: Relational memory (e.g. inference) is a fundamental cognitive faculty. Yet little is known about how and when this knowledge emerges. Here we explore whether human relational learning develops offline. Methods: Fifty-six healthy participants initially learned five pairs of items, in random order, one pair at a time. Unknown to the subjects, these premise pairs contained an embedded meta-structure. Following an offline delay of either 20-min, 12-hr (wake or sleep), or 24-hr, knowledge of the hierarchy was tested, including inferential judgments. Results: All groups performed similarly on premise-pair retention (all > 85%), which are considered the building blocks of the meta-structure. There was a striking dissociation, however, in subjects' ability to make inferential judgments: the 20-min group showed no evidence of inferential ability (52%; chance), while the 12-hr and 24-hr groups displayed highly significant inferential ability (both >75%; p<0.001). And if the 12-hr period contained sleep, relational memory for the most distant inferences received an additional boost (Sleep=93%, Wake=69%, p=0.03). Conclusion: Here we demonstrate that human relational learning specifically develops during offline time delays. Furthermore, sleep appears to preferentially facilitate this process, enhancing and binding hierarchical memory, thereby allowing superior performance (+35% advantage) for the most distant inferential judgments.

F108

THE INFLUENCE OF TASK INSTRUCTIONS ON ELECTROPHYSIOLOGICAL CORRELATES OF MEMORY RETRIEVAL *Lisa Evans[1], Jane Herron[1]; [1]School of Psychology, Cardiff University* – Event-related potentials (ERPs) were employed in three retrieval tasks to examine the effect of task instructions on ERP old/new effects. These effects are differences between the neural activity elicited by old (studied) and new (unstudied) test words. Study phases were identical (an equal number of words were encoded in one of two conditions), while retrieval instructions differed: i) Recognition - respond on one key to old words, on another to new words; (ii) Exclusion – respond on one key to words from one encoding condition, on another to unstudied words, as well as words from the other encoding condition; (iii) Source - respond on three different keys to new words, and words from the two encoding conditions. ERPs were acquired time-locked to the onset of test words, and the old/new effects did not vary with task before 800 ms post-stimulus. From 800-1900 ms there was greater negativity for old than for new words at right midline/posterior sites. This "late posterior negativity" (LPN) was largest in the exclusion task and smallest in the recognition memory task, confirming that the LPN is sensitive to more than requirements to bind item and source information. The novel finding across tasks was greater negativity for old than for new words from 1200-1900 ms at left anterior sites in the source task only. This new effect likely reflects task-specific retrieval processing operations mediated by left-prefrontal cortex. The reasons for the greater prominence of this effect here in comparison to previous ERP source memory studies will be discussed.

F109

THE INFLUENCE OF EVENT PERCEPTION ON LONG-TERM MEMORY FORMATION *Youssef Ezzyat[1], Lila Davachi[1,2]; [1]New York University, [2]Center for Neural Science, New York University* – Research has shown that humans can easily and reliably partition continuous actions into discrete units called "events." Studies using video (Newtson &

Engquist, 1976) and narrative (Speer & Zacks, 2005) suggest that this ability to segment spans domains; various studies have also examined the perceptual and narrative features that correlate with event segmentation (for a review, Zacks et al, 2007). Particularly for narratives, prior studies have found that significant spatial, temporal and goal-based changes in the story prompt segmentation of the narrative into discrete events. While there are theories about why these narrative manipulations prompt event segmentation (Zwaan & Radvansky, 1998), researchers have only recently begun to explore the neural mechanisms underlying narrative segmentation (Speer et al, 2007). Furthermore, less is known about how event segmentation influences long-term memory for events. The purpose of the present study was to examine long-term memory formation from the perspective of event perception. Using a paradigm from the event perception literature, we examined the extent to which event perception shapes the content and organization of long-term memory. To do this, we conducted a fMRI study in which subjects read narratives in which temporal cues signaled event boundaries. After scanning, we tested subjects' memory for various aspects of the narratives and used those results to analyze the imaging data. We find that subjects exhibit greater long-term recognition memory for information presented at event boundaries than at non-boundaries. Imaging analyses will focus on the brain regions involved in this mnemonic benefit.

F110

MAGNETO-ENCEPHALOGRAPHIC STUDIES OF RECOGNITION MEMORY FOR WORDS AND FACES *Carina Fraser[1,2], Edward Wilding[1]; [1]Cardiff University, School of Psychology, [2]Wales Institute of Cognitive Neuroscience* – Event-related fields (ERFs) were acquired during the test phases of recognition memory tasks in order to investigate the sensitivity of ERFs to processes supporting recognition memory for words and for unfamiliar faces. Study-test cycles comprised words or faces as stimuli. In study cycles, an equal number of items were shown on the left/right of the screen. Test lists comprised studied (old) items and an equal number of unstudied items. Old/new judgments were made for each item, and discrimination was superior for words. Analysis of the ERFs focused on old/new effects – differences between the neural activity associated with correct old and new recognition memory judgments. ERFs at left central scalp sites were more positive-going for old than for new items for both faces and words. This old/new effect had a spatio-temporal distribution similar to the left-parietal event-related potential (ERP) old/new effect that is assumed to index recollection. For words only, there was a greater relative left posterior positivity for new words compared to old words from 300 to 1000 ms post-stimulus. This content-specific ERF old/new effect remained when old/new analyses were restricted to a subset of participants for whom old/new discrimination for words and faces was most similar, suggesting that this effect is not due to differences in task difficulty. These findings complement recent findings using ERPs, where it has been shown that real-time measures of neural activity index content-specific retrieval operations. A remaining question is whether the retrieval processes indexed in the magnetic and electrical records are functionally equivalent.

F111

EXAMINING THE INTERPLAY BETWEEN EPISODIC AND SEMANTIC MEMORY DURING ASSOCIATIVE/RELATIONAL ENCODING: AN EVENT-RELATED POTENTIAL STUDY. *Andrea Greve[1,2], Mark C.W. van Rossum[2], David I. Donaldson[3]; [1]Wales Institute of Cognitive Neuroscience, Cardiff University, [2]Neuroinformatics, University of Edinburgh, [3]Stirling University* – A fundamental feature of episodic memory is the ability to encode relationships between stimuli; such associations can be based on a range of factors, including temporal and spatial connections, and shared meaning. Although evidence suggests that retrieval of associations is distinct from memory for the items themselves, relatively little is known about the processes that support associative encoding. Here we investigate this issue by recording Event-Related Potentials (ERPs) during the encoding phase of an associative recognition task. At study, we manipulated the semantic coherence of word pairs in relation to a preceding category name (to which two, one, or none of the words were related). ERPs revealed an early frontal negativity that separated semantically coherent word pairs from un-related word pairs (i.e., two = one > none). This activity reflected an N400 modulation, due to the presence/absence of a mismatch in meaning between the category cue and subsequent stimuli. More importantly, a subsequent parietal effect revealed a graded parametric modulation that was sensitive to the extent of semantic coherence (i.e., two > one > none). This parietal effect appeared to be specifically related to encoding; it was only present when participants detected the semantic relationship, and a subsequent recognition test revealed an equivalent graded pattern (i.e., better memory for two > one > none). The ERP data reveal two temporally and spatially dissociable modulations that support the processing of associations based on shared semantic meaning, highlighting one mechanism by which information from semantic memory is able to influence episodic memory.

F112

ICONIC MEMORY FOR FACES IN A PROSOPAGNOSIC PATIENT *Hans Grunert[1], Rosaleen McCarthy[2]; [1]University of Cambridge, [2]Southampton General Hospital* – PHD has a severe prosopagnosia due to a focal lesion to the left fusiform gyrus. He was asked to match successive pairs of faces displayed on a computer screen with random inter-stimulus-intervals (ISI's) between 20ms and 500ms. PHD was able to match faces at an ISI of 20ms. However, he showed a sharp decline with increasing ISI's. At an ISI of 75ms his responses were already at chance and remained at chance for longer ISIs. This sharp decline was not observed in control Subjects. These results also appeared to be face-specific since PHD performed well above chance on similar tasks with teapots, chairs and greebles. We discuss these results in the light of current theories of prosopagnosia and iconic memory.

F113

LATERALIZATION OF THE PARIETAL OLD/NEW EFFECT: AN FMRI STUDY COMPARING RECOGNITION MEMORY FOR WORDS AND FACES *Scott Guerin[1], Amy Frithsen[1], Danielle King[1], Meghan Roarty[1], Michael Miller[1]; [1]University of California Santa Barbara* – Numerous fMRI studies of recognition memory have observed that successful recognition of old items elicits greater activation than successful rejection of new items within the parietal cortex. The functional significance of this effect is poorly understood. It is commonly observed that the effect is heavily lateralized to the left. However, the vast majority of previous studies have used verbal materials. It is known that processing of verbal materials is lateralized to the left, while processing of other stimulus types, such as faces, is lateralized to the right. Previous studies have not directly compared verbal and non-verbal materials and have not included direct quantitative tests of laterality. We directly compared recognition memory for words and faces. Preliminary analysis suggests that that the old/new effect differs across distinct regions of the parietal cortex. Within medial parietal cortex, the old/new effect is left-lateralized for words and is bilateral for faces. Within lateral parietal cortex, the old/new effect is left lateralized for both words and faces, but the degree of lateralization is larger for words. These results suggest that although the lateralization of the parietal old/new effect is in part dependent on material type, the effect is quite complex and likely reflects the combined influence of several distinct subprocesses.

F114

TESTING THE DOMAIN DICHOTOMY VIEW OF ASSOCIATIVE RECOGNITION: HOW DOES THE RELATIONSHIP BETWEEN STIMULI AFFECT THE RELATIVE CONTRIBUTION OF FAMILIARITY? *Iain Harlow[1], Graham MacKenzie[2], David Donaldson[2]; [1]University of Edinburgh, [2]University of Stirling* – Episodic recognition memory is mediated by functionally and neurally separable retrieval processes, notably familiarity (a general sense of prior exposure) and recollection (the retrieval of contextual details), whose relative engagement depends in part on the nature of the stimuli being retrieved. Based on neuroanatomical evidence, Mayes and colleagues (Mayes et al., 2007; TICS) have recently proposed the Domain Dichotomy account. By this view, the relative engagement of familiarity and recollection is critically dependent on the amount of representational overlap that stimuli exhibit within perirhinal cortex. Importantly, the Domain Dichotomy account makes specific predictions about associative memory (where retrieval of the relationships between pairs of stimuli is required). Namely, since familiarity is thought to be supported by perirhinal cortex, it should contribute more to associative memory when stimuli are perceptually and conceptually similar (i.e., within-domain) than when they are distinct (i.e., between-domain), whereas recollection should remain unchanged. Here we tested the Domain Dichotomy account during an associative recognition test, using confidence based Receiver Operator Characteristic (ROC) curves to assess the contribution of recollection and familiarity. Participants studied stimulus pairs, and at test, discriminated same (intact) from rearranged (recombined) pairs. Stimuli were either within-domain (word-word or image-image pairs) or between-domain (word-image pairs), allowing ROC curves to be formed separately for each condition. Contrary to the predictions of the Domain Dichotomy account, the contribution of familiarity (and consequently recognition performance overall) was in fact lower for each within-domain condition than for the between-domain condition.

F115

DISSOCIATION OF THE NEURAL CORRELATES OF RETRIEVAL SUCCESS AND POST-RETRIEVAL PROCESSING *Hiroki Hayama[1], Michael Rugg[1]; [1]Center for the Neurobiology of Learning and Memory, University of California, Irvine* – Post-retrieval processes are engaged when the outcome of an episodic retrieval attempt must be monitored or evaluated. The present study used event-related fMRI to identify regions responsive to retrieval success as opposed to post-retrieval processing. During each of two study sessions, subjects were cued to make one of two semantic judgments on serially presented pictures. In one test phase, subjects were required to respond 'new' to unstudied pictures, but to make a semantic judgment, different from that at study, on studied pictures. In the other test phase, subjects were required to make the semantic judgment on pictures judged as unstudied. Retrieval success effects were operationalized as regions where activity was greater for studied than unstudied items regardless of which item was associated with the semantic judgment. Identified regions included left lateral and middle/inferior temporal cortex, and anterior prefrontal cortex. Post-retrieval processing effects were operationalized as regions where activity was greater for the items that required the semantic judgment relative to those that did not, regardless of study status. These regions included bilateral intra-parietal sulcus and dorsolateral prefrontal cortex, along with left lateral inferior prefrontal cortex. These findings demonstrate clear dissociations between regions that are frequently co-activated in studies of retrieval success. It appears that activity in several of these regions is associated not with successful retrieval per se, but to more general processes that are contingent upon, but do not support, retrieval success.

F116

PLACES INFLUENCING FACES: AN FMRI STUDY OF THE EFFECTS OF VISUAL CONTEXT ON EPISODIC FACE RECOGNITION MEMORY *Scott M. Hayes[1], Elsa Baena[1], Roberto Cabeza[1]; [1]Center for Cognitive Neuroscience, Duke University, Durham* – Previous research has suggested that medial temporal lobe (MTL) regions may reinstate visual context information to facilitate episodic object recognition (Hayes et al., 2007). Given that MTL regions have also been associated with recollection and familiarity processing, we aimed to identify whether these MTL regions were associated with scene reinstatement effects after controlling for recollection and familiarity processing. Fourteen participants viewed faces that were presented on naturalistic scenes. At test, the faces were presented on the same scene (Identical), a previously viewed scene that was not presented with that face (Recombined), or a black background (Scene Deletion). There was also a control condition in which faces were presented on a black background at both study and test (Face). Participants made old/new face recognition judgments on a 4-point confidence scale. Importantly, instructions emphasized that recognition judgments were to be based only on the face. Behavioral results revealed a Context Shift Decrement (CSD): decreased memory performance when context changed between study and test. The CSD was substantial and was equivalent for the Recombined (16%) and Scene Deletion (14%) conditions. Neuroimaging data indicated that, after controlling for recollection and familiarity, increased MTL activation was observed in the Scene Deletion condition relative to the Face condition. A comparison of correctly remembered Identical relative to Recombined trials revealed activation in the right hippocampus. These results suggest that context information may be automatically reinstated at retrieval, even when it is incidental to the memory task at hand, and may facilitate item recognition in young adults.

F117

FRONTAL AND PARIETAL CORRELATES OF GRADED RECOLLECTION DURING EPISODIC RETRIEVAL *J. Benjamin Hutchinson[1], Yudy Cristo[1], Alison R. Preston[2], Anthony D. Wagner[1,3]; [1]Stanford University, [2]Center for Learning and Memory, University of Texas at Austin, [3]Neurosciences Program, Stanford University* – The ability to remember past events depends on multiple component processes. Extant functional imaging data implicate frontal and parietal neocortical regions in episodic retrieval, with distinct subregions correlating with perceived familiarity vs. contextual recollection. Leverage on understanding the neurocognitive mechanisms subserving recollection may come from assessing the relationship between the degree of recollection and fronto-parietal neural responses. The current fMRI study used a source memory paradigm to assess how frontoparietal retrieval processes support item recognition and recognition accompanied by varying levels of contextual recollection. During encoding, participants incidentally encoded visually-presented words in one of four ways: generated an associated mental image of an indoor scene or outdoor scene, or generated an associated name of a famous female person or male person. A scanned recognition memory test probed for item recognition and source recollection using a one-step procedure. Specifically, participants were tested for (1) item recognition (old/new), (2) recollection of general event details (scene/person), and (3) recollection of full event details (indoor/outdoor or male/female). Whole-brain fMRI data revealed a predominantly left-lateralized pattern of frontoparietal activation during recognized items (hits) vs. correctly rejected lures. Initial analyses revealed that lateral inferior parietal and intraparietal subregions were differentially sensitive to gradations in the level of event recollection. These findings further highlight the correlated relationship between remembering the past and engagement of multiple frontoparietal networks.

F118

FUNCTIONAL NETWORK CONNECTIVITY IN SEMANTIC MEMORY *Kanchana Jagannathan[1], Michal Assaf[1,2], Vince Calhoun[3,4,1,2], Godfrey Pearlson[1,2]; [1]Olin Neuropsychiatry Research Center, Institute of Living, Hartford Hospital Hartford, [2]School of Medicine,Yale University, NewHaven, [3]The MIND Institute, Alburquerque, [4]University of New Mexico, Alburquerque* – Introduction: Recalling an object based on its features is a unique operation in semantic memory processing that is subserved by several neuronal networks that include thalamus, pre-supplementary motor area, left dorsolateral prefrontal cortex, inferior parietal lobule, middle temporal gyrus, rostral anterior cingulate and inferior frontal gyri. Methods: Fifty-five right handed healthy individuals performed fMRI object-recall task. Subjects were grouped as good or poor performers based on a discrimination index score. In an initial analysis, activations related to task performance score were not significant, we therefore hypothesized that differences in connections between the spatially independent neural components (i.e. networks) as measured by independent component analysis (ICA) would better reveal connectivity. Thus, component maps were generated for four major task-related regions that included a language network (A), a right hemisphere language network (B), the thalamus(C) and the default mode network (D). The lag-shifted maximal correlation between the component time courses for all the subjects were computed for all pair wise combinations. Results: Differences in correlation values for good and poor performers were defined as statistically significant at p<0.05. Good performers showed higher correlations between components A and B (p=0.002) and A and C (p=0.03) while poor performers showed correlations between component C and D (p=0.005). Conclusion: These results support the hypothesis that different temporal relationships between distributed brain networks underlie poorer object recall from semantic memory. This work demonstrates a new approach for understanding semantic processing in healthy individuals and could be applied to patients in whom these processes are impaired.

F119

SURGICAL LESIONING OF THE BASAL GANGLIA DISRUPTS IMPLICIT SEQUENCE LEARNING IN PARKINSON'S DISEASE *Marjan Jahanshahi[1], Jose Obeso[2], L Alvarez[3], R Macias[3], G Lopez[3], Leonora Wilkinson[1], Brian Day[1], Serge Pinto[1], N Pavon[3], MC Rodriguez-Oroz[2], J Tejeiro[3], J Artieda[2]; [1]Sobell Department of Motor Neuroscience and Movement Disorders, UCL Institute of Neurology, The National Hospital for Neurology & Neurosurgery, London, [2]Clinica Universitaria and Medical School, University of Navarra, Pamplona, Spain, [3]Movement Disorders and Neurophysiology Units, Centro Internacional de Restauracion Neurologica (CIREN), Havana* – Surgical lesioning of the subthalamic nucleus (STN) significantly improves the motor symptoms of Parkinson's disease (PD) but is often followed by hemiballism which is treated with a subsequent unilateral pallidotomy. We studied RP, a 53 year old right-handed man with a 12 years history of PD, who had been treated with a thermolytic lesion of the left STN and a left pallidotomy, which effectively led to interruption of the basal ganglia-cortical motor circuit in the left hemisphere. His PD was significantly improved following surgery. We compared speed of movement initiation and execution in simple, uncued and precued choice reaction time (RT) tasks and implicit sequence learning on a probabilistic serial reaction time task (SRTT) with the right (contralateral to the surgical lesions) and the left hands. RTs were faster with the right hand. RP showed similar warning signal, preprogramming and precueing effects with the right and left hands. In contrast, on the SRTT, no evidence of learning with the right hand was detected; whereas the left hand showed learning on a parallel sequence similar to previous data from patients with Parkinson's disease. These results suggest that learning on the SRTT is effector-specific. Most importantly, these data establish that the output of the basal ganglia to the cortex are essential for implicit sequence learning.

F120

FOLLOWING THE MUSIC TO THE MEMORIES *Petr Janata[1]; [1]UC Davis, Center for Mind and Brain* – Music commonly evokes vivid autobiographical memories and emotions, and therefore serves as a useful cue with which to study the retrieval, structure, and reliving of autobiographical memories. fMRI data were collected in a sample of UC Davis undergraduates as they listened to 30s excerpts of songs randomly drawn from the Billboard Pop and R&B charts for the years that they were between 7 and 19 years of age. Two models were used to analyze the data. The first used parametric regressors derived from the familiarity, affective valence and autobiographical salience ratings obtained immediately following the presentation of each song. This epoch-level model revealed a positive correlation between activity in both medial and lateral prefrontal areas and the degree of familiarity, autobiographical salience and positive affect. The second model represented the moment-to-moment movements of the musical excerpts through tonal space and identified those parts of the brain that followed the tonal structure of the music as a function of autobiographical salience. In individual subjects, this model showed focal areas of tonality tracking distributed in networks of frontal, temporal, parietal, occipital, and limbic regions. At a group level, the most common site of tonality tracking was in the medial prefrontal cortex, overlapping with the activations observed with the other model. Other prominent sites of tonality tracking were lateral BA10, the extrastriate cortex and the posterior superior temporal cortex. The results support a view in which autobiographical memories are constructed in the moment from diverse pieces of autobiographical knowledge (Conway & Pleydell-Pearce, 2000).

F121

IMAGINED PAST, PRESENT AND FUTURE EPISODIC EVENT CONSTRUCTION BY PATIENTS WITH HIPPOCAMPAL AMNESIA *Unni Jensen[1], Melissa Duff[1], Ralph Adolphs[2], Dan Tranel[1]; [1]University of Iowa, Iowa City, [2]Division of the Humanities and Social Sciences, California Institute of Technology, Pasadena* – Hippocampal amnesic patients have been found to be impaired in the elaboration of newly imagined events (Hassabis et al., 2007). However, whether amnesic patients can construct (Schacter et al., 2007) imagined episodic events in different time frames has not been well characterized. We hypothesized that amnesic patients would be impaired when asked to construct imagined past, imagined present and imagined future episodic events in a neutral word-cue task. Patients with hippocampal amnesia, non-amnesic brain-damaged patients without medial temporal lobe damage, and healthy comparison participants were given a neutral cue-word and then instructed to first construct imagined episodic events in different time frames (past, present, future) and then to elaborate on these events by describing what happens during the event and then describing a specific contextual setting from the event. Hippocampal amnesic patients were impaired in constructing imagined episodic events in the three different time frames as compared to the brain-damaged and healthy comparison groups. Specifically, the amnesic patients were unable to construct all the required episodic events, and for the ones they did construct they required more prompts and their mental representations contained fewer words and were less rich. These findings support our hypothesis, converge with fMRI data from normal healthy participants (Addis et al, 2007), and further support the idea that the construction of imagined episodic events in different time frames is linked to the medial temporal lobe.

F122

DISTINCT PATTERNS OF RECOGNITION-RELATED ACTIVITY IN MEDIAL TEMPORAL CORTEX: A HIGH-RESOLUTION FMRI STUDY *Jeffrey D. Johnson[1], L. Tugan Muftuler[1], Michael D. Rugg[1]; [1]University of California, Irvine* – Numerous electrophysiological, lesion, and functional neuroimaging studies have established that medial temporal lobe (MTL) cortex plays a crucial role in recognition memory. The roles of specific MTL regions in recognition, however, are not well characterized in humans. This is likely due, in part, to the spatial resolution of typical functional magnetic resonance imaging (fMRI) data, which leaves unclear the precise localization of recognition-related activity. Additionally, provided that activity can be adequately localized, it remains to be determined whether MTL regions track the novelty/familiarity of items in an 'all-or-none' or graded fashion. To address these methodological and conceptual issues, the present study employed high-resolution fMRI in an investigation of how MTL activity varies with successive item presentations. Subjects (N=16) completed a series of continuous recognition tasks in which old/new judgments were made for either words or pictures. Items were presented between one and four times, with a mean of 23 trials (approx. 55 s) between repetitions. Consistent with the hypothesis of MTL involvement in novelty detection, regions in bilateral anterior hippocampus and left parahippocampal cortex exhibited an all-or-none response profile of greater activity to new compared to old items. By contrast, the activity of adjacent right hippocampal and left parahippocampal regions decreased linearly with successive presentations. These results demonstrate that distinct MTL regions, and indeed distinct regions within hippocampus, respond in a qualitatively different manner during recognition memory. Further, the findings contribute to accumulating evidence that high-resolution fMRI can be used effectively to dissociate memory-related activity within MTL sub-structures.

F123

PUPILLARY RESPONSES DISCRIMINATE FAMILIARITY AND NOVELTY DETECTION PROCESSES *Alexandros Kafkas[1], Daniela Montaldi[1]; [1]School of Psychological Sciences, The University of Manchester* – Familiarity and novelty detection are often treated as mirror images of the same process. However, there is evidence suggesting distinct contributions of these signals to familiarity-based recognition. The present study explored pupillary responses as a potential indicator of differential processing during familiarity and novelty detection. Participants rated the strength of their feelings of familiarity and novelty, in two blocks with different proportions of novel and familiar items (novelty block: 70% new items, familiarity block: 70% old items). Participants were trained to classify feelings of familiarity and novelty as strong, moderate or weak and to discriminate familiarity from recollection-based recognition. The results showed that pupil dilation was greater for familiarity compared with novelty detection, despite novelty detection being more accurate. Effortless recollection of items produced pupil dilation that was greater than both novelty and familiarity detection. Finally, the comparison of pupillary responses in the two target blocks suggested that the detection of novelty elicited greater pupillary responses when it was unexpected (i.e. novel items encountered in familiarity block), whereas familiar items produced sustained processing across both blocks. Overall these results underline three important points: a) pupillary responses differentiate the processing underlying familiarity and novelty detection, a finding in accordance with a potential distinct contribution of these two signals to familiarity-based recognition; b) the more detailed the outcome of memory retrieval, the greater the pupil dilation and c) enhanced processing of novel items is dictated by the expectedness or salience of the novel event, rather than by its intrinsic novelty value.

F124

CHANGES IN HIPPOCAMPAL RESPONSE TO CUE AND FEEDBACK DURING ASSOCIATION LEARNING. *Eunjoo Kang[1], Jinhee Kim[1], Hyejin Kim[1]; [1]Kangwon National University* – In the current study, we identified those brain regions whose activity changes with repeated exposure to cue-response-feedback sequences across a learning session. Twenty two healthy young individuals were scanned with fMRI (1.5T, TR = 3 sec, 22 5m slices) while 16 cue-response associations were learned across three consecutive 9-minute scans. Responses to visually-presented letter cues were followed either by right/wrong or reward/punishment (monetary) feedback. We identified brain regions whose activity changed (FEW $p < .05$) over the three consecutive scans. VOI (volume of interest) analysis was performed for those clusters showing significant scan effects in voxel-wise analysis (SMP5). Repetition-associated changes were examined both for cue-associated and feedback-associated brain activations. The anterior hippocampus and amygdala showed monotonic decreases bilaterally over consecutive scans for the cue-associated activations only. In contrast, the left parahippocampus showed monotonic decreases for the feedback-associated activations only. Left parahippocampal activity was greater in response to correct (right or reward) than incorrect feedback (wrong or punishment). These findings are consistent with the involvement of the hippocampal system in explicit memory and novelty detection, both of which were probably more prominent in the earlier scans of this paradigm. However, the dissociation between the hippocampus and parahippocampus in cue and feedback processing was unexpected. We suggest that early phase of learning require more explicit memory, whereas the later phase requires less explicit memory as indicated by the different degree of involvement of the hippocampal system.

F125

CORTICAL DYNAMICS IN AN EMOTIONAL `THINK-NO THINK` TASK – AN MEG STUDY *Johanna Kissler[1], Hauswald Anne[1], Tesarek Katrin[2]; [1]University of Konstanz, Germany, [2]Technical University of Berlin, Germany* – We investigated the ability to intentionally control episodic memory and the underlying neuromagnetic activity as subjects engaged in mental rehearsal ('think') or active suppression ('no think') of previously learned neutral or unpleasant contents. Subjects first learned to associate neutral faces with neutral or unpleasant pictures from the IAPS set. Hereafter, only the faces were shown together with a cue that indicated that the subjects should either rehearse and think of the associated picture or actively inhibit recollection. A final free recall followed. Across all participants, a beneficial effect of rehearsal, but no detrimental effect of suppression on final recall emerged and no effect of emotional content was found. However, subsequent analysis showed that 9 of the 20 participants did show a significant suppression effect, while the other 11 showed the reverse pattern with a facilitation effect compared to baseline. The neural activities in the 'no think' phase revealed an early (100-200 ms) group difference: Activation of left pre-frontal cortex in the 'suppressors' was enhanced. This effect was missing in the 'non-suppressors', who instead showed sustained right temporal activation starting from 150 ms after cue onset. The results demonstrate that the ability to actively suppress memory contents varies considerably even among students but that subjects who are able to suppress memory contents are characterized by an early on-set frontal activation, in line with the notion that frontal structures may down-regulate medial-temporal brain structures during 'no think' trials. So far, we observed no impact of emotional content on intentional memory control.

F126

RIGHT-SIDED PARIETAL ACTIVATION DURING SUCCESSFUL RETRIEVAL OF AGRAMMATICAL MUSIC STIMULI *Ellen C. Klostermann[1], Arthur P. Shimamura[1]; [1]University of California Berkeley* – In fMRI and ERP studies, successful recognition performance has been associated with left-lateralized activity in the posterior parietal cortex (PPC). Schloerscheidt & Rugg (1997) have previously shown that the ERP successful retrieval effect occurs in the left hemisphere for both words and pictures of objects, even though in the medial tempral lobe (MTL) these two stimulus types seem to be lateralized (right MTL damage causes greater impairment in picture than word memory and vice versa). However, the picture stimuli used in this experiment were of common objects, and were, therefore, still verbalizable. Here, we investigated recognition performance, and particularly the lateralization of PPC activity, for short, agrammatical music stimuli (Blackwood, 2004), which are largely processed in the right hemisphere. For both study and test phases, participants closed their eyes and listened to music clips presented through electrodynamic, noise-suppression headphones. During the study phase, participants made pleasantness judgments. At test, participants made old/new recognition judgments with high/low confidence ratings. Right but not left PPC activity was observed during the successful retrieval of these agrammatical music stimuli. This finding suggests that the PPC activity in previous studies has been left-lateralized because they used verbal or verbalizable stimuli. This data further suggests that both the right and left PPC are involved in successful memory retrieval.

F127

THE LATERALIZATION OF SEMANTIC PROCESSES INVOLVED IN NATURALISTIC ACTION PERFORMANCE IN STROKE PATIENTS *Sabrina Lombardi[1], Norman Park[1]; [1]York University* – Naturalistic actions are multi-step actions in which tools are used to achieve goals. Routine actions (NA) have been performed many times, whereas novel actions (NNA) are unfamiliar prior to instruction. This study aimed to investigate the cognitive processes underlying NA and NNA enactment, as well as explore their lateralization. Thirty-four stroke patients with either left (LHD) or right (RHD) hemisphere damage and twelve controls were instructed to enact as well as arrange a set of photos depicting the same NAs and NNAs in an order that would result in proper task completion. Subjects were administered a neuropsychological battery including measures of tool-action knowledge. LHD and RHD participants were similarly impaired on NAs and NNAs relative to controls. High error producers with either LHD or RHD tended to make crux (central action) omission rather than commission errors in NAs. In NNAs however, high error producers tended to make crux commission rather than omission errors. Hemispheric differences were noted in NA and NNA picture arrangement measures, where RHD participants were more impaired than participants with LHD. Also, NA and NNA enactment was correlated with performance on measures of tool-action knowledge in participants with LHD but not RHD. These results suggest that overlapping yet distinct cognitive processes are present in NA and NNA enactment. These findings show that tool-action knowledge, which is associated with apraxia and left lateralized, is also linked to naturalistic action performance. Our findings further suggest that the right hemisphere plays a critical role in the representation of multi-step actions.

F128

WHEN VISION MEETS MEMORY: EVENT-RELATED POTENTIALS REVEAL THE TIMING OF OBJECT CATEGORIZATION, IMPLICIT MEMORY, AND RECOGNITION *Lisa Lucia[1], Haline Schendan[1]; [1]Tufts University* – Objects seen from unusual relative to canonical views require more time to categorize and recognize, and, by object model verification accounts, additionally recruit prefrontal-parietal networks for top-down cognitive control, and, by the multiple views plus transformation variant, the parietal process is mental rotation. View effects will be similar across tasks according to these vision frameworks, but differ between memory tests according to memory systems frameworks because distinct brain systems support generic memory for categorization and episodic memory for recognition. To test these vision and memory hypotheses, event-related potentials (ERPs) directly measured the view-dependence of cortical activity during object categorization and recognition. Participants categorized objects in canonical or unusual views during study and a later indirect memory test to assess priming of categorization. On a direct memory test, they recognized each object as remembered with high or low confidence, or as a new object. On both indirect and direct tests, objects were repeated in the same or different view than studied, or were new. Performance results replicated known view-atypicality effects and view-specific priming and recognition effects. ERP results showed view-atypicality and view-specific repetition effects on a frontopolar N350 that were larger on categorization than recognition. In contrast, these view effects on a later parietal positive complex (or P600) were similar across tasks. These findings and object-sensitive and mental rotation-related ERP effects in the same participants support the Two-State Interactive account of visual object knowledge activation (Schendan & Kutas, 2007; Schendan & Stern, 2007) that integrates vision and memory systems accounts.

F129

THE EFFECT OF DIRECTED FORGETTING ON MEDIOTEMPORAL LOBE ACTIVATION *Eva Ludowig[1], Christian G. Bien[1], Thomas Münte[2], Jürn Möller[2], Christian E. Elger[1], Timm Rosburg[1]; [1]University of Bonn, Germany, [2]Institute of Psychologie II, University of Magdeburg, Germany* – It is a matter of debate whether forgetting is merely the result of weak memory traces or whether it can also be achieved by active inhibition of memory contents. In a single-item directed forgetting paradigm, words were presented to subjects, either followed by the instruction that this word had to be remembered (TBR) or to be forgotten (TBF). We investigated the effects of the TBR/ TBF cues on intracranial event-related potentials from 15 patients with mesial temporal lobe epilepsy. All patients were implanted with multicontact depth electrodes along the hippocampus or with frontal grid electrodes as part of presurgical evaluation. As expected, subjects recognized significantly more TBR than TBF words in a subsequent recognition test. During encoding, both instruction cues elicited a P300 response of similar size in the hippocampus. In the rhinal cortex, each cue first led to a steep negativity at ~300 ms, rapidly followed by a positivity at ~400 ms. For the TBR instruction, this positivity returned to baseline level at ~600 ms, while the TBF instruction caused an ongoing positivity lasting up to 2000 ms. In several frontal grid electrodes, the TBF instruction led to more positive responses, too. The rhinal cortex is regarded as an essential link between neocortex and hippocampus that serves as a filter mechanism. The observed prolonged rhinal positivity in response to TBF instructions might reflect input from frontal cortices, resulting in active inhibition of hippocampal encoding.

F130

DISSOCIATION OF RULE-BASED AND IMPLICIT CATEGORY LEARNING: AN ELECTROPHYSIOLOGICAL APPROACH *Robert G. Morrison[1], Paul R. Reber[1], Ken A. Paller[1]; [1]Northwestern University* – Categories are central to mental lives and allow us to make sense of, describe, and order our mental and physical worlds by virtue of detected stimulus regularities. Behavioral, neuropsychological, and neuroimaging evidence has suggested that categories can often be learned either via a rule-based mechanism critically dependent on medial temporal and prefrontal brain regions, or via an implicit mechanism relying on the basal ganglia. In this study we used a visual category-learning paradigm (Maddox, Ashby, & Bohill, 2003) in which subjects learn to categorize Gabor patches based on either a rule-based strategy or an implicit strategy. In either case subjects are not told how to categorize, but rather discover how to categorize through feedback received on each trial. We measured event-related potentials while subjects (1) passively observed Gabor patches, (2) categorized patches according to one mechanism, and, one week later, (3) categorized patches according to the other mechanism. Performing either type of category learning engaged more negative occipital potentials at approximately 150-200 ms and more positive frontocentral potentials at approximately 400-800 ms, compared to the passive condition. In the rule-based condition, the latter potentials were greater for correct than incorrect trials, and amplitudes decreased when learning began to asymptote—two effects not found in the implicit condition. These results provide additional evidence for distinct brain mechanisms supporting rule-based versus implicit category learning; new insights into this distinction can thus be obtained by monitoring relevant neurocognitive processes in real time using these methods.

F131

RELATIONAL STRATEGY BIAS IMPROVES TRANSITIVE INFERENCE ACROSS AGE GROUPS *Sandra Moses[1], Melanie Ostreicher[1,2], Christina Villate[1], Jennifer Ryan[1,2]; [1]Rotman Research Institute, [2]University of Toronto* – Transitive inference is a complex task, conducive to the use of multiple strategies. We investigated whether transitive inference accuracy can be improved by biasing strategy choice towards a proposition-based approach that relies on the extraction of relations among stimuli, as opposed to an associative learning approach that relies on memory for previous reward history of individual stimuli. We biased strategy choice in younger (18-29), middle-aged (30-59) and older adults (60-80) by using familiar stimuli with known relations that tap prior knowledge. The familiar stimuli and relations could provide a relational hierarchical framework that may be applied to subsequent conditions with arbitrary relations. We hypothesized that encouraging the use of previously acquired semantic information would lead to the extraction of relations among the stimuli in both the familiar and novel stimulus conditions and facilitate a proposition-based reasoning approach. Semantic information led to increased accuracy for all ages, the use of a proposition-based approach rather than associative learning, and increased awareness of stimulus relations. Awareness accounted for the variability in performance accuracy to a greater extent than age. Increased age was associated with reduced awareness. However, aware older, middle-aged and younger adults showed similar accuracies on all conditions. Interestingly, unaware participants showed successful inference performance, and performance patterns were indicative of a relational proposition-based approach. The current work indicates that age differences in performance can be minimized, by providing semantically meaningful stimuli that bias participants to use a relational proposition-based approach.

F132

THE EMERGENCE OF SEMANTIC TOPOGRAPHY AND CATEGORY-SPECIFIC IMPAIRMENTS IN A NEURALLY-INSPIRED COMPUTATIONAL MODEL *Lee Newman[1], Thad Polk[1]; [1]University of Michigan* — Representations in sensory cortices are organized topographically and substantial progress has been made in understanding how such topography develops at a neurocomputational level. We extend this work by presenting a neural network model in which higher-level semantic representations develop based on topographic input from lower-level sensory maps. The receptive fields of cells in a higher-level association map correspond to the loci of activity within the cortical topography of lower-level sensory maps rather than to explicitly coded sensory features. Representations in the association map develop using the same self-organizing algorithms used for the sensory maps. Using this model, we show that t semantic representations at increasing levels of abstraction naturally emerge as a result of exposure to a set of visual stimuli. For example, when presented with a set of simple visual features (color, texture, size, and shape) the model develops semantic representations that distinguish basic level categories (dogs, tables, cars), superordinate categories (animals, furniture, vehicles), and living vs. non-living things. Furthermore, random lesions to the model produce the kinds of category-specific impairments reported in patients (e.g., selective impairments of living vs. non-living things). Our results demonstrate that semantic representations can be learned based on the same principles of neural computation known to be operating in early sensory cortex and suggest a possible computational role for topography in semantic cognition.

Poster Session G

Higher level cognition: Other

G1

INFERRING MENTAL STATES TO JUSTIFY BLAME *Dorit Kliemann[1,2], Liane Young[2], Jonathan Scholz[2], Rebecca Saxe[2]; [1]University of Bremen, [2]Massachusetts Institute of Technology* – Moral judgment depends critically on "Theory of Mind" (ToM): when an agent's beliefs and intentions are known, observers rely almost exclusively on those mental states when attributing moral blame for an action. In everyday life, however, the agent's thoughts are rarely known to the observer and so must be inferred from other available information, such as prior experience with the individual. We therefore investigated the cognitive and neural consequences during moral reasoning of such experience. We hypothesized that prior personal experience would modulate the utilization of mental state information in moral reasoning. Subjects first engaged in an economic game with fair and unfair competitors and then read descriptions of their competitors' actions that resulted in positive or negative outcomes. The descriptions were designed to leave the competitors' mental states ambiguous; the assignment of actions to fair or unfair competitors was counterbalanced. A behavioral study revealed that actions producing negative outcomes were judged as more "intentional" when performed by previously unfair competitors. In the functional magnetic resonance imaging (fMRI) experiment, subjects made blame/praise judgments of these actions. Negative outcomes were judged more blameworthy when caused by previously unfair competitors. Even though explicit mental state evaluation was not required, moral judgments in this case were accompanied by increased activation in a brain region associated with ToM: the right temporo-parietal junction. The magnitude of this activation was correlated with individual subjects' response to unfair play in the economic game, indicating a direct link between previous experience and current moral judgment.

G2

THE NEURAL CORRELATES OF FATIGUE IN TRAUMATIC BRAIN INJURY *Alex Kohl[1,2,3], Glenn Wylie[1,2], Helen Genova[1,2], Frank Hillary[4], John DeLuca[1,2]; [1]Kessler Medical Rehabilitation Research and Education Center, [2]University of Medicine and Dentistry of New Jersey, [3]Rutgers University, [4]Pennsylvania State University* – Cognitive fatigue is one of the most disabling symptoms following Traumatic Brain Injury (TBI). However, its assessment remains challenging and controversial. Functional magnetic resonance imaging (fMRI) offers a potential way to objectively measure fatigue. Previous work using fMRI has shown that TBI patients, relative to healthy controls (HCs), show a more diffuse pattern of brain activity when engaged in a variety of tasks. This has been interpreted as compensation – the injured brain must work harder to achieve the same level of performance. We hypothesized that this compensation is isomorphic with fatigue, and that tracking it over time might be an effective way to objectively measure fatigue. We used fMRI to track brain activity across time during a modified symbol digit modality task (mSDMT) in 13 TBI patients with moderate to severe injury, and 13 age-matched HCs. We analyzed the data with a 2 x 3 mixed ANOVA, with the factors of Group (HC vs. TBI) and Time (3 repeated blocks of mSDMT). In a network of areas including the middle superior frontal gyrus, anterior cingulate, and parietal/precuneus we found that persons with TBI showed increased activity (BOLD signal) across time, while HCs showed decreases across time. The implications of these results for models of fatigue will be discussed.

G3

WHAT HAPPENS WHEN A GRAPHEME-COLOR SYNAESTHETE LEARNS A NEW LANGUAGE? *Donna Kwan[1], Jonathan Carriere[1], Daniel Eaton[1], Emma Guild[1], Mike Dixon[1], Daniel Smilek[1]; [1]University of Waterloo, Canada* – Grapheme-color synaesthesia is a fascinating condition in which individuals perceive ordinary black letters of the Latin alphabet in vivid, specific, colors. In studies of adult synaesthetes, grapheme-color associations have been shown to remain highly consistent over time. In the present study we sought to evaluate how grapheme-color pairings form when a new writing system is learned. Specifically, we evaluated whether (1) grapheme-color pairings become more consistent with increased familiarity with a new writing system, and (2) whether the synaesthetic colors elicited by the Latin alphabet transfer to new writing systems as they are learned. To address these issues we tested a synaesthete, DE, who, in addition to the Latin alphabet, had some degree of functional familiarity with a number of other writing systems. We assessed the consistency of DE's grapheme-color associations for Latin, Hiragana, Katakana, Cyrillic (1918 version), and Korean (Hangŭl) writing systems. There was a strong relation between familiarity and grapheme-color consistency for DE. DE's grapheme-color associations were also analyzed according to their similarity across graphemes, providing an assessment of the extent to which colors transferred between each writing system. DE was asked to explain how each color transfer came about. Each writing system contained a number of unique and shared colors, with colors transferring between systems on the basis of both visual and phonological similarity. Overall the results indicate familiarity increases grapheme-color consistency and suggest both visual features and phonological information play an important role in the development of synaesthetic grapheme-color associations.

G4

BENEFITS FROM PRIOR EXPERIENCE IN STATISTICAL LEARNING: THE ROLE OF PERCEPTUAL VS. ABSTRACT SIMILARITY *Jill Lany[1], Rebecca Gomez[2]; [1]The University of Wisconsin-Madison, [2]The University of Arizona* – Sensitivity to statistical information is critical to language acquisition. Statistical structure pertains to the particular items experienced (e.g., item-frequency or probability of co-occurrence with another item), but such learning can also result in generalization to novel items. Moreover, statistical learning benefits from prior experience with similar patterns. We tested whether perceptual (vs. abstract) similarity between two patterns is required for such benefit. In a previous experiment, learners were exposed to two artificial languages in which words from the categories a, X, b, and Y were combined to form aX and bY strings. Successful learning entails categorizing words based on perceptual features, and acquiring permissible category combinations. Although the two languages had different vocabulary, in both the perceptual markers of word-categories were word-endings. Thus the languages contained similar perceptual features. Here, the features distinguishing word categories differed in the two languages (in one Xs and Ys had different endings, and in the other they differed in syllable number). Learners with prior experience performed significantly better than naïve learners, and also generalized to novel instances respecting the language structure. Thus, statistical learning is enhanced by prior experience with similar abstract language structure (involving co-occurrence restrictions on word-categories) despite differences in perceptual features.

G5

"YOU" AND "I": SHARED AND DISTINCT NEURAL SYSTEMS FOR THE SELF AND OTHERS DURING MENTALIZING OR PHYSICAL JUDGMENTS *Michael Lombardo[1], Bhismadev Chakrabarti[1], Susan Sadek[1], Greg Pasco[1], Sally Wheelwright[1], Simon Baron-Cohen[1]; [1]University of Cambridge, Autism Research Centre* – Various lines of research show that representations of the self and others (e.g., touch, pain, disgust, action) overlap within the brain (Keysers et al., 2004; Singer et al., 2004; Wicker et al., 2003; Iacoboni et al., 1999). It is unclear however, whether the brain handles reflective mentalistic and physical judgments of the self and other in a similar way. In the context of mentalizing, ventromedial prefrontal cortex (VMPFC) has been shown to be an area sensitive to thinking about the minds of oneself or a similar other (Mitchell et al., 2006). We tested 23 healthy male volunteers in a 2x2 factorially-designed 3T fMRI experiment in order to test whether reflective mentalizing or physical judgments about the self or other would recruit shared or distinct neural systems. Parametric group-level analyses in SPM5 showed that when asked to mentalize, overlapping regions in the VMPFC, posterior cingulate cortex/precuneus (PCC), and right temporo-parietal junction (RTPJ) were active for both self and other judgments. During physical judgments, both self and other conditions recruited shared regions within the dorsomedial prefrontal cortex (DMPFC) and bilateral inferior frontal gyrus (IFG). Across mentalizing and physical judgments, a greater bias for self over other-referential judgments was found in VMPFC, while greater bias for others over self-referential judgments recruited DMPFC and PCC. Our results are discussed in relation to simulation theory and its implications for informing investigations in populations where self- and other-referential cognition are atypical, such as autism (Lombardo et al., 2007).

G6

THE NEURAL BASIS OF BICONDITIONAL GRAMMAR LEARNING *Clarisse Longo dos Santos[1], Virginia Penhune[1], Maria Dellerba[1]; [1]Concordia University* – Learning a set of abstract rules, or general principles, is an important process in everyday life. The underlying brain structures associated with this process have been investigated by a few neuroimaging studies. The present study used a modified version of the Biconditional Grammar, to investigate the neural basis of different stages in abstract rule learning. Ten right handed adults participated in this study. Participants were exposed to 96 strings of consonants. In each trial, they studied a string and had then to choose, among three options, the one that followed the rules. Feedback was presented as "correct" or "incorrect". Between blocks, participants stated the strategies they used. A 3T fMRI scanner was used (SIEMENS; 36 interleaved slices; Voxel size: 3.5×3.5×3.5 [mm]; TR=2.5 s). Statistical analyses were conducted using fMRIstat. Voxels with |T| higher than 3.17 (uncorrected $p<0.001$) were considered for the cluster analysis. There was a clear behavioural dissociation between performance of participants who reported to be guessing and those who acquired explicit knowledge of the rules of the BG. This pattern was also observed in the neuroimaging data. In early learning, non-learners showed more activation in areas of visual association, suggesting perceptual based strategies, and learners showed in addition activation in frontal regions (9/46). In late learning, non-learners showed activation in areas related to explicit retrieval and procedure processes, and learners, areas related to explicit memory functions and control. Interestingly, during early learning, both groups did not differ in performance.

G7

NEURAL CHANGES WITH LEARNING AND EXTENDED PRACTICE: STIMULUS-SPECIFIC MAPPINGS VERSUS GLOBAL TASK PARAMETERS *Phan Luu[1,2], Catherine Poulsen[1], Don M. Tucker[1,2], Chelsea Mattson[1,2], Anne Smith[3]; [1]Electrical Geodesics, Inc., [2]University of Oregon, [3]University of California, Davis* – Cognitive and neurocognitive research indicates that learning is associated with a relative shift from controlled to automatic processing, and a corresponding reduction in frontal lobe activity related to executive control. We extended these findings to examine changes in human brain activity associated with two complementary corticolimbic learning circuits identified in animal studies: the ventral-limbic circuit (anterior cingulate, amygdala, medial thalamus) implicated in fast, early learning; and the dorsal-limbic circuit (posterior cingulate, hippocampus, anterior ventral thalamus) implicated in slower, late learning. Dense-array (256-channel) electroencephalography (EEG) was recorded as participants acquired, through trial and error, 16 different arbitrary stimulus-response (S-R) mappings (e.g., '27' paired with left index finger button press) using a Go-NoGo paradigm. Bayesian state-space analysis served to estimate the trial by which a given S-R mapping had been learned. Changes in stimulus-locked neural response from pre- to postlearning, and with overlearning (extended practice across three sessions), were assessed by scalp measures and distributed linear-inverse source analyses. Two early-learning circuit indices, the frontopolar contingent negative variation (rostroventral anterior cingulate source) and lateral inferior anterior negativity (temporal pole and ventrolateral prefrontal sources) decreased with learning and practice, whereas late-learning circuit indices, the N170 (lateral posterior temporal) and P300 (medial temporal and posterior cingulate) increased. The medial frontal negativity (MFN), previously attributed to performance monitoring, also increased from pre- to postlearning and throughout extended practice. A fourth session with new S-R mappings served to separate activity associated with the acquisition of specific S-R mappings versus learning of global task parameters.

G8

NEURAL MECHANISMS ASSOCIATED WITH REWARD ANTICIPATION IN OBESITY *Laura E Martin[1], Rebecca Chambers[1], Joseph Donnelly[2], Lisa Sanderson Cox[1], Cary R Savage[1]; [1]University of Kansas Medical Center, [2]University of Kansas* – In obesity, the neural systems of reward are disrupted and appear to increase the motivational value of food. To our knowledge, no studies have yet directly compared brain responses to non-food rewards in obese and healthy weight (HW) participants. The current study employed fMRI to examine the neural systems of reward when monetary rewards and punishments were predicted and delivered. The task consisted of the presentation of cues that predicted the delivery of a reward or punishment with 75% probability. Participants then received feedback on how much money they won or lost on the trial. To date, we have collected data in obese participants and HW controls. Threshold adjustments were based on Monte Carlo simulations to determine the cluster size for a cluster-wise probability $p<.05$. Preliminary results have identified a subgenual anterior cingulate cortex (ACC) region (xyz: HW = -7, 35, -4; Obese = -8, 25, -3) that responds differentially in HW compared to obese participants. During the prediction phase of the trial, HW but not obese participants showed greater ACC activations when rewards were predicted, compared to when punishments were predicted. However this pattern was reversed during the delivery phase of the trial, with obese but not HW participants showing greater ACC activations when rewards compared to punishments were delivered. These results are consistent with previous behavioral studies showing a preference for immediate over delayed rewards in obesity and suggest that abnormal activation in the ACC may be associated with impairments in learned associations of outcomes in obesity.

G9

DISEASE-RELEVANT FUNCTIONAL CONNECTIVITY IN MILD COGNITIVE IMPAIRMENT *Donald McLaren[1,2], Michele Ries[1,2], Guofan Xu[1,2], Barbara Bendlin[1,2], Michele Fitzgerald[1,2], Erik Kastman[1,2], Gemma Gliori[1,2], Britta Jabbar[1,2], Sterling Johnson[1,2]; [1]Geriatric Research Education and Clinical Center, William S. Middleton Memorial Veterans Hospital, [2]Universisty of Wisconsin, Madison* – Individuals with Mild Cognitive Impairment (MCI) and Alzheimer's Disease show functional and structural changes in the posterior cingulate and amygdala. Yet, very little is known about the contribution of amygdala dysfunction in producing clinical symptoms and modulating other brain areas. Here we investigate the functional connectivity of both the amygdala and posterior cingulate. Functional MRI data were collected in 22 young controls to investigate spontaneous low-frequency fluctuations correlations with the amygdala and posterior cingulate. In a voxel-wise analysis of the PC and amygdala, we found that there were two almost entirely discrete networks. Specifically, we replicated the traditional "default-mode" network showing connectivity with the posterior cingulate and a separate network involving the amygdala, basal forebrain, anterior cingulate and parts of the right frontal cortex. However, there were a few regions of overlap, including the retrosplenium, which might act to integrate the two networks. In a separate dataset from 16 MCI patients and 16 age-matched controls, we regressed out the task effects to look at the spontaneous fluctuations. We found differences in connectivity between MCI patients and controls that included: (1) increased connectivity between the amygdala and anterior cingulate/left frontal cortex; and (2) decreased connectivity between the posterior cingulate and ventral medial prefrontal cortex. Additionally, several frontal brain regions showed a correlation between connectivity and self-awareness measures. Thus, connectivity changes provide a possible physiological basis for explaining the symptoms observed in MCI patients. Further analyses will investigate how atrophy and and cognitive abilities affect connectivity.

G10

PERCEPTUAL AND COGNITIVE BILATERAL REDUNDANCY GAINS: EVIDENCE FOR HEMISPHERIC COOPERATION SPECIFIC TO THE PROCESSING OF LEARNED MEANINGFUL STIMULI *Bettina Mohr[1,2], Carmen Nielsen[2], Christine Schmalz[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, [2]Anglia Ruskin University, Cambridge* – Investigation of hemispheric interaction processes showed that redundant stimulus presentation facilitates perceptual and cognitive processing of elementary and complex stimuli. However, the magnitude of redundancy gains seems to vary with stimuli and tasks. In a series of visual half-field studies, we investigated the effects of unilateral and bilateral redundant presentation of verbal and nonverbal material across a range of tasks tapping into basic perceptual and higher cognitive processes. In a stimulus detection task, participants showed significantly better performance for all stimuli (words, pseudowords, objects, nonobjects) presented bilaterally, compared to unilateral stimulation, indicating unspecific redundancy gains which are independent from stimulus material. This pattern was also obtained for both, words and pseudowords involving elementary cognitive tasks, such as letter bigram detection. Interestingly, in tasks involving lexical and memory processes, words and objects as opposed to meaningless stimuli showed strikingly different signatures of hemispheric processing: In a delayed-matching-to-sample task, we found better performance for words and objects presented bilaterally compared with unilateral stimulation, but no such effect for pseudowords and nonobjects. This specific bilateral redundancy gain (BRG) was also found in a lexical and object decision task, thus indicating BRG effects specific to learned material. Further analyses revealed that the magnitude of the BRG for learned stimuli significantly exceeded the one obtained for unlearned material. These data suggest different mechanisms underlying BRG effects in perceptual and cognitive processing. Access to long-term memory traces may invoke a specific process of interhemispheric cooperation, possibly related to distributed transhemispheric cortical networks realising the traces.

G11

BRAIN MECHANISMS UNDERLYING HUMAN COMMUNICATION *Matthijs Noordzij[1], Sarah Newman-Norlund[1], Jan-Peter De Ruiter[2], Peter Hagoort[1,2], Stephen Levinson[2], Ivan Toni[1,3]; [1]F.C. Donders Centre for Cognitive Neuroimaging, Radboud University Nijmegen, The Netherlands, [2]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, [3]Nijmegen Institute for Cognition and Information, The Netherlands* – Human communication involves more than language abilities or symbolic codes: it relies on an infrastructure involving the attribution of communicative intentions, which a successful communicator must anticipate. In two fMRI studies we isolate this underlying ability by using a task requiring communication without prior conventions. Planning communicative actions and recognizing their communicative intention relied on the same brain region, the right posterior superior temporal sulcus (pSTS). The response of this region was lateralized to the right hemisphere, modulated by the ambiguity in meaning of the communicative acts, but not by their sensorimotor complexity. This finding supports the notion that our communicative abilities are distinct from both sensorimotor processes and language abilities.

G12

ROLES OF THE MEDIAL FRONTAL CORTEX AND HIPPOCAMPUS IN MEMORY-GUIDED FUTURE PLANNING *Jiro Okuda[1,2], Masataka Watanabe[3], Toshikatsu Fujii[4], Maki Suzuki[4,5], Nobuhito Abe[4], Minoru Tsukada[1]; [1]Tamagawa University Brain Science Institute, [2]Institute of Cognitive Neuroscience, University College London, [3]Graduate School of Engineering, University of Tokyo, [4]Tohoku University Graduate School of Medicine, [5]Cyclotron and Radioisotope Center, Tohoku University* – Converging evidence suggests that envisioning the future relies on a cerebral network involved with remembering the past (the medial frontal-temporal-parietal network). It remains unknown, however, if this network is responsible for planning specific future actions based on past experiences, not only for just imagining possible future events in mind. This study aimed to elucidate the role of subregions within the memory-prospection network in memory-based future planning. Twenty-four young volunteers participated in a functional MRI experiment during which they repeatedly made specific action plans (joystick control toward the right, left, up, or down) in association with specific visual stimuli (pictures of natural scenes and manmade objects). They were presented with an "action cue" 4 seconds after each picture presentation, and were asked to perform the action they planned in association with the picture. Twenty-four pictures were presented three times each in a pseudo-random sequence. In a memory-guided planning condition, the action cue was a question mark and the subjects had to make each plan based on their memory (the same action they made in the previous trial of that picture), whereas in a control condition they simply followed a visual cue of a unidirectional arrow to make an action. Event-related fMRI activation at the picture presentation was found in the medial frontal and hippocampal areas, exclusively in the memory-guided condition. Moreover, magnitude of the activation increased with the trial repetition. These results suggest specific roles of the medial frontal and hippocampal regions in planning for future actions according to past experiences.

G13

HIGH-DENSITY ELECTRICAL NEUROIMAGING IDENTIFIES EARLY RECRUITMENT OF RIGHT FRONTO-PARIETAL MIRROR NEURON SYSTEM FOR DECODING INTENTION OF ACTIONS. *Stephanie Ortigue[1], Giacomo Rizzolatti[2], Scott Grafton[1]; [1]UCSB Brain Imaging Center, Sage Center for the Study of the Mind, [2]University of Parma, Italy* – Brain imaging studies of intention understanding suggest recruitment of areas within the mirror neuron system (MNS), particularly in right inferior parietal lobule (IPL) and inferior frontal gyrus (IFG). However, the limited temporal resolution of this method precludes the ability to understand how this proposed intention understanding mechanism is activated. To test the effective involvement of the right mirror neuron system in intention understanding and to define the circuitry leading to its activation we used both fMRI and high-density visual event-related potentials (VEPs) in a total of 20 healthy human subjects while they were performing an intention inference test. Subjects observed one frame from video-clips displaying various types of objects followed by a second frame with hand-on-object actions. Each pair of stimuli was performed either with or without context. Participants received explicit instructions to pay attention only to meaningful actions, and to try to decode "why" an action was performed. Our fMRI results confirmed the specific recruitment of right MNS in understanding other's intention's, especially within a context. High-density VEPs revealed that this distinction between intentions performed within or without context occurs approximately 230ms after presentation of the hand-on-object frame. A distributed linear source estimation (LORETA) of this time progression established that both actions embedded within a context, and actions without context, recruited left followed by right IPL, and IFG. This multimodal approach confirms the crucial and automatic role of MNS, notably the right-lateralized part of this network, in the early stages of understanding other's intentions.

G14

IS A SELF-FACE SPECIAL?: AN FMRI INVESTIGATION OF SELF-FACE PROCESSING *Alessia Pannese[1], Joy Hirsch[1]; [1]Columbia University* – The ability to recognise one's own face is considered the signature of self-consciousness. In this study we hypothesized that the self-face, by virtue of its self-referential content, elicits unique patterns of neural activity representing privileged processing compared to other faces. We tested this hypothesis by employing functional magnetic resonance imaging (fMRI) in an event-related design. Subjects performed a gender-identification task on randomly presented face-photographs differing in identity (self, very familiar, moderately familiar, little familiar, famous, unknown) and length of display (200 ms (explicit condition); 17 ms or 33 ms, immediately followed by a second stimulus displayed respectively for 183 ms or 167 ms (masked condition)). Based on our model of privileged processing, we predicted that the self face would be associated with faster identification and distinct patterns of neural activity compared to other faces. Our results showed that, in both explicit and masked conditions, target self faces were associated with shorter reaction times and stronger engagement of subcortical structures (basal ganglia and thalamus) compared to famous and unknown faces. However, in the masked condition, an interaction effect was found between face and masking time, the self face being the strongest facilitator at 17 ms, but the strongest interferer at 33 ms. These results, in addition to being in agreement with our predictions, support a model whereby the self face undergoes privileged processing, and provide evidence for a complex interplay between self-face recognition and visual awareness.

G15

PAINTING'S INFORMATION INCREASES AESTHETIC PREFERENCE FOR CONTEMPORARY PAINTINGS *Seongmin Park[1], Kyongsik Yun[1], Jaeseung Jeong[1,2]; [1]Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Republic of Korea, [2]Columbia College of Physicians and Surgeons, NY* – Aesthetic preference (AP), an important motivation of art appreciation, toward contemporary paintings having abstract expressions showed wide individual variability under influence of personal traits and prior information, as well as visually discernible beauty. Little is known about the determinants of AP. The aim of this study was to investigate whether the information about paintings can change AP or not. 8 contemporary paintings including Jackson Pollock and Paul Klee were presented to 116 subjects with 5 kinds of painting information in an art museum. AP, evaluated by questionnaires, significantly increased as the information increased, particularly in cases that subjects highly agreed artist's and critic's comments. Furthermore, in scanning event-related fMRI images from 16 subjects under the same condition with 6 paintings, we found that subjects exhibited significant activations in the frontal cortex, anterior cingulated, and cuneus of left brain after the presentation of the artist and subject information and artist comment. Bilateral parietal lobe and right temporal gyrus were significantly increased by critic's comment, and the highest bid price induced activation in right thalamus and right precentral gyrus. These findings indicate that painting information elicited cortical activations on preference-related regions, not visual perception areas, resulting in the enhancement of AP. We suggest that AP arises from integration of various cognitive processes affected by resonant information.

G16

INTERHEMISPHERIC COLLABORATION FOR SIMULTANEOUS LETTER AND PICTURE MATCHING *Urvi Patel[1], Joseph Hellige[1,2]; [1]University of Southern California, [2]Loyola Marymount University* – The present research is an extension of previous work that examined whether it is beneficial to divide processing between the hemispheres by introducing an independent task without changing the complexity of a primary task per se. Hemispheric collaboration is advantageous when both tasks present the same type of stimuli (i.e. letters) as similar cortical regions are accessed. The current experiment was designed to test whether this advantage is found to the extent that such tasks engage overlapping brain areas by presenting stimuli that do no typically employ processing from similar regions (i.e. letters and pictures). Participants were presented with five items per trial in three conditions: (1) three-item letter comparison task (single primary), (2) two-item picture comparison task (single secondary), and (3) three- or two-item comparison task (dual-task). Observers were asked to indicate whether two letters projected to the same/opposite hemisphere(s) matched or whether two pictures projected to both hemispheres matched. The critical comparison involved trials on which the two matching stimuli project to the same visual field (within-hemisphere trials) versus trials on which the two matching stimuli project to opposite visual fields (between-hemisphere trials). Reaction time showed no differences as a function of trial type for single primary and dual primary conditions while error rate revealed a significant across-hemisphere advantage for both conditions. In light of the previously reported across-hemisphere advantage found for the all letter experiment, reaction time alone suggests that it is beneficial to divide processing load under the condition that two tasks access overlapping cortical regions.

G17

CHANGES IN NEURAL RESPONSE TO FEEDBACK GIVEN IN EARLY VERSUS LATE STAGES OF LEARNING *Catherine Poulsen[1], Phan Luu[1,2], Don M. Tucker[1,2], Chelsea Mattson[1,2], Anne Smith[3]; [1]Electrical Geodesics, Inc., [2]University of Oregon, [3]University of California, Davis* – Learning frequently progresses through trial and error, where knowledge of action outcome through feedback guides subsequent performance. Based on result patterns consistent with reward prediction studies in animals, recent human brain imaging studies have postulated mediation by the mesolimbic dopamine (DA) system. Dense-array (256-channel) electroencephalography (EEG) was recorded as participants acquired, solely through trial and error guided by immediate feedback, 16 different arbitrary stimulus-response (S-R) mappings (e.g., '27' paired with left index finger button press) using a Go-NoGo paradigm. As assessed with Bayesian state-space analysis, mappings were typically acquired within the first session. Extended practice was provided in a second and third session. In a fourth session new S-R mappings were introduced to distinguish activity associated with the acquisition of specific S-R mappings versus learning of global task parameters. Hypotheses related to feedback processing were examined in scalp and distributed linear-inverse source analyses. In line with the DA-mediation hypothesis, early in learning a second P2 peak (P2a) obtained to correct feedback ('unexpected reward') that was coincident with the time of the feedback-related negativity to error feedback. This early correct-feedback effect disappeared with extended practice sessions 2 and 3 (now an 'expected reward'), but returned in session 4 when new S-R mappings were introduced. In addition, in line with neurocognitive and animal research on early versus late stages of learning, extended practice was associated with a progressive decrease in frontal ventrolimbic activity (feedback-related negativity and left lateral inferior anterior negativity), and a progressive increase in posterior dorsolimbic activity (P3).

G18

AN INVESTIGATION OF THE NEURAL SUBSTRATES FOR AGENTIC VERSUS CONCEPTUAL REPRESENTATIONS OF SELF *Lindsey J. Powell[1], C. Neil Macrae[2], Jasmin Cloutier[3], Janet Metcalfe[4], Jason P. Mitchell[1]; [1]Harvard University, [2]University of Aberdeen, [3]Dartmouth College, [4]Columbia University* – One longstanding question regarding the human experience of a coherent sense of self has been whether "the self" is best considered as a unified cognitive system or as the result of multiple sets of mental processes, each subserving some distinct form of information processing. We used fMRI to address this question by examining two tasks that draw on different aspects of the self, yet have a similar influence on cognitive processing: enhanced explicit memory for stimuli processed in relation to the self. The first was a standard self-referential processing task during which participants judged how well trait adjectives described either themselves or a familiar other. Replicating previous work, self-referential trials elicited greater medial prefrontal cortex (MPFC) activity than trials that involved judging words in reference to the other. In the second task, participants took turns with a computer selecting cards out of a deck. Each selected card subsequently revealed a trait adjective. Participants demonstrated better memory for selected words (self-selected) than words randomly chosen by the computer (computer-selected). More importantly, self-selected trials elicited greater activity in a network of regions previously implicated in the representation of goals, including bilateral inferior parietal sulcus (IPS) and right middle frontal gyrus. Interestingly, activity in the MPFC did not distinguish between self- and computer-selected trials. Together, these findings suggest that the advantages of self-relevant processing are the product of several distinct cognitive systems, thus supporting a distributed model of the self.

G19

MEN CUT THE GRASS AND WOMEN SPREAD GOSSIP: THE NEURAL CORRELATES OF GENDER STEREOTYPING *Susanne Quadflieg[1], David J. Turk[1], Gordon D. Waiter[1], Jason P. Mitchell[2], Adrianna Jenkins[2], C. Neil Macrae[1]; [1]School of Psychology, University of Aberdeen, UK, [2]Harvard University* – Stereotypic beliefs profoundly shape human social interactions because they offer alleged insights into the thoughts, beliefs and actions of others. Given the pivotal status of stereotypical thinking in everyday life, the current study explored the neural correlates of gender stereotyping using fMRI. Twenty participants were asked to make either a gender or location inference about a variety of activities (e.g., to cut the grass, to bake a cake, to take photos). The dorsal medial prefrontal cortex (MPFC) and the right temporo-parietal junction (RTPJ) showed stronger activation during stereotypic judgments compared to location judgments. Additionally, gender-stereotypic trials relative to gender-neutral trials recruited a network including the ventral MPFC, the bilateral amygdala, the right middle temporal gyrus (MTG), the right supramarginal gyrus, the right putamen, the left precuneus, and the midbrain. Correlational analyses revealed that activity in the MTG and the left amygdala was modulated by a person's implicit and explicit stereotypic beliefs. These results reveal that stereotypic thinking recruits brain areas which have previously been associated with both mentalizing about others (MPFC, RTPJ, Precuneus) and evaluative processing (amygdala, putamen, midbrain), thereby suggesting that the cognitive and evaluative components of stereotyping may be dissociable. These findings advance our current understanding of the neural correlates of social-cognitive functioning.

G20

THE BRAIN RESPONSE TO THEORY OF MIND GENERALIZES ACROSS ITEMS AND MODALITIES *Andrea Quintero[1,2], Jonathan Scholz[2], Marina Bedny[3], Rebecca Saxe[2]; [1]Northeastern University, [2]Massachusetts Institute of Technology, [3]Beth Isreal Deaconess Medical Center* – Humans possess the cognitive capacity to reason about the contents of other peoples' minds ("theory of mind", ToM). Thinking about people's beliefs, goals and desires engages a network of cortical regions including: the temporo-parietal junction bilaterally, precuneus and the medial prefrontal cortex. In this study, we sought to further characterize the functional response in these regions. In experiment 1, we tested whether brain regions involved in ToM generalize across stimulus modality. We found that all ToM regions were recruited for both visually- and aurally- presented stories about a character's beliefs, suggesting that it is the abstract meaning of the stimuli, rather than any low-level stimulus feature, that is responsible for the observed activation. In experiment 2, we tested whether the brain response to false beliefs reflected the initial encoding of the belief or the use of this information when answering a question about beliefs. In all ToM regions, the response was determined by the content of the initial story; there was no effect of whether the question probed the belief or the reality. In experiment 3, we investigated whether the response in ToM regions generalizes from the specific stimuli used in the experiment to the category of belief stories, using an item analysis. Activity in all previously identified ToM regions was generalizable to the category. We conclude that the brain regions thought to mediate the cognitive capacity for ToM are involved in the initial encoding of the abstract feature of belief content, generalized across stimulus modalities and items.

G21

REWARD-INDUCED BIAS DURING PERCEPTUAL DECISION-MAKING *Aurora Isabel Ramos[1], Shruti Japee[1], Sean Marrett[1], Leslie G. Ungerleider[1]; [1]NIMH, NIH, Bethesda* – Studies suggest that higher-level cortical areas may compute perceptual decisions by comparing outputs of different pools of selectively tuned lower-level sensory neurons. To understand how reward may influence the computation of a decision, we measured performance and fMRI responses while subjects performed a face-house categorization task involving noise-degraded stimuli and multiple levels of monetary reward. Nine subjects participated in a behavioral study and eight in an fMRI study. Four noise levels: 46%, 54%, 56% and 58% and three reward levels: no reward, higher reward for face than house, or higher reward for house than face were used. On each trial, prior to stimulus presentation, subjects were cued to the level of reward for a correct response on the upcoming trial. Behavioral data showed that subjects shifted their decision criterion (as measured by signal detection theory) towards the more profitable response choice, especially at higher noise levels. Preliminary fMRI data showed that relative to a no reward cue, a cue indicating higher reward for face elicited a greater response in fusiform gyrus, while a cue indicating a higher reward for house elicited a greater response in parahippocampal gyrus. These results indicate that incentive in the form of a monetary reward biases decision-making, and anticipation of this reward enhances activity in category-specific brain areas during cue processing. Future studies will focus on how reward affects stimulus processing and how decision-making areas combine sensory evidence and reward value to compute decisions.

G22

SOCIAL COGNITIVE NEURAL NETWORKS DURING IN-GROUP AND OUT-GROUP INTERACTIONS *James K. Rilling[1,2], Julien E. Dagenais[1], David R. Goldsmith[1], Andrea L. Glenn[1], Giuseppe Pagnoni[1]; [1]Emory University, [2]Yerkes National Primate Research Center, Emory University* – Several functionally connected networks of activity have now been identified in the resting human brain that may be amplified or attenuated by specific goal-directed tasks. However, it is not known whether there exists a particular network that becomes more active when a person is engaged in a social interaction. fMRI was used to measure brain activity in subjects as they completed a social interactive task and a non-social control task sharing many of the same features. Comparison across the two tasks revealed a network of functionally connected areas that was consistently more active in the social task. This network included default mode network areas, raising the possibility that activity previously observed in default mode regions is related to social cognition. Within this network, information appears to flow from regions involved in salience detection (e.g. anterior insula) to regions involved in mentalizing (dorsomedial prefrontal cortex) to regions involved in executive control (dorsolateral prefrontal cortex). In a second experiment, subjects played the same social interactive task with alleged members of both an experimentally induced in-group and out-group. The default mode network was again active during the task, and several noteworthy differences distinguished interactions with in-group and out-group partners, providing a potential neural substrate for the human tendency to more readily identify with in-group members and more readily distrust, fear and discriminate against out-group members. Supported by NSF grant BCS-0446825.

G23

COGNITIVE AND AFFECTIVE HUMOR PROCESSING: DIFFERENT LOGICAL MECHANISMS IN NONVERBAL CARTOONS *Andrea Samson[1], Stefan Zysset[2,3], Oswald Huber[1]; [1]University of Fribourg, Fribourg, Switzerland, [2]Max-Planck-Institute of Cognitive Neuroscience, Leipzig, Germany, [3]NordicNeuroLab, Bergen, Norway* – This study investigates cognitive and affective humor processing. In order to investigate pure incongruity resolution without precedent processing steps, such as incongruity detection, nonverbal cartoons differing in their logical mechanisms were contrasted with unfunny pictures containing an irresolvable incongruity. Further, cartoons that differ regarding their logical mechanisms, i.e. how to resolve the incongruity in order to understand the punch line, shall be investigated. The three types of cartoons are: (1) visual puns (based on visual resemblance, PUNs); (2) semantic cartoons (based on pure semantic relationships, SEMs); and (3) Theory of Mind cartoons (which require additionally mentalizing abilities, TOMs). Thirty cartoons from each condition were presented to 17 healthy subjects while acquiring fMR images. The results reveal a left-sided network involved in pure incongruity resolution: e.g., temporo-parietal junction, inferior frontal gyrus and ventromedian prefrontal cortex. These areas are also involved in processing of SEMs, whereas PUNs show more activation in the extrastriate cortex and TOMs show more activation in so called mentalizing areas. We conclude that cognitive processing of different logical mechanisms depends on separate neural networks. Processing of pictures containing an irresolvable incongruity evokes activation in the rostral cingulate zone, which might reflect error processing.

G24

REASONING ABOUT BELIEFS IN BLIND AND SIGHTED: A MODALITY-INDEPENDENT NEURAL SUBSTRATE OF THEORY OF MIND. *Rebecca Saxe[1], Marina Bedny[1,2], Jonathan Scholz[1], Alvaro Pascual-Leone[2]; [1]Massachusetts Institute of Technology, [2]Beth Israel Deaconess Medical Center, Harvard Medical School* – By age 4 children can reason about beliefs. Are the cognitive and neural mechanisms that underlie this ability influenced by early sensory experience? To address this question, we compared belief reasoning in early blind (EB), late blind (LB) and sighted adults, using fMRI. In Experiment 1 participants listened to stories about mental versus physical (e.g. photographic) representations of reality. We found that the neural network involved in thinking about beliefs is largely unaffected by early blindness, with two exceptions: (1) the right-lateralization of this network was reduced in EB participants, and (2) a region in the right fusiform gyrus was selective for belief reasoning in EB but not sighted or LB individuals. In Experiment 2, we compared the response of regions in this network, when the same participants reasoned about a character's experience of seeing versus hearing. If we reason about mental states by simulating other people's specific experiences, early blindness should selectively affect reasoning about others' experiences of seeing. Alternatively, children may develop a naïve theory of mind (ToM) that includes concepts of mental states they have never directly experienced. When reasoning about seeing experiences, EB participants' performance and neural responses were similar to those of sighted participants. We conclude that people rely on a naïve ToM to reason about the beliefs of others and that the neural network that supports ToM is resilient to gross changes in sensory experience.

G25

THE EVOLUTION OF DELIBERATE COMMUNICATION *Marleen Schippers[1], Valeria Gazzola[1], Rainer Goebel[2], Christian Keysers[1]; [1]BCN Neuroimaging Center, University Medical Center Groningen, University of Groningen, the Netherlands, [2]Maastricht University, The Netherlands* – In the evolution of language, meaningful gestures probably played an important role. To examine the neural basis of gestural communication and the degree to which it involves the mirror neuron system (MNS), we scanned 9 couples (18 subjects) not only while they gestured concepts to each other through a video link (e.g. playing piano, hand cuffs), but also while they were guessing the meaning of their partner's gestures. An additional 16 subjects were scanned during the observation and execution of goal-directed hand actions (e.g. grasping a glass) to determine the location of the classical MNS for hand actions outside of the context of communication. Gesturing and guessing concepts involved overlapping fronto-parieto-temporal networks that seem virtually identical to the MNS for goal directed hand actions. Interestingly, the classical Theory of Mind areas were not recruited in these tasks. This supports the idea that the mirror system may represent a pre-adaptation for deliberate communication. In order to discriminate deliberate communication from the accidental observation of someone's action, we compared runs in which subjects had to guess the meaning of gestures with runs in which they passively reviewed the same gestures. Contrary to our expectation, the MNS was only marginally more involved in deliberate communication. Regions of the default network however were substantially more deactivated during deliberate guessing. This sheds light on what makes communication intentional: it is more the shutting down of irrelevant processes, than the boosting of activity in the MNS.

G26

DISTINCT REGIONS OF RIGHT TEMPORO-PARIETAL JUNCTION ARE SELECTIVE FOR THEORY OF MIND AND EXOGENOUS ATTENTION *Jonathan Scholz[1], Christina Triantafyllou[1], Susan Whitfield-Gabrieli[1], Emery Brown[1], Rebecca Saxe[1]; [1]MIT* – In functional magnetic resonance imaging (fMRI) studies, a cortical region in the right temporo-parietal junction (RTPJ) is recruited when participants read stories about people's thoughts ('Theory of Mind') (Saxe and Kanwisher 2003, Perner et al 2006, Gobbini et al 2007) Both fMRI and lesion studies suggest that a region near the RTPJ is associated with attentional reorienting in response to an unexpected stimulus (Corbetta et al 2002, Downar et al 2001, Vallar and Perani 1987, Vallar 1993). Do Theory of Mind and attentional reorienting recruit a single population of neurons, or are there two neighbouring but distinct neural populations in the RTPJ? A recent study directly compared these activations (Mitchell 2007), and found evidence consistent with a single common region. However, the apparent overlap may have been due to partial voluming in low resolution data. A recent meta-analysis suggested that the two regions are separated by approximately 10 mm (Decety and Lamm 2007). We sought to verify the result using a high-resolution protocol, within-subjects analyses, and more powerful statistical inferences. Strict conjunction analyses revealed that the area of overlap was small and on the periphery of each activation. In addition, a bootstrap analysis identified a reliable 6-10mm spatial displacement between the peak activations of the two tasks; the same magnitude and direction of displacement was observed in within-subjects comparisons. In all, these results suggest that there are neighboring but distinct regions within the RTPJ implicated in theory of mind and exogenous attentional reorienting.

G27

PROCEDURAL LEARNING AND SEQUENTIAL CONTROL OF BEHAVIOR IN A NEURAL NETWORK MODEL OF THE BASAL GANGLIA *Andrea Stocco[1], Christian Lebiere[1], John Anderson[1]; [1]Carnegie Mellon University* – The basal ganglia (BG) play a pivotal role in action selection, reinforcement learning, and working memory. Here, we present a connectionist model that explores the more general hypothesis that the BG implements a conditional information re-routing circuit, where cortical signals are gated and subsequently relayed onto different pathways projecting to the prefrontal cortex. In the model, distributed representations in cortical areas are copied onto separate compartments in the striatum. Striatal interneurons with continuous activation functions match patterns across the cortical inputs, and eventually gate a selection of them to output matrisomes. Two branches of the direct pathway (projecting to the substantia nigra and the ventral pallidus) transfer the gated representation and a topological representation of their destination, respectively. Projections from these nuclei to the thalamus determine how different patterns are switched to different loops. The indirect pathway through the lateral pallidus provides a transient memory of the previous action, and maintains tonic activity on the direct pathway. The model accounts for the anatomy of the BG circuit and mimics signature disorders when appropriately damaged, as well as the subsequent effects of two common surgical interventions (pallidotomy and deep brain stimulation). Hebbian learning among striatal units, fostered by dopamine projections, enables the model to develop internal representations of cortical inputs, eventually leading to the development of automatic procedures. Finally, it is shown that the model's cycles correspond to variable binding and action execution within production systems, providing a biological basis for the robust execution of sequential behavior.

G28

ME, MYSELF AND I: THE EFFECTS OF SELF IN SOCIAL COGNITION. *Kim van Bussel[1], Dave Turk[1], Neil Macrae[1]; [1]University of Aberdeen* – Numerous studies have shown that information encoded in relation to self is better remembered than information encoded in relation to others. This is referred to as the self-reference effect (SRE). To date, SRE research has tended to focus on explicit encoding paradigms where participants are asked to judge whether a trait adjective describes self or a familiar other person (e.g. Am I happy?). These findings have led to claims that the self is a special cognitive entity (Rogers et al., 1977) supported by a distinct neural architecture (Kelley et al., 2002). However, centuries of deliberation and theorizing about the self and its cognitive function suggest that this construct guides cognition in a less explicit, unobtrusive manner (James, 1890; Neisser, 1988). We therefore explored the SRE in memory for items that were incidentally associated with self and an other. In this fMRI-experiment, participants sorted pictures of shopping items into baskets that were either their own or someone else's. Afterwards, memory was assessed in a surprise recognition test. The results showed that items sorted into one's own basket are better remembered than items assigned to someone else's basket. This demonstrates that even under less explicit encoding conditions the SRE persists. fMRI-results showed greater activation in the insular cortices and bilaterally in the parietal cortex for owned items compared to not-owned items, suggesting an emotional and attentional component underlying the SRE.

G29

THE NEURAL CORRELATES OF SELF- AND OTHER PERSPECTIVES IN THE TRUST GAME *Wouter van den Bos[1,2], Eric van Dijk[1], Michiel Westenberg[1,2], Serge Rombouts[1,2,3], Eveline Crone[1,2]; [1]Leiden University - Institute for Psychological Research, the Netherlands, [2]Leiden Institute for Brain and Cognition (LIBC), the Netherlands, [3]Leiden University Medical Center, the Netherlands* – Economic decision-making research has suggested that decisions which require perspective taking recruit both medial PFC, thought to be important for mentalizing, and lateral PFC, thought to be important for future orientation. In this study we used fMRI with 22 healthy adults to examine neural mechanism of self and other perspective taking in the Trust Game (TG). Prior behavioral studies have shown that the risk taken by the trustor and the benefit received by the trustee influence the decisions made in the TG (van den Bos et al., 2007; Malhotra 2004), indicating that participants take their own as well as the other player's perspective into account. To examine these factors in more detail, participants performed multiple one shot Trust Games in the role of trustee. Risk was manipulated by comparing trials in which the trustor could lose much versus little money by trusting, and benefit was manipulated by comparing trials in which the trustee benefited much versus little by being trusted. Behavioral results revealed that high risk trials and high benefit trials resulted in more cooperation. For our fMRI analyses, we expect increased activation in cognitive control areas (DLPFC) as well as perspective taking areas (MPFC) for reciprocate versus defect decisions (Gallagher et al. 2002; Rilling et al. 2007) and for high risk and high benefit trials relative to low risk and low benefit trials. We also expect that these effects are modulated individual differences as measured by social value orientation scale and the sensation seeking questionnaire.

G30

INTEGRATING INFORMATION IN REASONING: AN EEG STUDY *Jean-Baptiste Van der Henst[1], Mathilde Bonnefond[1]; [1]Laboratoire Langage Cerveau et Cognition CNRS Université de Lyon* – How do people reason? Cognitive scientists commonly address this question by analysing factors that affect reasoning performance. However, most of the literature overlooks the integration dimension inherent to reasoning. In an EEG study, we describe what happens when people combine two pieces of information (two premises) in order to draw a conclusion. We investigate the integration of the second premise in the context of the first premise and the integration of a conclusion in the context of a previously drawn inference. Our stimuli involved arguments based on a major conditional premise (If P then Q), a minor premise (P) and a conclusion (Q). When the minor premise can be integrated in the context of the major premise to produce an inference (i.e. If P then Q; P) we observe a P3b and other parietal positive components as well as a late slow negative wave linked to working-memory processes. This profile is absent when P cannot yet be integrated (P; If P then Q). The P3b, is also present when the conclusion matches the conclusion participants drew (If P then Q; P, Q). When the minor premise does not match the antecedent of the major premise (If P then Q; R) or when the conclusion does not match the conclusion drawn from the premises (If P then Q; P, T) we observe a N2 component linked to conflict detection. In conclusion, this study reveals not only a specific integration profile but also a specific profile when integration is impossible.

G31

THE NEURAL BASIS OF SELF-INHIBITION IN THEORY OF MIND: AN FMRI STUDY *Lisette van der Meer[1], Willem Nolen[1], André Aleman[1]; [1]University Medical Center Groningen, University of Groningen, The Netherlands* – Previous research regarding the functional and neural basis of perspective taking has demonstrated that both the prefrontal cortex and the temporo- parietal junction play a role in this so called Theory of Mind (TOM) capacity. Recently, it has been suggested that this TOM capacity should be subdivided into two perspective taking components: (1) self-perspective inhibition and (2) other-perspective taking (Samson et al., 2005, Brain, 128, 1102-1111).). In this study, we tested this hypothesis using functional MRI. The task consisted of short movie clips developed by Samson et al. (2005) differing in demands regarding self-perspective inhibition and other-perspective taking. Conditions with a similar demand in other-perspective taking, but a differing demand in self-perspective inhibition were compared. The Results revealed activation of the right inferior prefrontal cortex for self-perspective taking. This novel finding is consistent with the evidence from the patient described by Samson et al. (2005). In addition, activation of the temporo-parietal junction was found when conditions similar in other-perspective taking demands were compared to a baseline condition. These results provide neurobiological evidence for a subdivision of the TOM capacity into two components. The self-perspective inhibition component is associated with the right inferior prefrontal cortex, whereas the other-perspective taking component is mediated by the temporo-parietal junction.

G32

COGNITIVE DISSONANCE ENGAGES ANTERIOR CINGULATE CONFLICT MONITORING *Vincent van Veen[1,2], Marie K. Krug[2], Jonathan W. Schooler[3], Cameron S. Carter[2]; [1]University of California, Berkeley, [2]University of California, Davis, [3]University of British Columbia, Vancouver* – When people's actions conflict with their prior attitudes, they adjust their attitudes to be more consistent with their actions, a phenomenon known as cognitive dissonance. In the present study, participants were scanned using functional MRI, while they "argued" that the uncomfortable scanner environment was nevertheless a pleasant experience. This cognitive dissonance engaged the dorsal anterior cingulate cortex (ACC); ACC activation tightly predicted participants' subsequent attitude change. Neither of these effects were observed in a control group who received payment for their "argument", a manipultation thought not to elicit dissonance. Our findings elucidate the neural representation of cognitive dissonance, and support the ACC's role in detecting cognitive conflict.

G33

IS THE BOOK OPEN OR CLOSED? HEMISPHERIC PROCESSING OF IMPLIED PERCEPTUAL INFORMATION DURING TEXT COMPREHENSION *Sandra Virtue[1], Brian Sundermeier[2]; [1]DePaul University, [2]Williams College* – Recent studies have found that people imagine the perceptual characteristics of what they read during comprehension (Zwaan, Stanfield, & Yaxley, 2002). However, little is currently known about how this information is processed in the left and right hemispheres. In the current study, subjects read sentences describing an animal or object in a certain shape (e.g., "There was a book on the shelf." or "There was a book on the photocopier."). Each sentence was followed by a picture of an object (e.g., a closed book) presented to either the left visual field-right hemisphere (lvf-RH) or the right visual field- left hemisphere (rvf-LH). The object either matched the shape implied in the preceding sentence or did not match the shape implied by the preceding sentence. Subjects then made a speeded response as to whether or not the object was mentioned in the previous sentence. Results from our study suggest that the right hemisphere, but not the left hemisphere, is sensitive to a mismatch between the implied, perceptual property in the text and the visual depiction of the object. Therefore, the right hemisphere may take advantage of our action based knowledge in helping to construct meaning from a text.

G34

IMPLICIT ACTIVATION OF THEORY OF MIND AMONG HIGH EMPATHIZERS *Dylan David Wagner[1], William M. Kelley[1], Todd F. Heatherton[1]; [1]Dartmouth College* – High empathizers report being good at understanding the emotional and mental states of others. Of interest is the degree to which this social orientation translates into motivation to engage in perspective taking, particularly in the absence of explicit mentalizing task demands. In the present study, fifty male participants (25 high and 25 low empathizers) were told that they would be performing a simple categorization task. No reference to the social nature of the task, nor to mentalizing were made. Participants were scanned using event-related fMRI while they categorized a series of natural scenes as either animal, vegetable or mineral. Critically, the animal category comprised both scenes of people and scenes of animals. Brain regions commonly implicated in mentalizing tasks (mPFC, TPJ, precuneus, temporal poles, STS) demonstrated greater activity to scenes of people, than to scenes of animals, vegetables or minerals. Furthermore, a comparison between high and low empathizers revealed greater activity in a small network of regions including the dorsal MPFC and bilateral STS. These results reveal that, in the absence of explicit task demands, those high in empathizing ability exhibit greater activity in areas involved in theory of mind when presented with stimuli rich in social content.

G35

NEUROANATOMY OF DECISION MAKING ABOUT EVERYDAY OBJECTS *John Wang[1], Julie Hall[1], Stephanie Preston[1]; [1]University of Michigan* – People make countless decisions about objects, ranging from mundane decisions on whether to keep plastic bags to major decisions about which home to purchase. Despite the significant effects such choices have on our lives, little is known about the cognitive and neural processes involved. We investigated the neural bases of acquiring and discarding everyday objects in a block-design fMRI study where subjects chose between two everyday household objects on each trial. In a 2x2 design, subjects either selected the object they wanted to acquire or removed the item they wanted to discard, and made each type of selection (acquire or discard) in the instructed frame of either maximizing monetary profit or their own personal preference. There was great overlap in the neural substrates associated with acquiring and discarding objects, but there were also regions particularly associated with each process. This suggests that acquiring and discarding are not equivalent, even when they produce equivalent outcomes. Choices based on personal preference differed from decisions to maximize profit as they were made in less time, involved selection of inexpensive objects over costlier ones, and activated different neural regions. These effects support more psychological models of decision making, which emphasize the effects of framing and the subjective nature of utility, in contrast to neoclassical economic models. This is the first neuroimaging study to investigate the ubiquitous decision-making process about acquiring and discarding everyday items, which informs our basic understanding of decision processes, clinical disorders of hoarding, and contemporary issues associated with consumerism.

G36

EMBODIED ACTION UNDERSTANDING IN THE MOTOR SYSTEM: EVIDENCE FROM LEFT- AND RIGHT-HANDERS *Roel M. Willems[1], Asl Özyürek[1,2], Floris P. de Lange[1], Peter Hagoort[1,2]; [1]F. C. Donders Centre for Cognitive Neuroimaging, Radboud University Nijmegen, The Netherlands, [2]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands* – What is the role of our own motor system in understanding the actions of others? Neural simulation theory states that an observed action is implicitly simulated, using the observer's own motor system. Indeed, empirical findings show that the specific make-up of an observer's motor system influences neural correlates of action understanding. However, in the understanding of common everyday activities, too strong a coupling between motor production and action understanding might be detrimental. Rather, in such cases action meaning may be abstracted away from an individual's motor practice. Here we used handedness to critically test the nature of cortical motor activation in understanding common actions. Neural networks involved in understanding pantomimic depictions of everyday activities were measured (using fMRI) in left- and right-handers. Our results show that although parts of the cortical motor system are involved in gleaning meaning from actions, its activation is not influenced by the observer's hand preference. Put differently, observers did not map the observed activation onto their own motor production preference. This is in contradiction to the strong coupling between motor production and action understanding predicted by a strong version of neural simulation theory. Embodied cognition - of which neural simulation can be regarded an instantiation - does allow for a flexible relationship between an individual's motor system and the neural processing of action meaning. We conclude that action understanding involves our own motor system, but not necessarily in the form of a one-to-one mapping between motor production repertoire and neural correlates of action observation.

G37

DISRUPTING NEURAL MECHANISMS FOR BELIEF ATTRIBUTION IMPAIRS MORAL JUDGMENT *Liane Young[1,2], Joan Camprodon[3], Marc Hauser[1], Alvaro Pascual-Leone[3], Rebecca Saxe[2]; [1]Harvard University, [2]Massachusetts Institute of Technology, [3]Berenson-Allen Center for*

Noninvasive Brain Stimulation, Beth Israel Deaconess Medical Center and Harvard Medical School — In judging the moral permissibility of an action, human observers try to read the actor's mind, often weighing beliefs, desires and intentions more than the action's consequences. The standard test for criminal liability, likewise, states "the act does not make the person guilty unless the mind is also guilty." Reasoning about mental states such as beliefs ("theory of mind") is correlated with activity in the right temporo-parietal junction (RTPJ). Here we show that disruption of RTPJ function by image-guided transcranial magnetic stimulation (TMS) introduces a systematic bias in healthy adults' moral judgments, reducing the influence of beliefs, relative to TMS to a nearby control region. Accidental harms were judged more forbidden, and failed attempts to harm were judged more permissible; moral judgments of intentional harms and non-harms were unimpaired. These results reveal a causal role for the RTPJ in theory of mind and for theory of mind in moral judgment.

G38

THE EFFECTS OF CONVERSATION DURATION AND COMPLEXITY ON VISUAL DETECTION DURING SIMULATED DRIVING *Richard Young[1], Li Hsieh[2], Sean Seaman[2]; [1]School of Medicine, Wayne State University, [2]Wayne State University* — We present an investigation into the effects of cellular phone conversations on driving performance. Simulated cellular phone conversations took place between a subject in a simulated driving environment and an experimenter located outside of the testing booth. Conversations were initiated by the subject using a voice-activated-like dialing system and the experimenter "answered" the call. Several call durations were used, and two complexity levels were controlled by the experimenter: low complexity, which consisted of simple personal or biographical questions and high complexity, which consisted of procedural questions. 17 subjects participated in this study. RT results showed that conversations took slightly longer RT in a validated event-detection paradigm, respectively, relative to no conversation control blocks during the simulated driving task. However, the conversation effect on RT is less than the impact of a single button press on RT. Notably, these events occurred during silent periods, and button press timing was at the discretion of the subjects. For accuracy, low complexity conversations showed a similar event detection miss rate to the no conversation condition. Interestingly, high complexity conversations were associated with a significant increase in miss rate when compared to the baseline block. Overall, our study found the effect of voice-activated cellular conversation on visual event detection during driving. Furthermore, this study investigated factors that might moderate this effect – conversation duration and content – and showed that content, not duration, may have a minor influence on the effect of conversation on driving event detection accuracy. Implications for theories of attention and multitasking are discussed.

G39

THE STRUCTURE OF POLITICAL BELIEFS AND ITS NEURAL CORRELATES *Giovanna Zamboni[1,2], Marta Gozzi[1,3], Frank Krueger[1], Jean-Rene Duhamel[4], Angela Sirigu[4], Jordan Grafman[1]; [1]Cognitive Neuroscience Section, NINDS, NIH, Bethesda, [2]Universita' di Modena e Reggio Emilia, Modena, Italy, [3]Università di Milano Bicocca, Milano, Italy, [4]Centre de Neuroscience Cognitive, CNRS, Bron, France* – Politics refers to the uniquely human ability to cooperate and debate in order to make decision affecting large groups over long durations of time. Recent neuroimaging studies have investigated the neural correlates of faces, names or declarations of well-known politicians. However, the one-dimensional liberal-to-conservative interpretation of political attitudes has been criticized. Therefore, we used multidimensional scaling (MDS) to derive a number of dimension structuring political beliefs, and parametric functional MRI to identify their neural correlates. In the behavioral pre-study, MDS was applied to similarity judgments between pairs of political statements obtained by 24 participants. In the fMRI experiment, other 26 subjects were presented with the same political statements and asked whether they agreed (experimental condition), or whether the statement was written in a certain font (control condition). Three dimensions were obtained in the MDS and labeled as conservatism, reflecting the ideological dimension, individualism, reflecting whether the statement was individual or society-centered, and radicalism, reflecting whether the statement was moderate or radical (either liberal-radical or conservative-radical). Conservatism correlated with activation in the right dorsolateral prefrontal cortex. Individualism positively correlated with activation in the ventromedial prefrontal cortex and negatively correlated with activation in dorsomedial prefrontal cortex and left temporo-parietal junction. Radicalism positively correlated with anteroventral striatum and negatively correlated with precuneus. These findings lend strong support for the hypothesis of anatomically separable dimension-specific representations of the organizational structure of political beliefs.

G40

SELF-CONSTRUAL PRIMING MODULATES FUSIFORM RESPONSE DURING IMPLICIT SELF PROCESSING *Li Zhang[1], Harada Tokiko[1], Joan Chiao[1]; [1]Northwestern University* — Individualism (IND) and collectivism (COL) refer to two main styles of self construal across cultures (Markus & Kitayama, 1991). Prior behavioral research has shown that priming self-construal style can temporarily orient bicultural individuals more towards one kind of self-construal relative to another (Oyserman & Lee, 2007). Activity within the right fusiform gyrus has been previously shown to be modulated by perceptual priming (Slotnick & Schacter, 2006). Here we examined whether self-construal priming modulates right fusiform activity during implicit processing of self-relevant information using functional magnetic resonance imaging (fMRI) at 3T. During self-construal priming, outside of the scanner, Asian-American participants read essays containing either IND (i.e., "I") or COL (i.e., "We") pronouns. Participants were then scanned while judging the spatial location of autobiographical word phases (i.e., home address, telephone number) relevant to the self, their father or an unfamiliar person. Preliminary behavioral results suggest that participants respond fastest to self information after IND priming and slowest to self information after COL priming. Whole-brain analyses demonstrate a network of brain regions recruited during implicit processing of self-relevant information, including the left posterior cingulate gyrus, left lingual gyrus, bilateral parahippocampal gyrus and right fusiform gyrus. Furthermore, preliminary ROI analyses suggest modulation of activity within the right fusiform gyrus as a function of self-construal priming. Our results suggest that implicit processing of self-relevant information activates a distinct neural network within occipitotemporal cortex and that neural activity particularly within the right fusiform gyrus may be modulated by self-construal priming in bicultural individuals.

Linguistic processes: Semantics

G41

WHEN THE TRUTH ISN'T TOO HARD TO HANDLE: AN EVENT-RELATED POTENTIALS STUDY ON THE PRAGMATICS OF NEGATION. *Mante Nieuwland[1,2,3], Gina Kuperberg[1,2,3]; [1]Tufts University, [2]MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical Imaging, [3]Massachusetts General Hospital* — Our brains are capable of rapidly integrating incoming language with world knowledge to establish whether what is stated is consistent with what we hold to be true. Yet there are claims of exceptions in which such integration and verification processes are supposedly delayed. In particular, it is often reported that sentences are harder to verify if they contain negation words like 'not' or 'never'. However, most experimental studies have confounded whether a sentence is true and whether it is a natural thing to say (e.g., "A robin is not a tree"). In an event-related brain potentials (ERP) experiment, we aimed to disentangle the effects of truth-value and pragmatic licensing on the comprehension of sentences conveying affirmation and negation statements. Our results suggest that true negative sentences are not more difficult to comprehend than true affirmative sentences, but only when the use of negation is pragmatically licensed.

G42

EFFECTS OF TRANSCRANIAL MAGNETIC STIMULATION ON DIFFERENT STAGES OF MOTOR AND NON-MOTOR VERB PROCESSING IN THE PRIMARY MOTOR CORTEX *Liuba Papeo[1], Antonino Vallesi[1], Alessio Isaja[1], Raffaella Ida Rumiati[1]; [1]Cognitive Neuroscience Sector, SISSA, Trieste, Italy* – The action-related language modulation of the left primary motor cortex (M1) activity has been documented in behavioural, psycophysiological, neuroimaging and transcranial magnetic stimulation (TMS) studies. The issue that we address in this TMS study is whether M1-activity is necessary for understanding action-related language, or it rather follows the lexical-semantic encoding, as a consequence of the access to the motor meaning of words. Thus, we investigated whether different linguistic tasks differentially affected M1-activity, by recording TMS-induced motor-evoked potentials (MEPs) from right-hand muscles while subjects explicitly accessed the word meaning (by judging whether a verb was action-related) or they decided on the number of syllables in the verb. Furthermore, to identify when M1-activity enhances during word recognition, we manipulated the timing of TMS delivery. In three experiments, TMS was applied during the two tasks at 170, 350 and 500 ms post-stimulus, consistently with event-related potential findings that distinguish between early, late lexical-semantic, and post-conceptual processes. No TMS-modulation of MEPs specific for action verbs was found when lexical-semantic processes presumably occurred (170 and 350 ms post-stimulus). At 500 ms post-stimulus, we found a greater M1-activity for action-verb semantically processed, relative to non-action verbs and action-verbs syllabically processed, and no TMS-effect on linguistic performance. These findings suggest that action-verb understanding does not necessarily recruit the motor programs of the corresponding physical actions. In contrast, we suggest that M1-activity may contribute to post-conceptual and presumably extra-linguistic processes triggered by the activation of representations involving motor content.

G43

FMRI REVEALS INTERACTIONS BETWEEN PHONOLOGY AND SEMANTICS IN AUDITORY LEXICAL PROCESSING *Jonathan Peelle[1], Jamie Reilly[2], Vanessa Troiani[1], Murray Grossman[1]; [1]University of Pennsylvania, [2]University of Florida* – Models of spoken word recognition assume the relationship between word form and meaning is completely arbitrary. However, recent distributional evidence suggests that the phonological form of a word is statistically related to several levels of its meaning. For example, abstract nouns tend to be longer and have fewer similar sounding neighbors (i.e., more sparse phonological neighborhood density) compared to concrete nouns (Reilly & Kean, 2007). We hypothesize that listeners use phonological clues about word structure and phonology to help determine the meaning of a word. In the current study we used BOLD fMRI to examine the neural basis for the interaction of phonology and semantics in lexical processing. We measured neural activity in healthy adults while participants performed an auditory lexical decision task on a set of stimuli that included 120 real words. These nouns varied orthogonally in concreteness and phonological neighborhood density, including both concrete and abstract words. We examined effects of concreteness and phonological neighborhood density by correlating values for individual items with each participants fMRI data, analyzing only words which were correctly identified during the lexical decision task. Main effects of concreteness and phonological neighborhood density were found in regions comparable to those seen in previous studies. Additionally, we were able to identify regions whose response was differentially modulated by the interaction of the two factors. We hypothesize that this modulation reflects facilitative effects of phonology on semantic knowledge that can aid lexical processing.

G44

REVERSING EXPECTATIONS – MEG EVIDENCE FOR PROCESSING SEMANTIC PRESUPPOSITIONS *David Poeppel[1], Ming Xiang[2], Ellen Lau[1]; [1]University of Maryland, [2]Harvard University* – The ERP/MEG literature has shown a robust semantic anomaly effect, such that incongruent words in a context induce larger N400/M400 responses compared to congruent words. However, since the manipulation of contextual plausibility is often correlated with lower-level lexical associations, it is difficult to determine whether the semantic anomaly effect demonstrates higher-level semantic processing or lower-level lexical processes like spreading activation. The current study uses MEG to investigate a specifically higher-level semantic operation: presupposition. We compare the response to a typical contextual plausibility pair [(1) Comic books are funny… (2) Greek tragedies are funny..] with the response to a pair in which the word even is added [(3) Even comic books are funny… vs (4) Even Greek tragedies are funny] Even presupposes that there exist alternatives to the event being presented, and asserts that the least likely event is true (Karttunen & Peters 1979). Therefore, adding even to the canonically standard (1) makes (3) pragmatically odd because of presupposition failure, and should make the original semantic anomaly more acceptable in (4). There is little prior evidence bearing on the time course of these higher-level semantic operations. Preliminary results (n=17) show the standard semantic anomaly effect in (1) vs (2), with (2) showing increased left-hemisphere RMS amplitude between 400-500ms, and between 500-600ms in the right. However, when even was added, differences were only seen in the right hemisphere [(3) > (4) between 200-400ms (p<.1)]. These results suggest very rapid higher-level semantic processing and potentially different roles of the two hemispheres.

G45

HEALTHY SUBJECTS MORE PRONE TO DELUSION DISPLAY REDUCED N400S AFTER PARANOID-LIKE INDUCTION. *Marie Prévost[1,2], Louis Renoult[1,2], Mathieu Brodeur[1,2], Claire Lionnet[2], Suzanne King1[1,2], J. Bruno Debruille[1,2]; [1]McGill University, [2]Douglas Mental Health University Institute* – Schizophrenia patients that are highly delusional produce smaller N400 event-related potentials than less delusional patients, suggesting a deficit in semantic processes (Debruille et al., 2007; Kiang et al, 2007). In healthy subjects no reduction of the N400 potential was found in those with a trend toward delusion relative to those without such trend, showing that these subjects do not share the same deficit as delusional patients (Prévost et al., in preparation). In the present study, we tested whether an attempt at inducing paranoid-like feeling in healthy subjects would induce an N400 reduction similar to that found in patients. Delusion proneness was assessed using the schizotypal personality questionnaire (Raine, 1991). The informed consent form was adapted to induce paranoid feelings. After having filled a paranoid evaluation questionnaire, the 34 subjects completed the same semantic matching task as that used in our previous study with healthy subjects. Prime-target trials were used where the prime word, 'ANIMAL?' was followed either by an animal name (e. g., dog) or by a name of a 'thing' (e. g., table). We found N400 amplitudes varied with proneness to delusion: the greater this proneness the less negative the ERPs in the N400 time window. Therefore, it seems that paranoid-like inductions may weaken semantic integration processes in subjects more prone to delusions. If repeatedly confronted to potentially threatening situations, these type of subjects might thus develop a deficit at integrating information that contradicts their expectancies. Therefore, they could keep their delusional ideas and, later, form a full-blown delusion.

G46

DOES CONCEPTUAL STRUCTURE MODULATE NEURAL ACTIVITY DURING SPOKEN WORD PROCESSING? *Billi Randall[1], Kirsten I. Taylor[1], Michael Ford[1], Barry Devereux[1], Lorraine K. Tyler[1]; [1]University of Cambridge* – How are the meanings of concrete objects neurally represented and processed? The Conceptual Structure Account claims that concepts are represented in a distributed system of concept features, and their statistical properties (e.g., the degree to which features are distinctive or shared or co-occur with another feature) determine conceptual representation and processing. We tested the neural implications of these claims by determining whether conceptual structure variables modulate functional brain activity associated with spoken word comprehension. Volunteers underwent sparse event-related fMRI imaging while making lexical decisions to concrete words and nonwords, and high/low tone decisions in a baseline task. A principal components analysis of psycholinguistic variables and conceptual structure variables produced nine orthogonalised principal components (duration, phonological, lexical, cohort size, imageability, feature production frequency, co-occurrence, distinctiveness, sharedness) modeled as parametric modulators of the words. Lexical decisions to words compared to the baseline task generated activity in the language network (left-lateralised middle and superior temporal gyri, left inferior frontal gyrus). Critically, conceptual structure variables significantly modulated functional activity: (a) concepts with fewer correlated features produced greater activity in left language and attentional (anterior cingulate)/middle frontal gyrus) networks reflecting greater processing required to activate concepts with few mutually co-activating features, (b) concepts with many distinctive features produced greater bilateral frontal activity suggesting the involvement of selectional mechanisms, (c) concepts with many shared features produced greater attentional network activity reflecting a greater difficulty differentiating between multiple activated concepts. These findings demonstrate that conceptual structure determines the representation and processing of concepts in the brain.

G47

EFFECTS OF SEMANTIC PRIMING AND OF SEMANTIC CATEGORY ON REACTION TIME AND N400 THAT RESIST TO NUMEROUS REPETITIONS *Louis Renoult[1,2], Bruno Debruille[1,2]; [1]Douglas Mental Health University Institute, Montréal, Québec, Canada, [2]McGill University, Montréal* – The N400 event-related potential (ERP) is a brain response to any potentially meaningful stimuli. Like the times taken to respond to meaningful stimuli (RTs), the amplitude of the N400 is reduced by stimulus repetition. It seems to reach a floor after several presentations. Meanwhile, RTs and N400 amplitudes are also lowered by the prior presentation of a semantically related stimulus compared to an unrelated stimulus. Results of a few studies suggest that this semantic priming effect on N400 could be reduced by repetition and rapidly disappear with further presentations. On the other hand, the topography of the N400 on the scalp depends on the semantic category of the stimulus and this effect also seems to be smaller when stimuli are repeated. Taken together, these data suggest that the semantic processes indexed by the N400 could be absent in conditions of multiple repetitions. Here, we show that this conclusion would be premature. ERPs were recorded from 27 subjects in two versions of a semantic categorization task. In the first version, two category words were used as primes and numerous non-repeated exemplars of these categories as targets. In the second version, the primes were the numerous non-repeated category exemplars and the target words, to which N400s were recorded, were simply the two category words, each presented 60 times in the experiment. Results showed that effects of semantic priming and of semantic category on RTs and N400s in high repetition conditions were significant and similar to those obtained with only one presentation.

G48

CATEGORICAL PERCEPTION OF SPEECH: BEHAVIOURAL AND NEURAL EVIDENCE. *Jack Rogers[1], Matthew Davis[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge* – We explore the effect of within and between category phonological variations on speech perception. Using audio-morphing and "Straight" (Kawahara, 2004), we produced 320 high-quality phonetic continua varying in place, manner or voicing across 4 conditions; word/word (blade/glade), word/pseudo (blouse/glouse), pseudo/word (bown/gown) and pseudo/pseudo (blem/glem) pairs. A 2AFC identification task confirmed the category boundary shift for word/pseudo and pseudo/word pairs (Ganong, 1980), equivalent for an onset (bench/gench) or offset (flad/flag) change. This suggests that lexical influences on categorical perception are not produced on-line but rather occur post-perceptually, consistent with top-down effects. Sensitivity to within- and between-category phonological variation was investigated using sparse fMRI in a paired auditory repetition priming paradigm. Minimal pairs (48 across the 4 conditions) were presented to participants in the context of a semantic monitoring task. Between-category pairs with a phonological change produced greater neural response in left posterior middle temporal gyrus compared to within-category pairs with the equivalent magnitude of acoustic change. This greater phonological response provides a neural correlate of categorical perception of speech similar to previous studies (Jacquemot et al., 2003; Joanisse et al., 2006). However, we also observe that left inferior frontal gyrus, precentral gyrus and supplementary motor area (SMA) respond to this phonological change. This may result from our use of a more natural-sounding and varied stimulus set that engages lexical and semantic processes. Both inferior frontal and SMA clusters show an additional response to phonological changes involving words, suggesting that these regions might contribute to higher-level influences on categorical perception of speech.

G49

HEMISPHERIC CHANGES IN THE FRONTO-TEMPORAL LANGUAGE SYSTEM IN YOUNGER AND OLDER ADULTS *Meredith Shafto[1], Billi Randall[1], Phyllis Tam[1], Lorraine Tyler[1]; [1]University of Cambridge* – Although widespread neural atrophy is an inevitable consequence of normal aging, not all cognitive abilities decline as we age. Most aspects of spoken language comprehension are well preserved, for example, despite atrophy in the neural regions known to be important for language function. In the present study we asked whether language comprehension is preserved because of the functional recruitment of other brain regions which successfully compensate for neural atrophy. We addressed this issue by manipulating the presence/absence of semantically ambiguous words in sentences. Previous research has shown (Rodd et al, 2005) that the presence of semantic ambiguity generates increased activity in left frontal and middle temporal cortex, due to the additional requirements of selecting between competing meanings. In a similar study we found correlated activity in these left fronto-temporal regions for young subjects. We also tested a younger-old group (aged 49-68) and an older-old group (aged 70-85) in this study. Unlike younger adults, younger-old participants showed activity in bilateral IFG and right MTG, but were as fast as younger adults. The older-old group had a left lateralised pattern of activity similar to younger adults, but were slower than the younger-old participants. These findings may be explained by differences between the older groups in the degree of correlation between active regions, suggesting age-related changes in modulatory processes that affect performance. Moreover, the extent to which bilateral systems were involved was associated with performance differences across both older groups.

G50

SUSTAINED LOW FREQUENCY SUPPRESSION AND HIGH FREQUENCY ENHANCEMENT OF BRAIN OSCILLATIONS DURING SEMANTIC EVALUATION OF SPOKEN WORDS *Antoine J. Shahin[1], Terence W. Picton[2,3], Lee M. Miller[1,4]; [1]Center for Mind and Brain, University of California, Davis, [2]Rotman Research Institute, Baycrest, Toronto, [3]University of Toronto, [4]University of California, Davis* – Oscillatory brain activity has been shown to correlate with specific perceptual and cognitive processes. For example, suppression of alpha waves (8-12 Hz) and enhancement of gamma rhythms (30-100Hz) has been shown to reflect enhanced selective attention and template matching in working memory, respectively. We examined oscillatory brain activity in 10 participants during speech tasks while subjects identified targets (20%) that represented semantic discrimination in one task and voice discrimination in the other (control task). The speech stimuli were the same for both tasks so stimulus effects are excluded. We hypothesized that suppression of alpha rhythms accompanied by enhancement of gamma band activity (GBA) should favor semantic processing compared to voice processing, because semantic discrimination would require maintaining and matching of semantic templates in working memory. Using EEG, we show enhanced left lateralized fronto-central sustained GBA in single-trial analysis in semantic compared to voice task. Sustained low frequency oscillations (< 30 Hz) were suppressed over frontal and parieto-occipital sites in the semantic compared to voice tasks. Because there were no differences between targets and non-targets, it is unlikely the two processes are associated with target detection. These results suggest the commencement of sustained processes during semantic evaluation likely due to enhanced synchrony of neural activity in a fronto-temporo-parietal network reflecting enhanced communication among these brain regions.

G51

THE PRIMING OF PRIMING: A CROSS-LINGUISTIC ERP STUDY *Karsten Steinhauer[1,2], Katherine Nadeau-Noel[2], John E. Drury[1,2], Phaedra Royle[1,3]; [1]Centre for Research on Language, Mind and Brain, McGill University, Montreal, [2]School of Communication Sciences and Disorders, McGill University, Montreal, [3]School of Speech Language Pathology & Audiology, University of Montreal* – The nature of mental processes eliciting the N400 component in event-related brain potentials (ERPs) is still controversial. Most evidence points to post-lexical semantic integration (Brown & Hagoort, 1993, Chwilla et al., 1995, 1998; Friederici et al., 1999), but recent studies have again argued in favor of automatic intra-lexical priming by means of spreading activation (e.g., Deacon et al., 2000). In 1995, Ratcliff and McKoon presented a behavioral priming study in which prime-target pairs strongly related on one semantic dimension (e.g., a member-category relation such as 'hammer-tool') were embedded in lists of other strong prime-target pairs related on a different semantic dimension (e.g., part/whole: 'finger-hand'), and vice versa. They found no priming for related word pairs that were inconsistent with the semantic dimension of the majority of list items. We replicated the experiment with ERPs, both in English and in French. Word pairs were presented with an SOA of 250 ms between prime and target. Word lists comprised 78% consistent related pairs, 11% inconsistent related pairs, and 11% unrelated word pairs. Inconsistent related pairs showed reduced priming (larger N400s) as compared to consistent related pairs. The results do not support a primarily automatic priming account for N400 effects and suggest that priming itself can be primed by context, potentially pointing to expectancy-based priming at SOAs of 250 ms.

G52

SEPARATION OF CONCEPT KNOWLEDGE INTO DISTINCT MODALITY-SPECIFIC PERCEPTUAL SYSTEMS *Benjamin Stengel[1], Jeffrey Binder[1,2], David Medler[2], Sara Berentsen[2], Mark Seidenberg[3]; [1]Medical College of Wisconsin/Biophysics, [2]Medical College of Wisconsin/Neurology, [3]University Wisconsin-Madison/Psychology* – According to sensory-motor accounts of semantic memory, concept knowledge is partly represented in modality-specific perceptual systems through which the concepts are acquired. Tests of this hypothesis have been hindered by the fact that concept acquisition typically involves a complex mix of perceptual, motor, and verbal experiences. In this study we trained participants on a set of unknown bird names by exposing them selectively to bird pictures (Visual condition) for one third of the set, bird calls (Auditory) for another third, and verbal statements (Facts) for the remaining third. During training, participants studied each bird name along with its associated picture, sound, or facts. The stimuli were then presented alone while participants attempted to retrieve the correct bird names, with corrective feedback given. Participants underwent 24 hours of training spread over 3-4 weeks. During fMRI, participants performed a similarity-rating task in which two bird names from the same training condition were visually presented and participants rated how similar the two birds were on a scale from 1 to 4. The left parahippocampal, fusiform and inferior temporal gyri showed greater activity for Visual over other conditions. The left posterior superior temporal, supramarginal and inferior frontal gyri showed greater activity for Auditory over other conditions. Bilateral angular and posterior cingulate gyri showed greater activation for Facts over other conditions. These results support the hypothesis that concept knowledge is represented within distinct modality-specific perceptual systems, and suggest that the angular gyrus plays a particular role in supporting knowledge acquired through language.

G53

NEWLY-LEARNED STIMULI: THE EFFECTS ON LATERALIZED LEXICAL DECISION *Travellia Tjokro[1], Christine Chiarello[1]; [1]University of California, Riverside* – The current project considers whether the right hemisphere plays a role in learning new word meanings. Lateralized lexical decision studies have found a strong left hemisphere advantage for word, but not nonword, stimuli (e.g., Leiber, 1976; Chiarello, Senehi, & Soulier, 1986). One difference between word and nonword stimuli is the presence of semantics. We examined whether learning meanings for nonwords could alter lexical decision asymmetry. Exp. 1 examined the effects of semantics by teaching subjects a newly-created language, and then observed performance on lateralized lexical decision. A visual field difference in sensitivity was observed when responding to newly-learned words as compared to other stimulus conditions. Exp. 2 extended the amount of learning, and used a semantic priming paradigm. Newly-learned words were primed by related English words to examine any shift in hemispheric asymmetry. We discuss how the results inform views of right hemisphere language processing.

G54

ASSOCIATIVE PROCESSING OF VERBS AND NOUNS RECRUITS DISTINCT NEURAL NETWORKS *Vanessa Troiani[1], Jonathan Peelle[1], Murray Grossman[1]; [1]University of Pennsylvania* – Nouns and verbs are supported by distinct neural networks, reflecting differences in the organization of word classes. For example, certain nouns are more likely to share overlapping features and are more hierarchically organized. These differences in representation may necessitate differential patterns related to semantic processing. Semantic access for nouns is frequently assessed using the Pyramids and Palm Trees (PPT) test, but the neural underpinnings of a comparable verbal associativity task has not been explored. We hypothesize that verbs rely on a more distributed processing network relative to nouns, in order to compensate for their less structured neural organization. To test this hypothesis we examined the differences between the PPT and a test of verbal associative knowledge using BOLD fMRI. We measured the neural activity of healthy adults while subjects performed the word version of the PPT and the 48-item Verb Similarity Test (VST). Participants were equally accurate across the tasks and there were no reaction time differences, reflecting comparable difficulty between the two tasks. Both nouns and verbs recruited left posterior parietal regions, presumably related to task-specific support by multimodal association cortex. A much larger scale neural network including bilateral dorsolateral frontal and motor cortex was recruited for verb associations as compared to nouns. There were no brain regions more active for nouns than verbs. We believe this indicates that the organizational differences between these word classes recruit distinct neural networks to support associative processing.

G55

TWO IS NOT BETTER THAN ONE: BILATERAL PRESENTATION FAILS TO ELICIT AN ELECTROPHYSIOLOGICAL MARKER OF SENTENTIAL CONSTRAINT *Edward Wlotko[1], Kara Federmeier[1,2,3]; [1]University of Illinois at Urbana-Champaign, [2]Neurosciences Program, University of Illinois at Urbana-Champaign, [3]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign* – Several recent event-related potential studies have uncovered a late (600-900 ms) frontal positivity that has been linked to semantic revision processes: unexpected words in strongly constraining sentence contexts elicit a larger positivity compared to unexpected words in weakly constraining contexts (and compared to expected words). In prior work we investigated this phenomenon as a function of visual field of presentation and found no evidence that this effect was elicited by either hemisphere alone, despite the fact that we previously observed the positivity for the same sentence materials with central presentation. To explore the discrepancy between results with central and lateral presentation, we replicated our study by employing central and bilateral (both visual fields) presentation in a within-subjects design. We again observed the frontal positivity for unexpected words in strongly constraining contexts when those words were presented centrally. However, we failed to observe the positivity for the same participants when words were presented simultaneously to the left and right visual fields. Thus, even when both hemispheres received the initial input, the processes that generate the positivity were not engaged to the same degree as when words were presented centrally. One possible explanation for this pattern is that bilateral presentation does not force the two hemispheres to cooperate. Thus, normal semantic revision processes may require hemispheric cooperation.

G56

BRAIN POTENTIALS REFLECT THE SEMANTIC DISTINCTION BETWEEN SINGULAR AND PLURALS *Ming Xiang[1], Taomei Guo[2], Jingjing Guo[2]; [1]Harvard University, [2]Beijing Normal University* – Work on numerical cognition has shown that pre-linguistic babies and non-human primates distinguish between singular and plural objects, suggesting the two domains are conceptually different. However, previous psycholinguistics/neurolinguistics work in this area has only focused on morpho-syntactic number markings. The current study investigates the semantic differences between the two in Mandarin Chinese, using ERP recordings. Without number marking morphology, nouns in Mandarin are interpreted as singular or plural depending on the context or preceding numeral information. The presence of numeral words requires obligatory classifiers (cf. the ungrammatical (1) vs the grammatical (2)). Count nouns (e.g. cow) and mass nouns (e.g. water) have distinct classifiers. However, the classifier "xie" with the numeral "one" may be used with all nouns, giving rise to plural interpretations for count ones (3). We tested three conditions in sentence contexts: one singular (4) and two plural conditions((2)&(3)). At the noun position, we found a larger N400 over the central-frontal area for the plural condition with "xie" (3), compared to the singular condition (4), but there is no such difference between (2) and (4). We discuss the N400 in terms of the individualization of the plural domain into measurable units. The effect is absent in (2), as the plural interpretation has been processed on the numeral prior to the noun. (1) *san niu (three cow, 'three cows) (2) san tou niu (three CL cow, 'three cows) (3) yi xie niu (one CL cow, 'a few cows') (4) yi tou niu (one CL cow, 'one cow')

G57

COMPARISON OF DISCOURSE LEVEL INTEGRATION DURING COMPREHENSION OF PICTURE AND SPOKEN STORIES: AN ERP STUDY *Corey Ziemba[1], Lara Polse[2], Tamara Swaab[1]; [1]University of California Davis, [2]School of Speech, Language, and Hearing Sciences, San Diego State University* – In this study we used ERPs to directly compare discourse level processing during comprehension of non-verbal picture stories and verbal stories to examine whether semantic processing of non-verbal and verbal materials is supported by identical or non-identical representational systems. In the verbal story experiment, participants heard three-sentence stories, presented with naturally produced and connected speech, with the last word of each story either congruent or incongruent with the preceding discourse. In the picture story experiment, participants were presented with a series of pictures (adapted from West & Holcomb, 2002). The last picture of each series was congruent or incongruent with the preceding discourse. An N400 effect of discourse congruence was observed for the verbal story experiment, which is consistent with previous findings (e.g., Camblin et al, 2007; van Berkum et al, 1999, 2003). In the picture story experiment, effects of final picture congruence showed up as a centro-frontally distributed N300 effect and a non-canonical centro-frontally distributed N400 effect, which replicates the study of West and Holcomb (2002). The direct comparison of non-verbal and verbal story processing in the present study showed separable ERP effects of discourse congruency which suggest that non-verbal and verbal semantic processing may access separable semantic systems in the human brain.

Linguistic processes: Syntax

G58

MULTIMODAL IMAGING OF LANGUAGE PROCESSING AND SYNTACTIC COMPLEXITY IN A NATURALISTIC CONTEXT *Asaf Bachrach[1], Meredith Brown[1], Carlos Cardenas[1], Olga Felsovalyi[1], Alec Marantz[2], John Gabrieli[1]; [1]Massachusettes Institute of Technology, [2]New York University* – We use functional Magnetic Resonance Imaging (fMRI) and Magnetoencephalography (MEG) to monitor brain activation while subjects listen to narratives followed by comprehension questions to verify attention. The narratives were designed to appear quite naturalistic while in fact containing high density of syntactically complex constructions (relative clauses, embedded questions, clefts, Raising, passives, etc.) not usually found, in such density, in naturally produced corpora. We calculate a number of processing complexity measures based on current linguistic (Chomsky 1994), psycholinguistic (Gibson 1998, Lewis & Vasishth 2005, Hale 2000) and computational linguistic (Roark 2001) theorizing. We correlate these measures with the time course of the BOLD measure (for fMRI) and of spectral coherence (for MEG). Since the main focus of the manipulation are cases of long distance dependency, subjects complete outside the scanner a battery of working memory tests (Waters & Caplan 2003). These measures are then used as regressors in the group analysis. The analysis along these lines of pilot fMRI data from 3 subjects allowed us to distinguish neural correlates of maintenance of the filler in a long distance dependency from those of reactivation (or retrieval) at the gap, supporting the view that syntactic working memory makes use of a maintenance mechanism (Gibson 1998) and cannot be reduced to cue based recall (Lewis & Vasishth 2005). In addition, we were able to distinguish these working memory related activation patterns from activation due to surprisal (Hale 2000), suggesting that both dimensions contribute to processing complexity contrary to certain current psycholinguistic proposals (Levy 2006).

G59

EVENT-RELATED POTENTIAL MEASURES OF MORPHO-SYNTACTIC PROCESSING IN ADULTS WITH TYPICAL LANGUAGE ABILITY *Stacy Betz[1]; [1]University of Washington* – This study used event-related potentials (ERPs) to investigate the neural correlates of morpho-syntactic processing in adults with typical language. Two ERP components are associated with morpho-syntactic processing: the P600 and the left anterior negativity (LAN). The P600 reflects controlled aspects of processing and the LAN automatic processing. Both a P600 and LAN have been found following morpho-syntactic errors; however, few studies have compared these components following different types of morpho-syntactic errors. Also unknown is the relationship between language ability and P600/LAN morphology. This project's goals were to: 1) compare the morphology of the P600 and LAN components following different types of morpho-syntactic errors and 2) determine the relationship between P600 and LAN amplitude and latency and behavioral measures of language ability. Participants included 20 adults with typical language abilities. ERPs were collected while they listened to and judged the grammaticality of sentences. Two types of morpho-syntactic errors were analyzed: sentences containing an omitted tense/agreement marker and sentences containing an overt use of an incorrect tense/agreement marker. These conditions were compared to control conditions with correct tense/agreement marking. Results will be analyzed in terms of differences in amplitude, scalp location, onset latency, and duration of the P600 and LAN between the two error conditions. Additionally, correlations between the ERP measures and behavioral language measures will be conducted. These analyses will determine whether ERPs are sensitive to subtle differences in the type of morpho-syntactic error processed and whether differences within the normal range of adult language ability are reflected in ERP measures.

G60

BOLD SIGNAL CORRELATES OF SYNTACTIC PROCESSING IN FONT CHANGE DETECTION *David Caplan[1], Gloria Waters[2]; [1]Neurology, M.G.H., [2]Sargent College, Boston University* – BOLD signal was measured while 16 participants made timed font change detection judgments in sentences that varied in their syntactic form (subject- and object-extracted sentences). Accuracy was above 85% for all sentence types. RTs showed unimodal distributions for all sentence types, indicating that the participants processed all sentences similarly. There were longer RTs to objectthan to subject-extracted sentences without font changes and longer RTs for sentences in which the font change occurred at the embedded noun or verb of object- compared to subject-extracted sentences, indicating that sentences were processed to the level of syntactic structure. BOLD signal increased for object-extracted sentences without font changes in left supramarginal gyrus. The result provides evidence that left supramarginal gyrus plays a role in implicit syntactic and associated semantic processing of object-extracted relative clauses. However, other results using a nonword detection task, in which syntactic processing is also implicit, showed left inferior frontal activation with the same sentence type contrast. The entire set of results suggest that tasks always interact with sentence comprehension, and raise the question of what parsing and interpretive operations are task-independent.

G61

NATIVE LANGUAGE SHAPED THE NEURAL MECHANISM OF SECOND LANGUAGE PROCESSING: EVIDENCE FROM ELECTROPHYSIOLOGICAL STUDY *Lang Chen[1], Yuping Zhang[1], Qirui Zhang[1], Youyi Liu[1], Hua Shu[1], Ping Li[2]; [1]Beijing Normal University, Beijing, [2]University of Richmond, Richmond* – Previous studies demonstrated that Chinese learners of English perennially suffer from syntactic errors, especially those rules absent in Chinese language. In this group of ERP studies, we aimed to investigate how the property of number information in Chinese (L1) influences the Chinese speakers' neural mechanism of processing the number agreement in their second language (L2), namely English. In experiment 1, twenty Chinese students read Chinese sentences with/without number incongruence between subject and verb [e.g., a.几个学生/讨论…(several students are discussing…); b.一个学生/讨论…(one student is discussing…)]; and in experiment 2, the same group of Chinese students were displayed with English sentences, containing number agreement errors or not (e.g., a. Some students were…; b. One student were…). In experiment 3, twenty native English speakers read the same English sentences as in experiment 2. All the participants were required to judge the acceptability of the sentences after they ended. The results showed that Chinese participants employed similar neural mechanism to process the number information (revealed by N400 effect, indicating the semantic processing) when reading both Chinese and English sentences. Contrarily, the native English speakers showed ERP effects related to syntactic processing (represented by P600 or LAN) when processing the number agreement in English. All together, the results reveal that although the Chinese learners of English have sufficient L2 proficiency, the neural mechanisms involved in their L2 processing are constrained by the properties of L1.

G62

SALIENCE DIRECTS THE LEARNER TO THE STRUCTURE: AN ARTIFICIAL GRAMMAR LEARNING EXPERIMENT. *Meinou de Vries[1], Padraic Monaghan[2], Stefan Knecht[1], Pienie Zwitserlood[1]; [1]University of Münster, Germany, [2]Lancaster University, UK* – Acquiring syntactic structure depends on information available from the input. We have previously shown that learning of recursive structures are extremely difficult to acquire in Artificial Grammar Learning (AGL) studies (De Vries et al., in press). Here, we investigated whether learning recursion could be helped by adding cues that direct the learner to the structure using links between vowels or consonants. Participants were significantly assisted in accuracy and speed of learning by agreement cues that consisted of vowels, but not by consonant agreement cues (Experiment 1). This was the case when the cues were in syllables of the form consonant-vowel as well as vowel-consonant. However, the agreement cues were not helpful when participants were not informed about the structure (Experiment 2), so the learning success cannot be explained by a natural preference for particular vowel sequences. This underlines the findings by Bonatti et al. (2005), indicating that structural information is extracted from vowels whereas lexical information is derived from consonants. Relating to natural language data, it has been suggested that grammatical development of languages with highly salient agreement cues, like Italian, is faster than in languages without such cues, like English. It seems that the salience of particular cues indeed directs the learner to the structure to be learnt. Such agreement cues embedded in the phonology may be critical for language acquisition.

G63

SENTENCE PROCESSING AND GRAMMATICAL COMPLEXITY *Anne-Dominique Devauchelle[1,2,3], Y-Lan Boureau[1,2,3], Stanislas Dehaene[1,2,3,4], Christophe Pallier[1,2,3]; [1]INSERM, U562, Cognitive Neuroimaging Unit, France, [2]CEA, DSV/I2BM, NeuroSpin Center, France, [3]University Paris-Sud, IFR49, France, [4]Collège de France, Paris* – The goal of this project is to investigate areas involved in the building of the syntactic trees. The approach consists in looking for areas that show higher activation more the complexity of the sentence increase. We varied in a parametric way the depth of the tree, the number of words and the number of constituents in sentences. Twenty volunteers were scanned at 3 Tesla while they passively read phrases of 12 words (in a rapid serial visual presentation). We used 8 different conditions. There were 6 conditions coming from purely right-branching sentences. All of these conditions were constituted by different number of constituents: (1) 1-word constituent (a list of 12 words completely independent), (2) 2-words constituent, (3) 3-words constituent, (4) 4-words constituent, (5) 6-words constituent and (6) 12-words constituent (an entire sentence of 12 words). Moreover, there were two other conditions coming from center-embedding sentences: (7) 3-words non-constituent and (8) 4-words non-constituents. These conditions allow us to differentiate the processing of constituents and non-constituents. We were looking for areas showing a linear correlation with complexity (positive or negative). We made a parametric comparison between the different conditions and we found areas showing a positive correlation with complexity: the left anterior and posterior temporal gyrus and the left inferior frontal lobe. Some areas showing a negative correlation with complexity were strangely symmetrical: the inferior and superior frontal regions, the occipital gyrus and the parietal lobe. With our design we can better detail the various steps of integration of syntax.

G64

ERP CORRELATES OF AUTOMATIC SYNTACTIC PROCESSING IN HIGHLY PROFICIENT L1 CHINESE-L2 SPANISH LATE LEARNERS. *Margaret Gillon Dowens[1,2], Horacio Barber[1,2], Jingjing Guo[3], Taomei Guo[3], Manuel Carreiras[1,2]; [1]Universidad de La Laguna, Tenerife, Spain, [2]Instituto de Tecnologías Biomédicas, Tenerife, Spain, [3]Beijing Normal University, Beijing, P.R.China* – Critical factors affecting second-language processing are the age of acquisition (AoA), the level of proficiency attained and the similarities/ differences between the syntactic structures of the L1 and L2. Despite much research, the relative importance and interaction of these factors is still unclear. Previous studies in our laboratory with highly proficient L1 English late learners of Spanish have indicated that proficiency, rather than AoA, is the key question in the attainment of native-like patterns of processing of morpho-syntax. However, the question of whether the syntactic patterns of L1 constrain the processing of L2 remains unanswered as English, although not as synthetic as Spanish, does compute some agreement features, notably number agreement, which could mean that there is some L1-L2 transfer. To clarify this question of the influence of language overlap, we conducted a study with highly proficient L1 Chinese late learners of Spanish. Unlike Spanish and English, Chinese is an isolating language with no grammatical agreement features. 22 Chinese learners of Spanish, and 22 Spanish native participants read sentences containing gender and number violations and performed a syntactic judgement task while ERPs were recorded using a 64 channel system. The results for the L2 group included a pattern of LAN-P600 similar to the native Spanish readers, although with differences in the topographical distribution of the LAN similar to the L1 English readers previously studied. These results indicate that not only features of the L2 which are present in the L1 can be processed in a native-like way.

G65

FMRI REVEALS THE ACTIVATION OF SYNTACTIC GENDER INFORMATION IN BARE NOUN PRODUCTION *Stefan Heim[1,2], Simon Eickhoff[1], Angela Friederici[3], Katrin Amunts[1,4]; [1]Research Centre Juelich, Institute of Neurosciences and Biophysics, [2]Brain Imaging Center West, [3]Max Planck Institute for Human Cognitive and Brain Sciences, [4]RWTH University Aachen, School of Medicine* – We investigated whether syntactic gender information becomes activated during overt picture naming with bare nouns for which gender information is not required. Pictures were presented in gender homogeneous blocks (all German picture names had the same gender), gender heterogeneous blocks (identical stimuli but mixed genders in each block), phonologically homogeneous blocks (all picture names start with the same phoneme), and phonologically heterogeneous blocks (identical stimuli but mixed phonemes in each block). Gender homogeneous blocks elicited higher activation than gender heterogeneous blocks in the left BA 44, BA 6, and pars orbitalis of the left inferior frontal gyrus (IFG/orb). Phonologically homogeneous blocks evoked higher activation than phonologically heterogeneous blocks in the left IFG/orb, left inferior temporal sulcus, and left angular gyrus. Subtracting the latter from the former contrast reflecting the gender-specific effect yielded gender-specific activation in the left BA 44 and BA 6 known to support syntactic/gender processing. This gender-specific effect in the fMRI data indicates that gender information was available during bare noun production.

G66

IMPAIRED "SET SHIFTING" IN APHASIC SENTENCE COMPREHENSION *Jesse Hochstadt[1,2], Myrna Schwartz[1]; [1]Moss Rehabilitation Research Institute, Philadelphia, [2]Hospital of the University of Pennsylvania, Philadelphia* – Impaired comprehension of complex sentences in aphasia has often been ascribed to deficits in syntax-specific "knowledge" or operations. Some researchers, however, have proposed that these comprehension difficulties derive from deficits in executive processes similar or identical to those operating in other domains. We tested the hypothesis that the processing demands of different syntactic structures may constitute different cognitive sets and that aphasic individuals may be "stuck" in more common or canonical sets. Seven aphasic subjects and 20 controls performed a picture-matching test using two sentence structures (e.g., "The queen was kicking the cook who was fat" and "The queen who was kicking the cook was fat"), which occurred both in separate blocks and intermixed within blocks. Different picture pairs probed separate aspects of sentence meaning (thematic roles or adjective attachment). We obtained two measures of syntactic set-shifting ability: "mixing cost" (poorer comprehension in mixed than single-structure blocks) and "switching cost" (poorer comprehension, for trials within mixed blocks, when the preceding trial tested comprehension of a different structure or a different aspect of sentence meaning). All aphasic subjects showed greater mixing or switching costs than controls; we will consider how these costs relate to comprehension accuracy on the different structures and picture probes. Impaired syntactic set-shifting showed no clear relationship with performance on the Trail Making and Wisconsin Card Sorting tests of non-linguistic set-switching. Thus aphasia may impair processes supporting the "syntactic flexibility" needed to comprehend complex sentences, but these processes may differ from those supporting cognitive flexibility in other domains.

G67

INFLUENCES OF GRAMMATICALITY ON THE N400 TO NOVEL VERBS *Mandy Maguire[1,2], Mary Kathryn Reagor[1,2], Raksha Anand[1], Samantha Sandgren[2], Mark Elliot[2]; [1]Center for BrainHealth, University of Texas, Dallas, [2]Callier Center for Communication Disorders, University of Texas, Dallas* – Traditionally the N400 is associated with semantic processing and the Early Left Anterior Negativity, or ELAN, and P600 are associated with syntactic processing. Recent literature reveals more interaction between these processes than previously believed (Hahne & Friederici, 1998; Kolk & Chwilla, 2007). In this study 24 right-handed, native English speakers listened to grammatically correct and incorrect sentences that contained either familiar verbs (The girl on the table danced. vs. The girl on the danced*) or nonsense verbs (The boy in the classroom ibbed. vs. The boy in the ibbed*). Regardless of verb familiarity the ELAN and P600 were statistically identical, both showing traditional grammatical violation effects. Additionally, there was a significant verb familiarity by grammaticality interaction for the N400, $F(1, 1485)=8.90$, $p=.003$. For novel verbs the N400 was significantly larger for grammatically correct than incorrect sentences, $t(677)=2.39$, $p=.008$. The opposite, though not to a significant degree, was true for familiar verbs. This effect is thought to be due to subjects' attempts to uncover meanings for the novel verbs, a hypothesis supported by our post-experiment debriefing. Thus, for grammatically correct sentences semantic processing was strong, as reflected by the N400 to novel verbs. However, similar to past findings that no N400 effect is present when there are dual violations (Hahne & Friederici, 1998), in the present study once the sentence was deemed grammatically incorrect attempts to process semantic information were attenuated. This finding supports claims that syntactic processing may precede semantic processing in language comprehension.

G68

ERP EVIDENCE FOR CONCEPTUAL EVENT STRUCTURE EFFECTS ON SYNTACTIC PROCESSING. *Evguenia Malaia[1], Ronnie Wilbur[1], Christine Weber-Fox[1]; [1]Purdue University* – Verbs contain multifaceted information about both the semantics of an action, and potential argument structures. Linguistic theory classifies verbs according to whether the denoted action has an inherent (telic) end-point (fall, awaken), or whether it is considered homogenous, or atelic (read, worship). The aim of our study was to examine how this distinction influences on-line sentence processing. Event-related brain potentials (ERPs) were recorded from 22 English speakers as they read sentences in which the main verb was either telic or atelic, e.g., "The actress awakened/worshipped by the writer left in a hurry". ERPs elicited by telic and atelic verbs, the preposition "by" introducing Agent, and the second argument, e.g., "writer", were compared. Additionally, participants where grouped according to receptive syntactic proficiency: normal (NP) or high (HP). ERPs from the NP group first diverged at the second argument, with the atelic condition eliciting larger amplitude negativity at the N100 ($p=.009$), and continuing to the P200 ($p=.045$) interval. In contrast, ERPs from the HP group first diverged earlier in the sentence, on the word "by". ERPs elicited by "by" in the atelic condition were also characterized by increased negativity, in this case significant at P200 ($p = .009$) and N400 ($p=.033$). Our results support the postulated conceptual/semantic distinction underlying the two verb categories, and demonstrate that world-knowledge about actions designated by verbs and syntactic proficiency are reflected in on-line processing of sentence structure.

G69

CAN METRIC CUES COMPENSATE SYNTACTIC DEFICITS ? AN ERP-STUDY WITH FOCAL BASAL GANGLIA LESION PATIENTS *Schmidt-Kassow Maren[1], Kotz Sonja A.[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig* – The P600, elicited by various syntactic violations, has been linked to syntactic reanalysis/

repair (Friederici & Kotz, 2003) or syntactic integration (Kaan et al., 2000) . This process is affected in patients with lesions of the basal ganglia (BG ; Frisch et al., 2003 ; Kotz et al., 2003) or neurodegenerative disease (PD ; Friederici et al., 2003) during auditory syntactic processing. However, Kotz and colleagues (Kotz et al., 2005) demonstrated that external metric stimulation re-elicits the P600 during auditory syntactic processing. If external cues function this way are there also speech inherent cues (i.e., meter) that influence syntactic processing ? Previous ERP-studies have revealed evidence that a) metric violations also elicit a P600 comparable to syntactic violations, and b) meter and syntax interact during auditory sentence processing (Schmidt-Kassow & Kotz, submitted) . Therefore, the present experiment investigated whether BG-patients profit from speech inherent metric cues (comparable to external metric stimulation) when processing syntactic information. We constructed metrically regular sentences that were either grammatically, metrically, or doubly violated. If meter works as a 'taktgeber' during auditory syntactic processing, the syntactic P600 should be re-elicited in BG-Patients. Our results clearly show a P600 response to syntactic violations in BG patients in metrically regular sentence context. Thus, meter can function as a ' taktgeber ' that enables BG-patients to initiate syntactic re-analysis. Furthermore, BG patients suffer from a metric processing deficit as the P600 in response to metric violations missing. Consequently, not only external but also speech inherent metric cues can compensate syntactic deficits. Thus, data support the high relevance of metric competence during auditory syntactic processing.

G70

RETENTION AND CONSOLIDATION OF SECOND LANGUAGE GRAMMAR: EVIDENCE FROM EVENT-RELATED POTENTIALS *Kara Morgan-Short[1], Stephanie Lukas[2], Marco Piñeyro[2], Cristina Sanz[2], Karsten Steinhauer[3], Michael Ullman[2]; [1]University of Illinois at Chicago, [2]Georgetown University, [3]McGill University* – Research examining second language (L2) grammatical processing in highly proficient speakers has revealed a native-like LAN-P600 ERP pattern. In a recent study this pattern was found in subjects who were implicitly-trained to speak and comprehend an artificial language, but not in explicitly-trained subjects (Morgan-Short et al., 2007). The current study compared behavioral and ERP measures of syntactic and morphosyntactic processing at the end-of-training of this study with those measures 3-6 months after training (i.e., within subjects). After this period, the implicitly-trained group retained all behavioral gains on grammatical processing, as well as the LAN-P600 response for the syntactic condition and the P600 response for the morphosyntactic condition. The explicitly-trained group also retained all behavioral gains on grammatical processing. Surprisingly, they also showed a P600 for both syntactic and morphosyntactic structures, as well as an N400 for morphosyntactic structures. These results suggest that implicit training can not only lead to a native-like neurocognitive pattern of grammatical processing, but that this pattern may be retained over the course of months or longer. Interestingly, the data suggest that although explicit training does not initially lead to native-like neurocognitive grammatical processing, aspects of such processing can emerge over time, even (or perhaps only) with no training, perhaps due to a process of consolidation. The data are consistent with the view that L2-learners can not only acquire but also retain aspects of grammar (evidenced by the LAN) in procedural memory, and that this may depend on type of training or exposure to the language.

G71

IMPAIRED LANGUAGE MORPHOLOGY IN HUNTINGTON'S DISEASE PATIENTS *Dezso Nemeth[1,2], Gabriella Gardian[2], Peter Klivenyi[2], Tamas Sefcsik[2], Geza Ambrus[2], Agnes Lukacs[2], Laszlo Vecsei[2], Michael Ullman[1]; [1]Georgetown University, Washington DC, [2]University of Szeged, Hungary* – The role of the basal ganglia in language and cognition is still unclear. The goal of this study was to explore language production in Hungarian patients with early Huntington's disease (HD) or pre-HD (that is, presymptomatic HD). HD is a progressive neurodegenerative disorder with macroscopic atrophy primarily of the caudate nucleus at early stages. We tested the processing of two aspects of language production – rule-governed and idiosyncratic linguistic knowledge – using a Hungarian inflectional morphology production task. Fluency tasks (letter and semantic) and working memory tasks (digit span, non-word repetition, word-list recall, listening span) were also administered. Compared to healthy controls, both the HD and pre-HD groups demonstrated impaired performance on the production of morphologically complex words, producing significantly more over-suffixation errors. In addition, performance on the letter fluency task was significantly lower in both patient groups than in controls. These findings have implications for the role of the basal ganglia in language, and may have diagnostic value for clinical practice.

G72

EFFECTS OF ATTENTION ON EARLY AND LATE SYNTACTIC PROCESSES IN 3 TO 4 YEARS OLD CHILDREN *Franziska Nikolaizig[1,2], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, [2]Graduate Program Function of Attention in Cognition, Leipzig* – In a recent study (Hahne, & Friederici, 1999) it was shown that the two-pass syntactic parsing process reflected by an early left anterior negativity (ELAN) and a late positivity (P600) is differentially affected by attentional aspects, in this case the probability of syntactically correct and incorrect stimuli. The ELAN was stably elicited irrespective of the attentional manipulation whereas the P600 was influenced. These findings were interpreted as the ELAN representing a highly automatic sentence parsing process and the P600 reflecting a more controlled one. In the present study we investigated the influence of attentional factors on syntactic processes in 3 to 4 year-olds, i.e. in a sentence processing system which is still undergoing development. We varied the proportion of syntactically correct and incorrect sentences respectively with incorrect sentences being either of a low (20%) or a high (80%) proportion. Previous research on syntactic processing in 2;8 year-olds reported the presence of two ERP components which were interpreted as precursors to the ELAN and the P600 (Oberecker, & Friederici, 2005). Here attentional factors were expected to differently affect the ERP pattern in children compared to those observed in adults. Finding an ELAN and no P600 for both proportion conditions confirmed our predictions. In order to interpret the ERP data with respect to the general development of the children's attention networks we correlated the EEG data with the "Children's Behavior Questionnaire", were we found interactions between the children's ability to shift their attention and the mean amplitude differences of both sentence types.

G73

INTERFERENCE BETWEEN SYNTACTIC PROCESSING IN LANGUAGE AND MUSIC *Aniruddh Patel[1], L. Robert Slevc[2], Evelina Fedorenko[3], Daniel Casasanto[4], Jonathan Winawer[4], Jason Rosenberg[5], Edward Gibson[3]; [1]The Neurosciences Institute, [2]Rice University, [3]MIT, [4]Stanford University, [5]UCSD* – Do linguistic and musical syntax rely on shared processing mechanisms? One way to address this question is to examine whether the processing of musical syntactic (harmonic) relations interferes with the processing of linguistic syntactic relations. Two studies are presented which take this approach. In the first, sentences with syntactic ambiguities (garden-path sentences) were paired with chord progressions in a self-paced reading task. On the critical disambiguating word, the music was manipulated to have either a normal chord, a structurally incongruous chord (out-of-key), or an acoustically incongruous chord (different timbre). Reading times at the critical word were slower for the syntactically ambiguous vs. unambiguous sentences, and this effect was exaggerated when an out-of-key chord (but not an out-of-timbre chord) occurred on the critical word. The second study used sung sentences which were either syntactically simple or complex, based on the structure of an embedded relative clause (subject vs. object-extracted). Within the relative clause, the music was manipulated so that a critical note was either in-key, out-of-key, or acoustically deviant (suddenly loud). Comprehension accuracy for the sentences was lower for the more vs. less complex linguistic structures, and this effect was exaggerated when an out-of-key note occurred in the relative clause. This interaction did not occur when a loud note was used. Together these studies show interference between linguistic and musical syntax in two distinct paradigms. This points to shared processing of musical and linguistic syntax, in accordance with a hypothesis of shared neural resources as outlined by Patel (2003).

G74

LANGUAGE DEVELOPMENT IN CHILDREN WITH SPASTIC DIPLEGIA CEREBRAL PALSY *Linda Phan[1], Judy Reilly[1], Natacha Askshoomoff[2], Tamara Harris[2], Joan Stiles[2], Wendy Ark[2]; [1]San Diego State University, [2]University of California San Diego* – Spastic Diplegia (SD), the most common form of cerebral palsy results from early diffuse bilateral white matter damage. Cognitively, studies have shown marked visual spatial deficits in SD, but language has generally thought to be spared. Here, we investigate spoken language development in high functioning children with SD (N=9, ages 6-12) compared to three groups: Typically Developing children (TD, N=72), children with Perinatal Stroke (PS, N=34) and children with Language Impairment (LI, N=32). Children were administered standardized language measures (Peabody Picture Vocabulary Test, (PPVT); Recalling Sentences from the Clinical Evaluation of Language Function, (CELF)) and a quasi-naturalistic narrative task (Telling the picture story, Frog, where are you?). Consistent with previous studies, performance of the SD group on standardized measures is generally comparable to TD children. In the narrative task, their stories are of comparable length and complexity to the TD group. However, with respect to grammar, the SD group makes significantly more morpho-syntactic errors than controls, PS or LI groups. Surprisingly, the SD group uses complex syntax at a rate comparable to controls, and significantly more often than the other clinical groups. Finally, the types of syntactic structures that the children with SD recruit are diverse and unusual for school-age children. Comparing performance of the SD group to that of controls and children with other neurodevelopmental disorders suggests that the linguistic profile of children with SD is atypical.

G75

ELECTROPHYSIOLOGICAL CORRELATES OF THEMATIC INTEGRATION IN SENTENCES COMPREHENSION *Fabrizio Pizzioli[1], Bruno Rossion[1,2], Hiroko Nakano[1]; [1]University of Louvain, [2]Laboratory of Neurology, [3]Saint Mary's College of California* – In this study event related potentials (ERP) were used to investigate auditory thematic integration processes in syntactically unambiguous sentences in French. We monitored the N400 component, a marker of semantic integration (e.g. Kutas & Hillyard, 1980) and the P600, associated with syntactic reanalysis (e.g. Kaan et al. 2003). Participants listened to sentences, where the critical verbs were either: congruous, (e.g., the old man read the newspaper); Incongruous, Semantically-Unrelated, (e.g., The tree read the old man); Incongruous, Thematically-Reversible, (e.g., The newspaper read the old man); Passive (e.g., The newspaper was read…). In the Semantically-Unrelated condition, the subject noun did not fit either the "agent" or the "theme" role. In the Thematically-Reversible condition, there was a highly plausible alternative interpretation, (i.e., the subject noun fits to the "theme" role). The plausibility of the subject as a theme was also manipulated. We observed that the incongruous and semantically unrelated condition elicited both P600 and N400 effects while the thematically reversible condition elicited the P600 effect, but not the N400 effect. Additionally, the P600 effect in the Thematic-Reversible condition was modulated by the degree of plausibility of the subject noun as "theme." The P600 without N400 in syntactically unambiguous sentences with semantic anomalies is consistent with recent results in other languages (e.g., Kim & Osterhout, 2005; Kolk et al., 2003; Kuperberg et al., 2003). The nature of P600 and N400 effects in sentence integration processes are discussed in terms of thematic attraction, semantic association, thematic structural violation, and animacy.

G76

AN FMRI INVESTIGATION OF NEURAL ADAPTABILITY AS A FUNCTION OF INDIVIDUAL WORKING MEMORY CAPACITY AND TASK DEMANDS DURING SYNTACTIC PROCESSING *Chantel Prat[1], Marcel Just[1]; [1]Center for Cognitive Brain Imagin, Carnegie Mellon University* – Recent research suggests that skilled brain functioning is related to the ability to adapt neural responses in the face of changing demands. This experiment investigated the relation between working memory and syntactic processes by comparing neural adaptability (as indexed by the difference in neural activation elicited by syntactically simple versus complex sentences) across individuals with varying working memory capacities, and across tasks with varying working memory demands. In the low-load condition, participants read sentences and answered comprehension questions. In the medium-load and high-load conditions, participants were additionally given three concrete nouns and three pronounceable non-words, respectively to hold in memory before reading sentences. 26 Carnegie Mellon undergraduates with reading spans ranging from 2.0 to 5.0 read a total of 60 sentences, 10 per condition (2 syntactic complexity levels x 3 working memory loads). Syntactic adaptability (the extra activation for object relatives compared to conjoined active sentences) was positively correlated with working memory capacity across memory loads (i.e., high-capacity individuals had greatest adaptability) in distributed cortical areas including bilateral middle and superior temporal and right inferior frontal gyri. Similarly, adaptability was highest in the low-working-memory-load condition across individuals, with the largest differences between high and low-working memory load conditions in bilateral inferior frontal regions, including Broca's area and its RH homologue. The findings suggest that the ability to modulate brain activation in the face of changing syntactic demands is related to the mental resources available to an individual.

G77

INVESTIGATING SEMANTIC-SYNTACTIC INTEGRATION WITH FMRI IN AN ISSS PARADIGM *Tim Raettig[1], Angela Friederici[1], Sonja Kotz[1]; [1]Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – The current study aimed at the differentiation of two distinct aspects of syntactic processing, morphosyntax and phrase structure in terms of their functional localization. In addition to this, we were interested in the integration of these two types of syntactic information with semantics. We investigated the processing of spoken sentences which either contained a subject-verb disagreement or an illegal word-category sequence. We tested all sentences in a real word as well as in a pseudo-word context. FMRI data were acquired on a 3T scanner for 15 healthy subjects. We implemented an ISSS paradigm (Schwarzbauer et al. 2006), presenting auditory stimuli during periods of scanner silence that were followed by the rapid acquisition of 5 functional volumes. In the real word condition, phrase structure violations elicited extensive brain activations in the left supramarginal, precentral and inferior frontal gyrus when compared to correct sentences while in the pseudo-word condition, analogous violations elicited activations in the bilateral anterior and middle superior temporal gyrus. Morphosyntactic violations induced a small activation of the posterior left superior temporal gyrus in the real word condition, but did not elicit a significant increase in brain activity in the pseudo-word condition. Our study shows that phrase structure violations are processed by two distinct cognitive networks, depending on the availability of semantic information for integration. The processing of morphosyntactic violations compared to morphosyntactically correct sentences apparently only poses very limited demands on specialized processing systems, explaining the lack of a major difference to correct sentences.

G78

AN FMRI STUDY OF SYNTACTIC AND SEMANTIC AMBIGUITY RESOLUTION IN SPOKEN LANGUAGE *Jennifer Rodd[1], Billi Randall[2], Lorraine K. Tyler[2]; [1]University College London, [2]University of Cambridge* – Language is highly ambiguous. Not only can words refer to more than one concept (e.g, the bark of the tree/dog), but their syntactic roles within the sentence can also be ambiguous (e.g, landing planes is/are). Here we investigate the time-course with which syntactic and semantic ambiguity is processed and resolved by using a new semi-sparse fMRI protocol (Schwarzbauer et al. 2006) in which auditory stimuli are presented in the silent period between clusters of six scans. Sentences either contained semantically ambiguous phrases that were disambiguated by the subsequent verbs meaning (e.g., brown hares/hairs hop), or phrases whose syntactic role was ambiguous and was disambiguated by the subsequent verbs syntactic inflection (e.g., visiting relatives annoy(s)). These were compared with unambiguous control sentences. Consistent with our previous study of semantic and syntactic ambiguity (Rodd et al., CNS 2005), we found that both syntactic and semantic ambiguities produced activation in the left inferior frontal gyrus (BA 44/45). However, only syntactic ambiguity activated the left middle temporal gyrus and this was sensitive to dominance such that activation was only increased when there was a strong preference against the syntactic structure that was used. In addition, the left inferior temporal gyrus/ fusiform gyrus (which shows no activation for syntactic ambiguities) was more active for the semantically ambiguous sentences. We use information about the locations and timings of these responses to the two types of ambiguity to constrain theories about the precise functional roles of these different components within the fronto-temporal speech comprehension network.

G79

THE EFFECTS OF THE ANTECEDENT'S DEFINITENESS AND SYNTACTIC FUNCTION ON REFERENTIAL PROCESSING *Dietmar Roehm[1], Petra Burkhardt[2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Junior Research Group Neurotypology, Leipzig, [2]University of Marburg, Germany* – Syntactic, semantic and discourse factors influence referential processing (when an expression refers to a discourse entity). In the present study, we examined how different aspects of the accessibility of an antecedent expression (definiteness and syntactic function) impact referential processing . In a reading experiment conducted in German, we assessed the processing of noun phrases in mini-discourses and manipulated the definiteness of the antecedent (indefinite vs. definite) and its syntactic function (subject vs. object). Context sentences contained either [A] an indefinite subject antecedent (Recently, an athlete observed a pianist.), [B] a definite subject antecedent (Recently, the athlete observed the pianist), [C] an indefinite object antecedent (Recently, a pianist observed an athlete), or [D] a definite object antecedent (Recently, the pianist observed the athlete). ERPs were measured to the onset of the critical expression in a subsequent sentence (Soon the athlete…). ERPs revealed different N400-effects for definite vs. indefinite [B/D>A/C] and subject vs. object [A/B>C/D] antecedents. This demonstrates first that definiteness affects the accessibility hierarchy of referential expression. Second, previous research has shown that referential processing as in [A-D] is independent of the number of intervening discourse entities (Burkhardt & Roehm 2007), thus syntactic function - rather than linear order – is here considered to influence the accessibility status of the referent. These results support previous N400-findings for the integration of referential expressions that differ in their discourse saliency. In addition, they indicate that definiteness and syntactic function interact to yield a sophisticated accessibility hierarchy.

G80

AN FMRI INVESTIGATION OF THE FUNCTIONAL SPECIFICITY OF SENTENCE PROCESSING NETWORKS: A COMPARISON OF SENTENCES AND MELODIES *Corianne Rogalsky[1], Gregory Hickok[1]; [1]University of California, Irvine* – A number of recent studies have identified portions of the anterior temporal lobe (ATL) that respond preferentially to structured sentence-level stimuli (versus word-lists, for example). It is unclear, however, whether this response to sentences reflects syntactic computations, semantic integration operations, or more general hierarchical structure-building. The present study directly compares the neural systems associated with sentence and melodic structure processing to investigate the specificity of this ATL activity. We implemented a mixed-design fMRI paradigm to compare activity in the ATL whiles subjects listened to blocks of jabberwocky sentences, scrambled jabberwocky sentences, simple novel melodies, and scrambled novel melodies. In order to separate activations associated with hierarchical structure processing from activations resulting from general temporal processing, stimuli were presented at three different rates within each block. Regions with a greater BOLD response to sentences than to scrambled sentences, and regions with a greater response to melodies than to scrambled melodies were identified. In agreement with previous research, inferior frontal areas and ATL sub-regions, bilaterally, were found to prefer sentence-level structure. Similar regions were found to prefer hierarchical structure in general: these areas were more active for melodies than scrambled melodies. Further analysis indicates that inferior frontal, not anterior temporal regions are more active for sentences than melodies, once the response to the corresponding scrambled condition is subtracted out. These preliminary analyses suggest that regions that prefer sentence-structure in the ATL also are recruited during more general hierarchical-structure building. Supported by NIH DC03681.

G81

LINGUISTIC APPROACH TO SYNTACTIC TROUBLES IN STRIATAL DYSFUNCTION: THE MODEL OF HUNTINGTON'S DISEASE AT EARLY STAGE *Sara Sambin[1], Marc Teichmann[1,2], Dominique Sportiche[2,3], Philippe Schlenker[2,3], Anne-Catherine Bachoud-Lévi[1,2,4]; [1]Equipe 1-NPI INSERM U841, Creteil, FRANCE, [2]ENS, Paris, France, [3]UCLA, [4]Henri Mondor Hospital, France* – The nature of language impairment in striatal damage is still unclear, since some authors explain it by co-occurring deficits in non-linguistic functions such as working memory (WM), whereas others propose the striatum to be involved in linguistic rule processing. We investigated the role of WM and of rule application in sentence comprehension deficits in Huntington's disease (HD), by using two syntactic rules that allow to disentangle these two components. WM demand is tested by manipulating surface distance between the name and its determinant in sentences governed by gender agreement, while syntactic operation is held constant (the girl watches the dog that is green and the girl that watches the dog is green). To assess rule application we varied conditions of coreference between a noun and a pronoun (as determined by Principle C of the Binding Theory) while holding WM constant. We contrasted sentences were principle C blocks coreference (He smiled when Paul entered) and sentences that are ambiguous for coreference (When he smiled, Paul entered). Fifteen HD patients at early stage of disease and 15 healthy controls were tested. Results show that patients, like controls, have a preference for coreference in ambiguous sentences; conversely, unlike controls, they accept coreference even when it is blocked by principle C. Increase of WM in gender agreement sentences has no impact on controls' nor patients' performance. We show that WM does not affect patients' ability to process syntax, suggesting sentence comprehension impairment in striatal dysfunction is more likely to rely on linguistic rule deficits.

G82

NEURAL AND TEMPORAL DYNAMICS OF RETRIEVAL AND UNIFICATION IN SENTENCE COMPREHENSION. *Tineke Snijders[1], Theo Vosse[1,2], Giovanni Piantoni[1], Gerard Kempen[2,3], Jos van Berkum[3,1], Karl Magnus Petersson[3,1], Robert Oostenveld[1], Peter Hagoort[1,3]; [1]F.C. Donders Centre for Cognitive Neuroimaging, Radboud University Nijmegen, the Netherlands, [2]University of Leiden, the Netherlands, [3]Max Planck Institute for Psycholinguistics, Nijmegen, the Netherlands* – Sentence comprehension requires the retrieval of single word information from long term memory, and the integration of the individual word information into multi-word representations. Using fMRI, we explored the hypothesis that the left posterior temporal gyrus supports the retrieval of lexical-syntactic information, while the left inferior frontal gyrus contributes to syntactic unification operations (Hagoort, 2005). Twenty-eight subjects read sentences and word sequences containing word-category (noun-verb) ambiguous words at critical positions. Regions contributing to the unification process were hypothesized to show enhanced activation for sentences compared to words, and to display a larger signal for ambiguous than unambiguous items only within the sentence condition. Left inferior frontal gyrus (LIFG) showed exactly this predicted pattern, confirming our hypothesis that LIFG contributes to syntactic unification processes. Left posterior middle temporal gyrus (LpMTG) was activated more for ambiguous than unambiguous conditions (main effect over both sentences and word sequences), as predicted for regions subserving the retrieval of lexical-syntactic information from memory. We conclude that understanding language involves the dynamic interplay between left inferior frontal and left posterior temporal regions. Additionally, to explore the temporal dynamics of the unification process, we ran an MEG study (32 subjects) using the same design as the fMRI experiment. Stronger event-related-fields were elicited for the ambiguous sentence condition 400-700 ms after onset of the disambiguating word (the word following the ambiguous word) over left-frontotemporal regions. This might reflect the selection/unification of the context-relevant interpretation of the ambiguous word. Finally, oscillatory brain responses to the word-category ambiguity will be discussed.

G83

EFFECTS OF PRIOR SYNTACTIC INFORMATION ON THEMATIC ROLE PROCESSING: AN EVENT-RELATED POTENTIALS STUDY IN SPANISH *Clare Stroud[1], Colin Phillips[1]; [1]University of Maryland College Park* – It has been widely assumed that compositional semantics is built on top of syntactic structures. This view has been challenged by recent electrophysiological findings from various labs (Kim & Osterhout, 2005; Kuperberg, 2007; van Herten et al., 2006) that appear to show that semantic composition can proceed independently of syntactic structure. For example, a semantically anomalous but grammatical sentence such as "The meal was devouring…" elicited a P600 (K&O, 2005). Because the P600 is classically elicited by syntactic anomalies, this result has been interpreted as if the processor first analyzed "the meal" as a good theme for "devour", and subsequently determined that the syntax is wrong ("–ing" not "-ed"). It remains unclear, however, whether semantic composition really is substantially independent or whether in this case the syntactic cue arrived later than the relevant semantic information. We present results from a Spanish ERP study that exploits the contrasting distribution of the auxiliary verbs "ser" and "estar" to show that knowledge about upcoming syntactic structures restricts semantic representations to those compatible with that expected structure. Specifically, if semantic composition conforms to syntactic structure, when the auxiliary is "estar" (which is unlikely to be followed by a passive verb) the processor should not consider analyzing the NP as the theme of a passive verb. Results show a P600 when the auxiliary was likely to be followed by a passive verb, but not when a progressive was likely. This suggests that semantic composition does not proceed completely independently of syntactic structure.

G84

GRAMMATICAL DIFFICULTIES IN AUTISM AS REVEALED BY A SENTENCE-PICTURE MATCHING TASK. *Matthew Walenski[1], Stewart Mostofsky[2,3], Jennifer Gidley-Larson[2], Michael Ullman[4]; [1]University of California San Diego, [2]Kennedy Krieger Institute, [3]Johns Hopkins University School of Medicine, [4]Georgetown University* – Although deficits of language and communication are diagnostic of autism, not all aspects of language appear to be equally affected in the disorder. Here we examine syntactic processing in autism with a sentence-picture matching task – the Test of Active and Passive Sentences (TAPS; van der Lely 1996). On this task subjects listen to a sentence and choose the picture (one of four) that is most consistent with the meaning of the sentence. The sentences are either active ("The boy cuts the elephant"), passive ("The elephant is cut by the boy"), a shortened passive sentence ("The elephant is being cut"), or an ambiguous shortened passive sentence ("The elephant is cut", which is ambiguous between a verbal interpretation, "The elephant is being cut" and a grammatically simpler adjectival interpretation, "The elephant is in a state of having-been-cut"). We tested native-English-speaking high functioning children with autism (n=9) and typically-developing control children (n=12). Preliminary results indicate that for the three unambiguous sentence types the children with autism performed worse than the control children (79% vs 92%), consistent with prior claims of syntactic and other grammatical difficulties in autism (e.g., Ullman, 2004; Walenski et al., 2006). For the ambiguous sentences, the controls were split roughly evenly between the verbal interpretation and the adjectival interpretation, while the children with autism appeared to show a stronger preference for the adjectival interpretation. This apparent preference for the less complex structure is also consistent with grammatical difficulties in autism. Additional implications will be discussed.

Perceptual processes: Auditory processing

G85

IMPAIRED TEMPORAL AND PRESERVED SPECTRAL PROCESSING OF SPEECH SOUNDS IN NOISE IN PATIENTS WITH SCHIZOPHRENIA *R. Alison Adcock[1], Heather Warm[3], Arul Thangavel[2], Addie Hearst[3], Melissa Fisher[2,3], Sophia Vinogradov[2,3]; [1]Duke University, [2]University of California, San Francisco, [3]Veterans Affairs Medical Center San Francisco* – Chronic ear disease sometimes causes auditory hallucinations like those of schizophrenia. How much does early sensory processing contribute to development of symptoms? We used psychophysical assessments of spectral and temporal auditory processing to investigate the hypothesis that schizophrenic patients resolve temporal acoustic information poorly. We studied patients with schizophrenia, along with age-matched healthy controls, all with 20dB or less hearing loss. Participants listened to pairs of syllables presented at constant volume over speech-spectrum noise, and then reported what they heard. Noise volume increased or decreased in a three up-one down method. We tested Spectral and Temporal discriminations (respectively: "ba" and "da", or "ba" and "pa") under two conditions. In the High Constraint condition, participants could use predictive rules to improve performance, whereas in Low Constraint they could not. Both groups performed comparably on High and Low Constraint conditions of the Spectral discrimination task, and on the Low Constraint condition of the Temporal discrimination task. However, controls performed significantly better than patients at the High Constraint Temporal discrimination task (Multivariate ANOVA, $F=5.71$, $p = .026$). As performance on Spectral discrimination pairs in the High Constraint condition was not impaired, patients' failure to maintain context cannot alone explain this deficit. These data suggest a failure to use predictive contextual processing to resolve temporal information among individuals with schizophrenia.

G86

THE FUNCTIONAL ORGANIZATION OF HUMAN AUDITORY CORTEX: A META-ANALYSIS OF FMRI STUDIES *Kimmo Alho[1], Teemu Rinne[1], Timothy J. Herron[2], David L. Woods[2,3,4]; [1]University of Helsinki, [2]Human Cognitive Neurophysiology Laboratory, VANCHCS, Martinez, CA, [3]UC Davis, [4]Center for Mind and Brain, UC Davis* – We reviewed 277 functional magnetic resonance imaging (fMRI) studies of human audition and found 81 studies reporting the MNI or Talairach coordinates for auditory-cortex activations related to the processing of pitch (28 studies reporting 124 auditory-cortex loci), timbre (6 studies, 17 loci), spatial location (12 studies, 46 loci), speech (26 studies, 140 loci), human voice (9 studies, 42 loci) or to selective attention (11 studies, 32 loci). We transformed these activation loci into 2D cortical surface coordinates and evaluated the statistical significance of the differences in median 2D and MNI coordinates using permutation testing. We found evidence for separate auditory "what" and "where" pathways, as in each hemisphere, pitch processing was associated with activations near the crossing of Heschl's gyrus (HG) and the superior temporal gyrus (STG), while location processing produced significantly posterior activations in the planum temporale. Speech processing, in turn, elicited activations similar to those produced by voice processing, with both foci located in STG lateral to HG and significantly lateral to activations related to processing of spectral features (pitch or timbre) of non-human sounds. Differences were also found in median locations of attention-related modulations (ARMs) of auditory-cortex activity between studies using speech as attended and unattended stimuli and studies using other sounds, ARMs for speech being located in STG anterior to ARMs for non-speech. Our results indicate that the meta-analysis methods applied here are powerful tools for elucidating the functional organization of human auditory cortex.

G87

SELF-TRIGGERED TONES ELICIT ATTENUATED EARLY AUDITORY EVENT-RELATED POTENTIALS IN HUMANS *Pamela Baess[1], Andreas Widmann[1], Anja Roye[1], Erich Schroeger[1], Thomas Jacobsen[1]; [1]Institute of Psychology I, University of Leipzig, Germany* – Several theoretical concepts address the question how the central nervous system is able to anticipate the sensory consequences of self-generated actions, and thus enables the discrimination between the origin of these consequences as either self-generated or externally-generated. In accordance with these notions, the representations of these sensory consequences of self-generated actions were assumed to be attenuated compared to those of externally-generated actions in different modalities. Previous studies in the auditory domain yielded evidence for attenuated responses of self-generated sounds in contrast to externally generated sounds in the human auditory cortex. The aim of the present study was to examine the time course of processing differences between self-generated sounds and externally generated ones using human electroencephalography recordings. In our paradigm, the subjects were asked to press a button in a self-paced rate of about 1.25 /s which triggered the presentation of a click sound (self-generated motor-auditory condition). In an externally generated auditory-only condition, the click sound sequence of the motor-auditory condition was replayed. To rule out motor activity, an additional motor-only condition was conducted without any sound presentation. Results showed attenuations in early auditory components of the event-related potentials in response to the self-generated sounds starting around 20 ms after stimulus presentation. Thus, the sensory consequences of different origins as either self-generated or externally generated are distinguished at subcortical and initial cortical levels of auditory processing stages. This indicates the far-reaching applications of a forward mechanism to anticipate the consequences of self-generated actions in the human central nervous system.

G88

LOW-SCORING PARTICIPANTS EXHIBITED HIGHER-AMPLITUDE EVENT-RELATED POTENTIALS DURING A SPEECH DISCRIMINATION TASK FOLLOWING ALTERATION OF SLEEP-WAKE CYCLES. *Maria Barnes[1,2], Rachel Waford[2], Natalie Armstrong[1], David Gozal[1], Dennis Molfese[2]; [1]University of Louisville, [2]University of Louisville, Birth Defects Center* – We investigated the effect of sleep restriction on brain activation in adults identified as high-scoring or low-scoring on the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). Studies investigating performance in space show that sleep deprivation impacts cognition (Flynn, 2006). Following overnight polysomnography, 30 individuals' (15 females; aged 30-45 years) sleep cycles were monitored for one week. We studied baseline performance on the RBANS and event-related potentials (ERPs) recorded using a 256-electrode net during a speech discrimination task. Individuals were randomly assigned to one of three sleep groups, and ERPs were recorded at the end of each week for four weeks. We examined differences in their performance on the RBANS and ERPs following experimental sleep alteration. ERP data were analyzed using principal components analysis with subsequent factor loading scores from the 4 factors serving as the dependent variable in a repeated measures analysis of variance. Results indicated Week*Vowel*Electrode*Group ($F=2.363$, $p=0.036$) and Week*Consonant*Vowel*Electrode*RBANS ($F=2.631$, $p=0.029$) interactions at 152ms. At 204 ms, Week*RBANS ($F=4.973$, $p=0.037$) and Electrode*RBANS ($F=3.471$, $p=0.041$) interactions were found. Post-hoc analyses showed significantly higher-amplitude activation in the low-scoring group in left temporal and parietal areas at baseline, reflecting more effortful processing. After alteration of sleep cycles, low-scorers showed increased activation in not only left temporal and parietal areas but also right inferior occipital and prefrontal areas. This indicates more diffuse—less effective—resource recruitment consistent with our previous report of lower-scorers being at increased risk for impairment after alteration in sleep cycles due to lack of cognitive reserve.

G89

MODULATION OF STEADY-STATE RESPONSES DURING CONCURRENT SOUND PERCEPTION: DIRECT RECORDING FROM HUMAN AUDITORY CORTEX *Aurélie Bidet-Caulet[1,2], Catherine Fischer[1,3], Françoise Bauchet[1,4], Julien Besle[1,5], Pierre-Emmanuel Aguera[1], Marie-Hélène Giard[1], Olivier Bertrand[1]; [1]INSERM U821, Lyon, Institut Fédératif des Neurosciences, Lyon, University Lyon 1, Lyon, [2]Helen Wills Neuroscience Institute, University of California, Berkeley, [3]Neurological Hospital, Lyon, [4]MEG Department, Lyon, [5]Cognitive Neuroscience and Schizophrenia Program Nathan S. Kline Institute for Psychiatric Research, Neurological Institute, Columbia University* – In ecological situations, we are often confronted with a mixture of sounds produced by several simultaneously active sources and it is crucial to parse and identify these multiple sources. This acoustic segregation relies on both bottom-up (detection of a clearly isolated sound) and top-down (selection of the relevant information mechanisms). The aim of the present study is to characterize the neural mechanisms underlying the implicit grouping/ segregation of two simultaneous streams and the active selection of one stream. Electrophysiological recordings were carried out in epileptic patients with pharmacologically resistant partial epilepsy, implanted with depth electrodes. We manipulated sound onset asynchrony to induce the segregation/grouping of two concurrent streams. To dissociate the neural activity specifically corresponding to either stream, we used long-duration sounds at different amplitude modulation frequencies. Thus, each stream elicited an evoked steady-state response (SSR) at the same frequency as the amplitude modulation of the sound. First, to study implicit segregation/grouping, patients were presented with the stimuli while they were performing an auditory distracting task. Second, to test the influence of top-down processes on concurrent sound processing, patients had to focus their attention on one of the two streams in order to perform a difficult spatial task. We found that SSR, generated along Heschl's gyri, were enhanced when the two concurrent streams were implicitly grouped into one complex stream and were modulated according to the attention orientation. These results suggest that the representation of concurrent sounds, in the primary auditory cortices, can be modulated by both acoustic and attentional contexts.

G90

NEURAL CORRELATES OF SPEECH-IN-NOISE LEARNING IN THE AUDITORY BRAINSTEM. *Jessica de Boer[1,2], Roger Thornton[1,2]; [1]MRC Institute of Hearing Research, [2]School of Medicine, University of Southampton* – Neural correlates of speech-in-noise learning in the auditory brainstem. Auditory training has been shown to enhance brainstem representations of speech-sounds in noise in children with learning problems, concomitant with improved speech-in-noise performance (Russo et al 2005). In this study, we investigated whether training-induced improvement in speech-in-noise performance involves changes in the activity of the medial olivocochlear bundle (MOCB), which is thought to enhance pre-neural responses to transient signals in background noise. MOCB activity was monitored in normal-hearing adult listeners (n = 16) during a 5-day training regime on a phoneme-in-noise discrimination task. The sounds were taken from a 96-step linear continuum between /bee/ and /dee/, and were delivered monaurally to the right ear in continuous broadband noise (40 dB SL) at a signal to-noise ratio of 10 dB. The results show significant group learning, with great inter-individual variability in initial performance and improvement. Strikingly, MOCB activity measured on the first training day strongly predicted the subsequent amount of learning. Moreover, in listeners that improved significantly, an increase in MOCB activity was observed after training. Correlation analysis showed that MOCB activity did not explain variation in performance between listeners on any training day, but rather reflected an individual listeners' performance relative to a personal optimum. The results indicate an MOCB-mediated listening strategy that facilitates speech-in-noise perception. This listening strategy appears to be flexible and susceptible to training, presumably through changes in descending control of MOCB activity. The findings suggest the possibility of MOCB involvement in impairment and remediation of speech-in-noise processing in the central auditory pathway.

G91

THE BIRTH OF MUSICAL EMOTION : A DEPTH ELECTRODE ERP STUDY IN HUMAN *Delphine Dellacherie[1,2], Micha Pfeuty[3], Dominique Hasboun[4,5,6], Julien Lefèvre[4], Claude Adam[2,4,6], Laurent Hugueville[4], Denis P Schwartz[7], Michel Baulac[2,8], Séverine Samson[1,2]; [1]Neuropsychologie et Cognition Auditive, JE 2497, Université Lille 3, [2]Unité d'Epilepsie, Hôpital de la Pitié Salpêtrière, Paris, [3]CNRS (UMR 5231), [4]Laboratoire de Neurosciences Cognitives et d'Imagerie Cérébrale, LENA, [5]Hôpital de la Pitié Salpêtrière, Paris, [6]Pierre et Marie Curie University, Paris, [7]MEEG Center, Pitié-Salpêtrière Hospital Paris, France, [8]Cortex et Epilepsie, INSERM U739, Faculté de Médecine Pitié* – The role of musical harmony in inducing emotions is very well known. More specifically, major and minor chords lead to happy and sad feelings whereas consonant and dissonant chords produce pleasant and unpleasant experiences. Although several lines of evidence suggest that auditory areas and mesial temporal lobe structures are involved in perceptual and emotional processing of music, the time course of this processing remains largely unknown. To explore the cerebral signature of musical harmony and its relation to emotion, we recorded intracranial event-related potentials to musical chords in epileptic patients during a presurgical evaluation. The stimuli were composed of musical chords in which the mode (major-minor) and the dissonance (consonant-dissonant) were systematically manipulated. The chords were played on two different timbre (organ and piano) and the task consisted of detecting chords presented on a specific timbre. Our results revealed (1) different evoked potentials in response to dissonant as compared to consonant chords in auditory areas : the latency of the N100 being delayed for dissonant chords and (2) different evoked potentials in response to minor as opposed to major chords in the auditory areas as well as in the amygdala. These findings suggest that musical chords associated to different emotional experiences can trigger distinct event-related responses. The time course of the involvement of lateral and medial temporal lobe structures and the role of the amygdala in processing negative emotions will be discussed in relation to the theoretical context of emotion.

G92

AN ELECTROPHYSIOLOGICAL INVESTIGATION OF CONTEXT USE IN INTACT AND DISTORTED SPEECH *Kate Dupuis[1], Natalie Phillips[2], Kathy Pichora-Fuller[1]; [1]University of Toronto at Mississauga, [2]Concordia University* – Kate Dupuis1, Natalie Phillips2, & Kathy Pichora-Fuller1 1Human Communication Laboratory, Department of Psychology, University of Toronto at Mississauga, Mississauga, Ontario 2 Department of Psychology, Center for Research in Human Development, Concordia University, Montréal, Québec Supportive context, such as a highly predictable sentence structure, has been shown to improve spoken language understanding. The use of context has been studied both behaviourally and through use of event-related potentials (ERPs). The N400 component is a negative-going waveform that is related to aspects of contextual/semantic processing. Unpredictable sentence-final words (e.g., She was talking about the stripes) typically elicit a larger N400 than do predictable sentence-final words (e.g., The zebra has black and white stripes). Aydelott and colleagues (2006) showed that degradation of auditory stimuli through low-pass filtering attenuated the N400 response. We used multi-band noise-vocoding, a different form of degradation, to investigate the effect of context and acoustic distortion on sentence intelligibility in eleven young adults. Identification was greater for high context (HC) compared to low context (LC) terminal words in all conditions and was negatively correlated with the level of degradation. N400 amplitude was larger for LC compared to HC sentences across all listening conditions. The N400 response differed between the high and low context conditions in the intact and the most degraded condition but not in the moderately degraded condition. This partially supports Aydelott et al. and suggests that N400 amplitude can be influenced by different types of acoustic distortion.

G93

INTENSITY DISCRIMINATION FOLLOWING BILATERAL LESIONS OF AUDITORY CORTEX *Andrew R. Dykstra[4,1,2,3], Louis D. Braida[3,1,4], Christine K. Koh[2,1,3], Mark Jude Tramo[2,1,3]; [1]Institute for Music and Brain Science, Boston, [2]Massachusetts General Hospital, Boston, [3]Sensory Communication Group, Research Laboratory of Electronics, MIT, Cambridge, [4]Speech and Hearing Bioscience and Technology Program, Harvard-MIT Division of Health Sciences and Technology, Cambridge* – The ability to discriminate small changes in sound intensity, especially evident for normal-hearing listeners under optimal listening conditions, is important for both speech and music perception. Loudness conveys important source properties such as strength, size, location, and, for animate objects, intentionality. The effects of various types of hearing loss on loudness discrimination are well documented, but the effects of cortical lesions on loudness perception remain unclear. We measured pure-tone (1 kHz) intensity discrimination thresholds in a young stroke patient with chronic bilateral infarctions of auditory cortex, clinically normal pure-tone detection thresholds, and markedly elevated frequency discrimination thresholds (Tramo et al., 2002). We hypothesized (1) elevated intensity discrimination thresholds for both monaural and binaural stimulus presentation, (2) a larger deficit when presenting stimuli to the ear (left) contralateral to the larger lesion (right) and (3) larger deficits for quantitative (louder/softer) vs. qualitative (same/different) judgments given analogous results for frequency discrimination reported previously (Tramo et al., 2002). Case A1+'s ability to detect small changes in intensity were significantly impaired relative to age-matched normal controls for both monaural and binaural stimulus presentation as well as for both qualitative and quantitative judgments. There was no effect of ear for monaural stimuli, possibly suggestive of compensatory mechanisms in the left hemisphere. Case A1+ was relatively worse for qualitative judgments, contrasting with the previous study on frequency discrimination. Our results highlight the necessity of in tact cortical stimulus processing in intensity discrimination specifically, as well as perceptual acuity in the auditory domain more generally.

G94

CROSS-MODAL PERCEPTUAL LEARNING OF SPECTRALLY DEGRADED SPEECH *Frank Eisner[1], Carolyn McGettigan[1], Stuart Rosen[2], Andrew Faulkner[2], Sophie K. Scott[1]; [1]Institute of Cognitive Neuroscience, University College London, [2]University College London* – We investigated normal-hearing listeners' ability to learn to understand a speech signal that simulates some aspects of the stimulation received from a cochlear implant. Participants were trained with syntactically simple, spoken sentences that were spectrally degraded by noiseband-vocoding. The sentences were also shifted upwards in frequency in order to simulate a shallow insertion of the electrode array in cochlear implantation, and the ensuing misalignment with cochlear tonotopicity. A control condition consisted of unintelligible stimuli in which the order of bands was inverted in the spectral domain during noiseband-vocoding. During training, participants listened passively to these sentences, and on each trial received visual feedback which could be either a written version of the sentence or a video of the talker who originally produced it. Learning under both feedback conditions was relatively fast: Subjects improved on average by 25% on keyword recognition scores after 100 trials. The control condition produced no significant learning effect with either type of feedback. We further used functional magnetic resonance imaging to investigate which cortical areas may be recruited for learning this type of speech signal. A comparison of degraded and learnable sentences with the unlearnable control stimuli showed activity in the left superior temporal sulcus both during passive listening and receiving feedback. In contrast, the left inferior frontal gyrus was activated only when subjects were receiving feedback in the learnable condition. These results suggest that the inferior frontal gyrus plays an important role in integrating acoustic-phonetic processing with externally provided feedback.

G95

TEMPORAL COUPLING OF THE LEFT AND RIGHT M100: PURE TONE PROCESSING IN CHILDREN WITH AUTISM, UNAFFECTED SIBLINGS AND TYPICALLY DEVELOPING CHILDREN. *Paul T. Fillmore[1], A. Lisette Isenberg[1], M. Anne Spence[1], Nicole M. Gage[1]; [1]University of California, Irvine* – In healthy adults, latency of the auditory-evoked M100 is closely coupled in time (<20ms) in left (LH) and right hemispheres (RH), with LH latency typically slightly later than RH. Though the neural bases of this effect are as yet unclear, it is present for both speech and non-speech sounds. To investigate this temporal coupling in development (both typically and in the presence language disorders, such as autism) we measured hemispheric asymmetries of M100 latency in typically developing children (TD, N=10), children with autism disorder (AD, N=16), and their unaffected siblings (SIB, N=9) in response to sinusoidal tones of varying frequency (250, 500, 1000, 2000Hz). We compared LH and RH M100 latency offset by calculating a laterality index (LI), [2(L-R)/(L+R)], where positive LI values indicate LH>RH, and computing absolute left-right M100 latency differences. Results: All groups (TD, AD, SIB) had RH>LH asymmetries in M100 latency, unlike the typical LH>RH effect seen in adults. TD: LI=-0.0030. Mean absolute LH-RH M100 offset = 10.6ms (SD=7.5, |Range|=0-29ms). SIB: LI=-0.0120. Mean absolute LH-RH offset = 17.1ms (SD=14.7, |Range|=1-62ms). AD: LI=-0.0480. Mean absolute LH-RH offset = 23.9ms (SD=21.3, |Range|=1-95ms). Findings provide evidence that TD children show a relatively tight temporal coupling of LH and RH M100, similar to findings for adults, however with a reversed hemisphere direction. Both AD children and their siblings have a greater LH-RH offset than TD children, with siblings showing a laterality index that is 4-fold that of TD children and AD laterality at 16-fold that of TD children.

G96

THE BENEFICIAL EFFECTS OF NEUROPLASTICITY-BASED COGNITIVE TRAINING IN SCHIZOPHRENIA PERSIST 6 MONTHS BEYOND TRAINING *Melissa Fisher[1,2], Christine Holland[1,2], Karuna Subramaniam[1,2], Michael Merzenich[3], Sophia Vinogradov[1,2]; [1]University of California, San Francisco, [2]San Francisco Veterans Affairs Medical Center, [3]Posit Science Corporation, San Francisco* – We examined the persistence of neurocognitive gains provided by a novel neuroplasticity-based cognitive training program that targets the deficits in schizophrenia. In this randomized controlled trial, schizophrenia subjects are stratified by age, IQ, and symptom severity and randomly assigned to either the active targeted cognitive training (TCT) condition or a computer games (CG) control condition. The TCT condition consists of computerized exercises that first adaptively increase the fidelity of early representations of auditory information, followed by exercises that require the immediate recall and increasingly complex manipulation of this information. Subjects are driven to make progressively more accurate distinctions about the spectro-temporal fine-structure of verbal stimuli, and to incorporate and generalize these improvements in signal salience. We find that, after 40-60 hours of this form of training, and relative to the CG group (N=20), TCT subjects (N=22) show significant improvements on neuropsychological measures of processing speed (p=.04) and verbal working memory (p=.05) (moderate to large effect sizes, d = 0.73 and 0.63), with generalization of improvement into verbal learning (p < .01), memory (p < .01), and problem-solving (p = .02) (large effect sizes, d = 1.05 to 1.27). Preliminary data suggest that these significant neurocognitive gains persist 6 months after cessation of training: notably, the TCT group shows better performance on measures of global and verbal neurocognitive functioning relative to the CG group (moderate to large effect sizes, d = .60 and .81).

G97

A NEURAL NETWORK SENSITIVE TO SPECTRAL ORDER DETERMINES HOW MUCH MUSICAL SOUND ENGAGES THE AUDITORY CORTEX. *Thomas Fritz[1], Derek Ott[1], Karsten Mueller[1], Stefan Koelsch[1,2]; [1]Max Planck Institut for Human Cognitive and Brain Sciences, [2]University of Sussex* – Whether the percept of consonance and dissonance is hardwired in the auditory perceptual pathway, or an effect of late cognitive processing is still an unresolved issue. Here we demonstrate the existence of a perceptual gating mechanism in the auditory domain that is dependent on the degree of dissonance in musical signals and is governed by a neural circuit involving several levels of the auditory pathway and the amygdala. Our findings contribute to the understanding of how the perceptual system in Western adults deals with auditory signal of variable spectral order. They imply a neural mechanism that responds selectively to the degree of dissonance in music, illustrating how several levels of the auditory pathway interact with each other and the amygdala to regulate the engagement of the auditory cortex.

G98

REDUCED FRONTAL LOBE CORTICAL THICKNESS AND P50 SENSORY GATING RATIO *Stephanie Gorman[1,2], Lauren Parks[1,2], Faith Hanlon[1,2], Mollie Monnig[1,2], Robert Thoma[1,2], Gregory Miller[4], Jose Cañive[1]; [1]The University of New Mexico, [2]Mental Illness and Neuroscience Discovery (MIND) Research Network, [3]The University of Illinois at Urbana-Champaign* – Title: Reduced Frontal Lobe Cortical Thickness and P50 Sensory Gating Ratio Authors: Stephanie Gorman, Lauren Parks, Faith M. Hanlon, Mollie Monnig, Robert J. Thoma, Gregory A. Miller, & Jose M. Cañive A deficit in information processing is characteristic of schizophrenia. One means of assessing that deficit is via auditory sensory gating with an event-related brain potential (ERP) paired-click paradigm. As a group, patients with schizophrenia reliably show impaired sensory gating. The neural network supporting successful gating is slowly being identified and is known to include frontal cortex, but the particular feature(s) or region(s) are unclear. It was hypothesized that thinner cortex would reflect disease-related abnormality in schizophrenia and that this frontal lobe abnormality would affect network function and result in more impaired sensory gating. Electroencephalography (EEG) and structural magnetic resonance imaging (sMRI) were used to examine the relationship between sensory gating ratio and frontal-lobe cortical thickness. Ten schizophrenia and five healthy control subjects underwent EEG procedures and received 3D sMRI scans. The ERP P50 for each click in the pair (S1, S2) was identified and ERP latency and amplitude information were recorded for each subject. Gating ratio was computed as the ratio S2/S1. Patients with schizophrenia had thinner left frontal-lobe cortical thickness and higher (more impaired) sensory gating ratio. Using multiple regression, gating ratio was shown to have a significant negative association with both left- and right-hemisphere frontal-lobe thickness, regardless of group membership. These results are broadly consistent with the hypothesis that reduced frontal-lobe cortical thickness would result in impaired sensory gating ratio. That this extended to healthy controls was unexpected. Further research using neuropsychological measures of prefrontal function and a larger sample is warranted.

G99

DIFFERENT TYPES OF CUES TO THE 'BEAT' IN RHYTHM MODULATE MOTOR AREA ACTIVITY *Jessica Grahn[1], James Rowe[1]; [1]MRC Cognition and Brain Sciences Unit* – Rhythm perception activates areas typically associated with movement (premotor cortex (PMC), supplementary motor area (SMA), cerebellum, and basal ganglia). Here we examine how these areas are influenced by different types of cues to the beat in rhythm. Musicians and non-musicians underwent fMRI scanning during perception of rhythms with and without a beat. For half the beat rhythms, the beat was explicitly emphasized with volume accents, and for the other half the beat had to be internally generated in accordance with duration accents in the rhythm. Nonbeat control rhythms were also generated for each condition. Beat rhythms minus nonbeat rhythms activated the putamen. Duration beat (minus duration nonbeat) rhythms compared to volume beat (minus volume nonbeat) rhythms activated bilateral PMC, SMA, STG, cerebellum, and inferior frontal gyri. Functional connectivity analyses showed increased coupling between the putamen and bilateral SMA, PMC, and superior temporal gyri (STG) during beat rhythms. Moreover, the coupling of motor (SMA and left PMC) and auditory (STG) areas was greater during the duration-based beat condition than the volume accented beat condition. Increased connectivity was observed with greater musical experience. A second study compared the volume-accented rhythms with unaccented versions, to test the hypothesis that the interaction between duration and volume beat rhythms in the first experiment was due to internal generation of the beat, not greater temporal complexity in the duration-accented rhythms. Interactions in the same areas were observed between unaccented beat (minus unaccented nonbeat) rhythms compared to volume beat (minus volume nonbeat) rhythms, confirming the hypothesis.

G100

THE CEREBELLAR SUBSYSTEM FOR THE ABSOLUTE PERCEPTION OF TIME *Manon Grube[1], Freya Cooper[1], Jessica Foxton[2], Patrick Chinnery[1], Timothy Griffiths[1]; [1]The Auditory Group, Medical School Newcastle University, UK, [2]INSERM U280, Mental Processes and Brain Activation Laboratory, Lyon* – This study tested the hypotheses that the cerebellum is a necessary substrate for auditory timing analysis, and examined the relative importance of the cerebellum to single interval and higher-order pattern analysis [1-5]. Seven subtests of auditory timing analysis were administered in 34 patients with the genetic disorder spinocerebellar ataxia type 6 and a matched control group. Cerebellar patients exhibited significant impairments for single subsecond intervals of variable and fixed durations as well as within neutral simple pattern context, and a trend for suprasecond durations. Relative interval timing in beneficial context of a simple isochronous pattern, metrical pattern processing and pulse detection in contrast were not significantly different from controls. Correlations between subtests suggest the reliance on one timing mechanism in patients but two in controls. The data support the existence of a cerebellar subsystem that critically subserves absolute but not relative analysis of time and are consistent with recent results from our laboratory based on repetitive transcranial stimulation of the cerebellum. References: 1 Harrington DL et al. 2004. Brain 127(3): 561-74. 2 Ivry RB & Keele SW 1989. Journal Cog Neurosci 1: 136-52. 3 Malapani et al. 1998. NeuroReport 9: 3907-12. 4 Mangels JA et al. 1998. Brain Res Cog Brain Res 7: 15-39. 5 Nichelli P et al. 1996. Neuropsychologia, 34, 863-71.

G101

DEVELOPMENT OF ELECTROPHYSIOLOGICAL RESPONSES TO CHANGES IN PITCH PATTERN BETWEEN 2 AND 4 MONTHS OF AGE *Chao He[1], Laurel Trainor[1]; [1]McMaster University* – Infants are attracted to the pitch patterns of music and to the large intonation contours of infant-directed speech. Our goal was to examine the development of cortical processing of pitch patterns between 2 and 4 months. Previous studies indicate that in response to occasional simple changes in pitch, 2-month-olds show an increase in a frontally-positive slow wave whereas 4-month-olds show a negative response similar to adult mismatch negativity (MMN) at about 200 ms after onset of the deviant notes. In the present study, we tested responses to a change in a pitch pattern (standard: piano tones C5 - F#5; deviant: piano tones F#5 - C5). Adults and 4-month-olds showed an MMN response, but 2-month-olds did not show either a significant MMN response or a positive slow wave response. The MMN in 4-month-olds was smaller and later than that of adults. These results suggests (1) that the slow wave seen to change at 2 months may reflect processing of simple sound features such as pitch, but not complex sound features such as pitch patterning, and (2) that the auditory cortex of 2-month-olds is too immature to support pitch pattern processing. Most models of pitch pattern perception in adults suggest that regions beyond the primary auditory cortex are involved. Our results suggest, however, that 2-month-old infants may processes pitch patterns differently, perhaps making substantial use of subcortical areas.

G102

ATTENTIONAL MODULATION OF THE PERCEPTION OF ILLUSORY VOWELS AND SOUND ONSETS: TWO FMRI STUDIES *Antje Heinrich[1,2], Matthew H. Davis[2], Robert P. Carlyon[2], Ingrid S. Johnsrude[1]; [1]Queen's University, Kingston, Canada, [2]MRC-CBU, Cambridge, UK* – Our first study presented the two formants of a vowel in an alternating pattern, and showed that filling the gaps in each formant with bursts of noise caused the formants to be heard as continuous and the resulting sound as more more vowel-like. When this "Illusion" condition was modified by increasing the Formant-to-Noise Ratio (FNR), the formants were heard as interrupted ("Illusion Break" condition) and less vowel-like. We showed, using fMRI, that activation in Middle Temporal Gyrus (MTG) was greater for Illusion than for Illusion Break stimuli, reflecting the difference in speechlikeness. Conversely, the opposite occurred in primary auditory areas (PAC), a finding attributed to the Illusion Break stimuli containing more perceived sound onsets than the Illusion stimuli. In the follow-up study we investigated whether the neural activation to illusory vowels and sound onsets was modulated by attention. We presented Illusion, Illusion Break, and two types of intact vowels with a differing number of sound onsets to listeners while asking them to direct their attention either to the vowel stimuli or to one of two types of distractors (auditory or visual). Using a sparse-imaging design (Hall et al., 1999) we collected whole-brain echo-planar images from 24 listeners. The data show that activation to intact and illusory vowels in MTG, and to sound onset in PAC, is indeed modulated by attention. Preliminary analyses also indicate that the activation profiles do not differ for intact and illusory vowels in MTG.

G103

CORTICAL PROCESSING OF SPOKEN VOWEL-CONSONANT AND CONSONANT-VOWEL SYLLABLES *Alexis Hervais-Adelman[1], David Ives[1], Roy Patterson[1]; [1]Centre For the Neural Basis of Hearing, University of Cambridge, Cambridge* – Uppenkamp, Johnsrude, Norris, Marslen-Wilson, & Patterson (2006) used fMRI to localize the initial stages of speech specific processing in the auditory system. They contrasted synthetic vowel sounds with acoustically matched nonspeech sounds and demonstrated that regions of the superior temporal gyrus (STG) and the superior temporal sulcus (STS) were more active in the presence of the vowel sounds. The present study uses fMRI to investigate the processing of consonant-vowel (CV) and vowel-consonant (VC) syllables to determine the locus of consonant-processing in the human brain. We used 3 classes of consonant (fricatives, sonorants and stops) combined with 5 canonical English vowels (/a/, /e/, /i/, /o/, /u/), to create CVs and VCs. Vowels, a spectrally matched nonspeech condition, and silent intervals were included as controls. Stimuli were 6.8s strings of 10 pseudo-randomly assorted tokens from one condition. We used a sparse imaging design. Stimuli were presented during a 6.9s silent inter-scan interval (TA: 2.1s, TR: 9s). 14 normally-hearing, right-handed, native English speakers heard 8 stimuli from each condition in a randomised order, in 3 blocks of 72 scans. Similarly to Uppenkamp et al (2006), we found significantly enhanced activity in left STS for vowels over nonspeech. We observed a significant main effect of consonant class on activity along posterior to mid left STG, and a significant interaction between consonant class and syllable type (CV vs VC) in left posterior STS. These results suggest that initial speech-specific processing of auditory signals occurs beyond primary auditory areas, in the left STG and left STS.

G104

MEG EVIDENCE FOR AUDITORY RESTORATION OF FUNDAMENTAL PITCH *William Idsardi[1], Philip Monahan[1], Kevin de Souza[1]; [1]University of Maryland, Linguistics, CNL* – Although pitch has been extensively investigated, many details of the neuro-physiology of pitch perception remain unknown [1]. One striking phenomenon is the restoration of fundamental pitch from a partial series of harmonic overtones. Previous magnetoencephalographic (MEG) studies have shown that M100 (an early, automatic evoked auditory component) latencies for inferred fundamental pitch [2] follow the same response curve as those obtained for pure sinusoidal and sawtooth tones at equivalent pitches [3]. However, this previous research has not held gross spectral properties constant across stimulus materials. The present study corrects these deficiencies, and examines inferred fundamental pitches from 100Hz to 600Hz. The spectral center of gravity was held constant by maintaining two outer harmonics at 1200Hz and 2400Hz. Additional harmonics were added in pairs at 100Hz intervals from 1300 and 2300Hz in to 1800Hz. Because the perceived pitch is equal to the GCD of the series of harmonics, this design generates inferred fundamental pitches of 100, 200, 300, 400 and 600 Hz. The latencies of subjects' M100 responses to pure tones and tone complexes were compared and found to pattern similarly, both following the previously established response curve. This evidence suggests that the auditory system rapidly extracts abstract properties of acoustic signals, such as computing the inferred fundamental pitch from the signal spectrum, within 100ms of stimulus onset. [1] Plack CJ et al. 2005. Pitch: Neural Coding and Perception. [2] Matsuwaki Y et al. 2004. Auris Nasus Larynx 31: 208–211. [3] Roberts TP et al. 2000. J Clinical Neurophys. 17: 114-129.

G105

TEMPORAL COUPLING OF THE LEFT AND RIGHT M100: SPEECH SOUND PROCESSING IN CHILDREN WITH AUTISM DISORDER, THEIR UNAFFECTED SIBLINGS, AND TYPICALLY DEVELOPING CONTROLS *A. Lisette Isenberg[1], Paul Fillmore[1], M. Anne Spence[1], Nicole Gage[1]; [1]University of California, Irvine* – In healthy adults, M100 latency is closely coupled in time (<20ms) in left (LH) and right hemispheres (RH), with LH latency typically peaking slightly later than RH. Although the neural bases remain unknown, it is observed in response to both speech and non-speech sounds. Far less is known about the temporal coupling of M100 in LH and RH in typical development and language disorders, such as autism. We measured M100 latency hemisphere asymmetries in typically developing children (TD, N=9), children with autism disorder (AD, N=15), and their unaffected siblings (SIB, N=8) in response to natural speech tokens: consonant-vowel syllables (CVs) that differed in distinctive features: place of articulation (POA, e.g. /ba/ vs. /da/), voice onset time (VOT, e.g. /ba/ vs. /pa/) or both (e.g. /ba/ vs. /ta/) We compared LH and RH M100 latency offset by calculating a laterality index (LI) ([2(L-R)/(L+R)], thus positive LI values indicate LH>RH, and computing absolute left-right M100 latency differences. Results: TD and SIB had hemisphere asymmetries that differed by VOT cue, with LH>RH LI for +VOT and RH>LH for –VOT. AD asymmetries were all LH>RH. TD mean absolute LH-RH M100 offsets ranged 0-46ms. AD absolute mean offsets ranged 0-98ms. SIB: mean absolute offsets ranged 0-53ms. Findings of hemisphere differences are discussed with respect to neural synchrony in cortical processes underlying speech perception in development.

G106

PERCEPTION OF WITHIN LANGUAGE PHONOLOGICAL CONTRASTS *McNeel Jantzen[1], Amanda Hahn[1]; [1]Western Washington University, Bellingham, WA* – Adult monolingual and bilingual listeners find it difficult to perceive speech sounds not present in their native or first language. Previous work on the perception of non-native phonemic contrasts has shown that speech perception depends upon the phonemic categories of the native or first language (Pallier et al. 2001). More recently, the impact on speech perception of within-language phonological variation has found that speakers' perception of phonemic contrasts in non-native dialects are sensitive to priming effects when discriminating minimal pairs of words (Dufour et al. 2007; Conrey et al. 2005). This study examined the perception of the low back vowel contrast (open back unrounded vowel and the open-mid back rounded vowel) and the high/low front vowel contrast (near-close near-front unrounded vowel and the open front unrounded vowel) by American English native speakers from the Pacific Northwest and portions of the Midwest and Northeast. The low back vowels have undergone a merger in the Pacific Northwest dialect, but not in areas of the Midwest and Northeastern regions of the US (no merger exists for the high/low front contrast in either population). We employed a long lag repetition priming paradigm consisting of both contrasts and a lexical decision task that required subjects to discriminate between words and nonwords. Response times were measured from the onset of each word. Results indicate that subjects where the low back vowel merger exists assimilate contrasting sounds into an existing phonological category; perceiving two distinct words as the same.

G107

THAI LEXICAL TONE PERCEPTION IN NATIVE SPEAKERS OF THAI, CHINESE AND ENGLISH: AN ERP TRAINING STUDY *Edith Kaan[1], Christopher Barkley[2], Mingzhen Bao[1], Ratree Wayland[1]; [1]University of Florida, [2]University of California San Diego* – Tone languages such as Thai and Mandarin Chinese use pitch differences to distinguish lexical meaning. The aim of the present study was to investigate the effects of language background and training on the pre-attentive perception and speaker normalization of lexical tones. Eleven native speakers of Thai, twelve of Mandarin Chinese and twelve of American English (a non-tone language) participated in a behavioral discrimination task and an EEG oddball task, before and after a two-day perceptual categorization training. Multiple tokens of the Thai syllable [kha:] pronounced with a mid-level, high-rising or low-falling tone were employed. Discrimination performance improved after training, especially for the English and Chinese speakers. Low-falling deviants elicited a mismatch negativity (MMN) in all groups. Although the English speakers showed the poorest behavioral performance, their MMN was largest before training, but became smaller and equal to that of the tone language speakers after training. This pattern of results suggests that speakers of a non-tone language are more sensitive to early different in pitch onset – which were more prominent in the low-falling versus mid-level contrast – but that this can be suppressed by training. In addition, all groups showed a late negativity to both the low-falling and high-rising deviants. The negativity to the high-rising deviants was left-lateralized in the English and Chinese speakers, but not in the Thai, suggesting that native speakers differ from non-native speakers with respect to the processing of Thai late pitch contours.

G108

NEURAL ACTIVATION TO ONE'S OWN, FRIEND'S AND STRANGER'S VOICES: AN FMRI STUDY *Sachiko Koyama[1,2], Akira Toyomura[2,1], Tamaki Miyamoto[3], Atsushi Terao[4], Takashi Omori[5], Harumitsu Murohashi[6], Shinya Kuriki[1]; [1]Res. Institute Elect Science Hokkaido University, [2]RISTEX, JST, [3]Graduate School of Med. Hokkaido University, [4]Information Sci. Res. Ctr., Aoyama Gakuin University, [5]Tamagawa University Res. Institute, [6]Graduate School of Education ido University* – Under delayed auditory feedback (DAF) conditions where speech is fedback with a short time delay (ca. 200 ms), speech production is often severely deteriorated in healthy subjects (e.g., stuttering). However when the pitch of the feedback voice is transformed (either upward or downward), the effect is suppressed (e.g., Toyomura and Omori, 2005). This finding suggests neural mechanisms specific to one's own speech sound. To examine this hypothesis, we conducted an fMRI experiment. We morphed digitally recorded voices between (1) subject A and a stranger B, (2) subject's friend C and a stranger D and (3) strangers E and F step by step using speech analysis, modification synthesis system STRAIGHT (Kawahara 1998). Due to bone conduction, the perception of recorded voices is different from "live" voice. Each sound above 1 kHz were decreased by 3 dB and those below 1 kHz were increased by 3 dB (Shuster and Durant, 2003) to make the voice more real to the subjects. Subjects (n=19) listened the morphed voices and were asked to judge a speaker of voices (self, a friend or a stranger) by pushing button during MRI scanning. We classified the imaging data according to subjects' decisions and analyzed as an event-related design using SPM2. As a result broad areas activated including the bilateral prefrontal areas and the right inferior parietal lobule when the subjects judged the voice as their own compared to stranger voices. This result suggests that the neural system works selectively for perception for one's own voice.

G109

NEURAL BASIS OF INTELLIGIBLE SPEECH *Jeong-Sug Kyong[1], Sophie K. Scott[2], Richard J. S. Wise[3], Stuart Rosen[1]; [1]University College London, [2]Institute of Cognitive Neuroscience, University College London, [3]MRC Clinical Sciences Centre, Hammersmith Hospital, London* – In order to look at the neural basis of speech perception, we contrasted intelligible with unintelligible speech using sparsely sampled fMRI. Spectrally rotated speech was used for the unintelligible speech stimuli (Scott et al., 2000). Intelligible speech activated the left temporal areas anterior and posterior to the primary auditory cortices. The posterior activation might be related to sensitivity to complex sounds, a pre-requisite to hear sound as speech. Intelligible speech was coupled with frontal activation, which could explain the information projection of meaningful complex sound from the superior temporal gyrus to the higher cognitive area of the inferior frontal lobe and support the idea that the left inferior frontal gyrus and the superior temporal gyrus mediate normal sentence comprehension. These findings support a parallel, hierarchical model of dual streams in speech processing suggested by Wise et al. (2001), Scott & Johnsrude (2003) and Hickok & Poeppel (2007) in which the ventral stream is assumed to be involved more with sentence-level comprehension tied to the frontal lobe in order to compute the meaning of a sentence.

G110

CHANGES IN FUNCTIONAL ORGANIZATION FOLLOWING NATURALISTIC TRAINING ON COMPLEX AUDITORY CATEGORIES *Robert Leech[1], Lori Holt[2], Joe Devlin[1], Fred Dick[1,3]; [1]Birkbeck, UCL Centre for NeuroImaging, London, [2]Carnegie Mellon University, Pittsburgh, [3]Center for Research in Language, University of California, San Diego* – A cardinal challenge to the auditory system is acquiring complex, context-dependent auditory categories, such as the phonetic categories underlying speech perception. Recent behavioral work (Wade & Holt, 2005) showed that listeners could acquire complex artificial perceptual categories implicitly while playing a video game where characters' identities were toggled to multiple exemplars of linearly or non-linearly separably sound categories. In the current study, we adapted the Wade & Holt (2005) task to fMRI, using rapid sparse sampling to investigate changes in the brain's response to complex categorizable sounds. Scanning took place before and after 5 hours of playing a custom video game, where participants had to either shoot or capture different alien characters.In both pre- and post-training scanning sessions, participants were presented with pictures of different alien characters; one of the sounds associated with that character was presented at the same time. In order to maintain and monitor performance without drawing attention to the auditory stimuli, participants pressed a button whenever they saw an upside-down alien. Half of the trials in each run were category mismatches between sound and picture. We observed training-related changes in temporal, parietal, and frontal regions, with individuals varying considerably in their responses to all classes of auditory stimuli.

G111

SPECIFICITY WITHIN AUDITORY CORTICES FOR NONLINGUISTIC AUDITORY TIMING PATTERNS RELATED TO SPEECH PROCESSING *Daniel A. Lieberman[1], Heesoo Kim[2], Kala Lakshminarayanan[3], Gary H. Glover[4], Paula Tallal[3], John D. E. Gabrieli[1], Nadine Gaab[1,5]; [1]MIT, [2]Helen Wills Neuroscience Institute, University of California at Berkeley, [3]Center for Molecular and Behavioral Neuroscience, Rutgers University, Newark, [4]Stanford University, [5]Children's Hospital Boston, Developmental Medicine Center, Harvard Medical School* – The integration of rapid spectrotemporal auditory cues is essential for speech processing. Accurate perception of certain English syllables requires efficient processing of cues occurring between 20-40ms. We aimed to examine how the auditory cortex responds to rapid timing patterns using nonlinguistic pitch sequences. Twenty subjects listened to a series of three-tone-sequences comprised of two complex tones (100Hz/300Hz) that either varied in pitch (e.g:100Hz-300Hz-100Hz) or did not (e.g:100Hz-100Hz-100Hz). Within each sequence, the ISI between tones was fixed at 5, 20, 50, or 300ms. Participants reproduced sequences manually. Imaging was performed on a 3.0T scanner using a sparse-imaging technique, and conditions were contrasted with a silent baseline. Random-effects analyses revealed bilateral recruitment of heschl's gyrus (HG), planum temporale (PT), and superior temporal gyrus (STG; left>right) in all conditions as compared to baseline. Analyses were performed using anatomically defined regions of interest (ROI) of HG, PT and STG. Significant decrease in activation for the 20ms ISI compared to all other ISIs (5, 50, 300ms) was observed in bilateral HG and left PT. Non-significant differences between 5 and 20ms ISIs were observed in right PT and bilateral STG. These results suggest that HG and left PT may have a more efficient mechanism for processing non-linguistic auditory stimuli within the 20ms time-frame, which is crucial for perception of certain speech syllables. Future studies will examine the neural correlates of this task in dyslexics, as developmental dyslexia has been linked to deficits in processing rapid acoustic cues in linguistic as well as nonlinguistic stimuli.

G112

PRODUCTION WITHOUT PERCEPTION IN TONE-DEAFNESS: A COMBINED PSYCHOPHYSICAL AND DTI STUDY *Psyche Loui[1], Gottfried Schlaug[1]; [1]Harvard Medical School, BIDMC* – People affected by tone-deafness, also known as congenital amusia, have normal speech and hearing, but are impaired in their ability to sing in tune. We tested the hypothesis that tone-deaf individuals might have rudimentary pitch production abilities despite profoundly impaired pitch perception. Tone-deaf listeners were identified based on a psychophysical pitch-discrimination task showing abnormally large thresholds of above one semitone at a center frequency of 500Hz. Pairs of pure tones, forming different small intervals, were presented to tone-deaf and normal control listeners, who reproduced the tones by humming (production task), and then indicated whether the second tone was higher or lower than the first (perception task). Tone-deaf listeners performed at chance for the perception task, and were significantly worse than controls. However, in the production task, tone-deaf individuals were above chance at reproducing pitch directions, with performance being indistinguishable from controls. Spectral analysis showed that while directions of interval production were intact, variability in produced pitches was significantly higher in tone-deaf listeners than in controls. This leads to the common observation that tone-deaf individuals cannot sing in tune. Results implicate dissociated brain mechanisms underlying sound perception and production, suggesting a multiplicity of auditory pathways where pitch information sufficient for intact speech can be obtained separately from pathways necessary for conscious perception. Preliminary Diffusion Tensor Imaging data show abnormalities in white matter tracts connecting superior temporal and inferior frontal gyri (arcuate fasciculus) in tone-deaf individuals, suggesting that abnormal pruning in auditory perception-to-production pathways may be characteristic of this developmental condition.

G113

TWO PRIVILEGED TEMPORAL WINDOWS IN HUMAN AUDITORY CORTEX *Huan Luo[1,2,3], David Poeppel[2,3]; [1]Institute of Biophysics, Chinese Academy of Science, [2]Neuroscience and Cognitive Science Program, University of Maryland College Park, [3]University of Maryland College Park* – Critical information in natural sounds, including vocal communication sounds, occurs at multiple time scales. The two main temporal modulations rates in speech sounds have been found to be at ~20-50 ms and at ~150-300 ms, corresponding to segmental and syllabic rate processing respectively. The neural correlates of such privileged temporal windows in human auditory cortex remain unclear. We recorded MEG responses from 12 subjects listening to nonspeech auditory stimuli with different temporal structures, crafted by concatenating frequency-modulated temporal segments of varied segment duration. We find that listening to non-speech stimuli with matching temporal structure to the speech-relevant rates (~25 ms and ~200 ms) reliably engages phase tracking in the corresponding oscillatory frequencies (gamma band and theta band). In contrast, stimuli with nonmatching temporal structures do not elicit phase tracking in their corresponding oscillatory frequencies. Furthermore, the topology of theta band phase tracking shows rightward lateralization and the gamma band phase tracking occurs bilaterally. The results support the view that there are privileged temporal scales that form the basis for perceptual analysis in hearing, specifically the Asymmetrical Temporal Sampling (AST) model, and reveal a macroscopic-level neural mechanism underlying multi-time resolution processing – the gliding and resetting of intrinsic temporal windows.

G114

NEURAL BASES OF ILLUSORY CONTINUITY IN SPEECH PERCEPTION *Lee M. Miller[1], Christopher W. Bishop[1], Antoine J. Shahin[1]; [1]Center for Mind & Brain, University of California, Davis* – Background noises often completely obscure brief portions of speech, but a listener will hear the speech continuing uninterrupted through the noise. This powerful filling-in illusion, called phonemic restoration or auditory induction, helps maintain robust comprehension in adverse environments. This study identifies the neural networks supporting both the phenomenology of phonemic restoration as well as the unconscious template-matching that supports it. In a rapid event-related fMRI design, subjects with healthy hearing evaluated words with brief noise bursts centered about fricatives. The words were either actually interrupted by the noise or continued through the noise. Subjects indicated whether they perceived each word as being continuous or interrupted. Therefore, each word could be i) actually (acoustically) continuous or interrupted, and independently ii) perceptually continuous or interrupted. We evaluated the BOLD (blood oxygenation level dependent) signal based on whether subjects experienced the illusion (actually interrupted but perceived continuous), correctly perceived interrupted speech, or correctly perceived continuous speech. Regions showing sensitivity to the continuity illusion include left posterior angular gyrus and bilateral superior frontal sulcus. Areas reflecting unconscious repair of signal degradations, with greater activity for interrupted speech, include Broca's area, anterior insula, and pre-supplementary motor area. A control task using phonotactically legal nonwords showed that part of the restoration illusion uses lexical constraints in addition to local phonetic and spectrotemporal cues. This demonstrates how the brain actively repairs degraded sensory inputs to improve intelligibility. Supported by the NIH/NIDCD.

G115

SPEECH PERCEPTION AND THE EFFICIENCY OF INTEGRATING LOW-LEVEL CUES *Mor Nahum[1], Israel Nelken[1,2], Merav Ahissar[1,2]; [1]Interdisciplinary Center for Neural Computation (ICNC), Hebrew University, [2]Hebrew University* – Perceptual discriminations require the use of low-level sensory cues, but low-level cues may not always be optimally used. Different theories diverge in their predictions of whether and when optimality should fail. Ideal Observer models assume that low-level cues are always optimally integrated. In contrast, attention models suggest that optimality fails when discrimination is attentionally demanding. We now tested these predictions by measuring the use of low-level binaural cues for identification and comprehension of speech in noise. Behavioral results were compared to those calculated using an "Ideal Listener" computer simulation. Surprisingly, we found that neither of these predictions fitted the observed pattern of results. When discriminating between phonologically-different words, binaural cues were always used optimally, regardless of task demands. In contrast to this robustness, when discriminating between phonologically-similar words, binaural cues were generally used sub-optimally. Optimal use of binaural cues was achieved only with consistent repetitions of the same binaural configuration and when comprehension was not required. Thus, optimal use of low-level sensory cues is determined by the nature of high-level representations of the stimulus set and not by task demands. We propose that perception optimally uses low-level cues only when these cues are integrated into well-segregated phonemic level representations of the stimuli, as in the case of phonologically-different words. However, when phonological representations of words largely overlap, optimal performance requires direct access to segregated lower-level representations. Our results further suggest that when access to low-level representations is required, it is gradual and at the cost of concurrent comprehension.

G116

RAPID RECOVERY OF BINAURAL LOCALIZATION IN A BILATERAL COCHLEAR IMPLANT RECIPIENT *Elena Nava[1], Davide Bottari[2], Francesca Bonfioli[3], Chiara Abbadessa[3], Millo Achille Beltrame[3], Giovanna Portioli[4], Patrizia Formigoni[4], Giovanni Bianchin[4], Francesco Pavani[1,2]; [1]Centre for Mind/Brain Sciences, University of Trento, Italy, [2]University of Trento, Italy, [3]Rovereto Group for Cochlear Implants, Hospital Santa Maria del Carmine, Rovereto, Italy, [4]Hospital Santa Maria Nuova, Reggio Emilia, Italy* – Cochlear implants represent a unique example for the study of functional plasticity, in which they allow observing the consequences of reafferentation after long-term auditory deprivation. Here we report on changes in auditory localization in two bilateral cochlear implant recipients tested 15 minutes after bilateral activation and in the one-month follow-up. The two patients differed in their deafness onset: P.A. became deaf at the age of 3, S.P. at the age of 39. Their task was to localize sounds presented at 8 different spatial locations around them. They performed the task monaurally (with the first implanted device only) and binaurally (with the two implants). 15 minutes after bilateral activation both patients were better at localizing sounds monaurally (S.P., overall mean error = 57 deg.; P.A., overall mean error = 57 deg.) than binaurally (S.P., overall mean error = 90 deg.; P.A., overall mean error = 65 deg.). After one month, the two patients showed different performances: S.P. (late deafness) decreased his localizing abilities in the monaural hearing condition (overall mean error = 78 deg.), but substantially improved his localizing abilities when performing with two implants, reducing his overall mean error by 70%. On the contrary, P.A. (early deafness) remained stable in his monaural hearing localizing abilities, but did not improve significantly in his binaural hearing condition. These results suggest that recovery of binaural abilities can start shortly after bilateral cochlear implantation, but also suggest a critical role of deafness onset and duration in modulating this recovery phenomenon.

G117

SEMANTIC CONSTRAINTS ON DEGRADED SPEECH: FINE-TUNING THE SPEECH COMPREHENSION NETWORK *Jonas Obleser[1], Sonja A. Kotz[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig* – In speech comprehension auditory decoding and contextual inference are mutually dependent processes, especially in noisy environments. The current study sought to scrutinise how minimal variations in a constraining semantic context [cloze probability, p(cloze)] interact with comprehension of degraded [1-, 4- and 16-band noise-vocoded] German sentences and their respective brain activity (fMRI, N=16). Behaviourally, high p(cloze) (e.g., [he captures the ship] vs. [he awaits the ship]) induced the expected significant improvement in comprehension at intermediate signal quality. The expected increase of activity in the anterolateral STG and STS to increasingly intelligible speech was almost entirely driven by low-p(cloze) sentences. It appeared more constraint and with a peak in mid-STS under high-p(cloze) conditions. Notably, a bilateral fronto-temporal array of posteromedial STG/STS and bilateral inferior frontal gyrus (BA 44) was more activated by low-p(cloze) sentences. Left BA 44 showed more pronounced p(cloze)-differentiation with improving signal quality: The specific involvement in processing low-p(cloze) constructions was observed only under fair intelligibility conditions. Furthermore, individual comprehension scores predicted the bilateral activation along the STS (positive correlation) as well as in bilateral posteromedial STG, and left dorsolateral prefontal activations (BA 9,10; negative correlations, possibly reflecting unsuccessful search and matching). Our results show (i) how successful signal decoding is a necessary precursor to processing steps attributed to semantic computation (IFG), and (ii) in return also how semantic computation offers constraints on processing steps attributed to signal decoding (STS).

G118

INDIVIDUAL DIFFERENCES IN SPEECH PERCEPTION ARE PREDICTED BY THE DISTINCTNESS OF UNDERLYING NEURAL REPRESENTATIONS *Rajeev Raizada[1], Feng-Ming Tsao[2], Huei-Mei Liu[3], Patricia Kuhl[1]; [1]Institute for Learning & Brain Sciences, University of Washington, [2]National Taiwan University, Taipei, [3]National Taiwan Normal University, Taipei* – This study tested the hypothesis that the more distinct a person's neural representations of two stimuli are, the better their behavioural ability to discriminate those stimuli will be. We tested this by presenting the /r/-/l/ phonetic contrast to English and Japanese speakers. These phonemes differ primarily in their third formant, F3, which English speakers can discriminate well, but which Japanese speakers cannot. The F2 dimension does not differentiate /r/ from /l/ in either language. The distinctness of neural representations was quantified by measuring the statistical separability of their spatial fMRI patterns, thus leading to the following prediction: in English speakers, phonemes that differ along the F3 dimension will evoke fMRI patterns that are more separable from each other than do phonemes that differ in F2, whereas in Japanese speakers the fMRI pattern separability of F3 and F2 differences will not differ. We used the information-based fMRI approach of Kriegeskorte et al., PNAS, 2006: the local spatial patterns evoked by the stimulus conditions to be compared, e.g. high-F3 vs. low-F3, were passed as input into a linear SVM, and the SVM's ability to separate the two conditions' fMRI patterns from each other was determined. We found that in right primary auditory cortex the statistical separability of the evoked fMRI patterns strongly predicted the pattern of perceptual discriminability across the English and Japanese subjects. These findings reveal a new link between perception and spatial fMRI patterns, and also a hitherto unknown role played by right auditory cortex in processing speech.

G119

INDEPENDENT COMPONENT ANALYSIS OF THE ODDBALL PARADIGM *Mari-Anne Rosario[1], Hiroko Nakano[2], Chris Ray[1]; [1]Saint Mary's College of California* – We report results on EEG measurements in the visual and auditory oddball paradigm. Independent component analysis (ICA) and standard event related potential (ERP) methods were used to analyze the data. As expected, the ERPs showed a P300 response for both infrequent 'targets' and 'novel' objects/sounds in both modalities. ICA revealed two components that contributed to the P300 responses in the auditory modality: one component distributed in the central parietal region for both targets and novel sounds; and distributed mainly in the right hemisphere region only for the novel sounds. The results suggest an independent process is associated with the hemispheric difference.

G120

AUDITORY ADAPTATION IN THE PERCEPTION OF VOICE GENDER *Stefan R. Schweinberger[1], Christoph Casper[1], Nadine Hautha[1], Jürgen M. Kaufmann[1], Hideki Kawahara[2], Nadine Kloth[1], David Robertson[1], Adrian P. Simpson[3], Romi Zäske[1]; [1]Friedrich-Schiller University, Jena, Germany, [2]Faculty of Systems Engineering, Wakayama University, Japan, [3]Friedrich-Schiller University, Jena, Germany* – Visual after-effects following adaptation to simple stimulus attributes (e.g. motion, colour) have been studied for literally hundreds of years. A striking discovery in the last few years has been that adaptation, a mechanism by which specific neural responses decrease after prolonged stimulation, is also of central importance for human perception of complex visual stimuli, and particularly faces. Utilizing a novel technique of voice morphing, we show (Exp. 1) that adaptation to the gender of voices elicits strong auditory after-effects, such that adaptation to male voices causes subsequent voices to be perceived as more female (and vice versa). At least one minute after adaptation, these auditory adaptation effects in perception of voice gender were still significant, albeit reduced in magnitude. By contrast, cross-modal adaptation effects were completely absent, both when prototypical male or female first names were used as adaptors (Exp. 2), and when adaptors were silent videos of articulating male or female speakers (Exp. 3). Our findings exclude an explanation of the effect in terms of post-perceptual adaptation to gender concepts, and suggest instead that adaptation to voice quality may routinely influence voice perception. This demonstration of a role of adaptation in calibrating properties of high-level representations for auditory stimuli suggests that adaptation is not confined to vision, but is a ubiquitous mechanism in the perception of social information from faces and voices.

G121

ADAPTATION REVEALS MULTIPLE LEVELS OF REPRESENTATION IN AUDITORY STREAM SEGREGATION *Joel Snyder[1], Olivia Carter[2], Erin Hannon[1], Claude Alain[3]; [1]University of Nevada, Las Vegas, [2]Harvard University, [3]Rotman Research Institute* – Listeners perceive 2 streams of tones ("streaming") in alternating patterns of low and high tones with a large frequency separation (Δ*f*), a percept that is further enhanced by more pattern repetitions ("buildup"). However, the same large-Δ*f* sequences reduce streaming for subsequent patterns. Buildup occurs at a level of neural representation with sharp frequency tuning, supporting the theory that streaming is a peripheral phenomenon. Here, we used adaptation to demonstrate that the contextual effect of prior Δ*f* arose from a representation with broad frequency tuning, unlike buildup. Separate adaptation did not occur in a representation of Δ*f* independent of frequency range, suggesting that any frequency-shift detectors undergoing adaptation are also frequency specific. A separate effect of prior perception was observed, dissociating stimulus-related (i.e., Δ*f*) and perception-related (i.e., 1 stream vs. 2 streams) adaptation. Viewing a visual analogue to auditory streaming had no effect on subsequent perception of streaming, suggesting adaptation in auditory-specific brain circuits. These results, along with previous findings on buildup, suggest that processing in at least three levels of auditory neural representation underlies streaming.

G122

ADVANTAGE OF TONAL LANGUAGE SPEAKING ON PITCH PERCEPTION *Emily M. Stanley[1,2], Shalini Narayana[2], Peter Q. Pfordresher[3], Nicole Y. Y. Wicha[1,2]; [1]University of Texas at San Antonio, [2]University of Texas Health Science Center at San Antonio, Research Imaging Center, [3]SUNY Buffalo* – The use of lexical tone in one's native language alters how speakers produce and perceive pitch in language. Moreover, the brains of tone (T) language speakers respond differently than non-tonal (NT) language speakers to perceived lexical tone (Gandour, Wong and Hutchins, 1998). It is unclear, however, whether such differences correlate with differences in pitch perception in non-linguistic contexts, such as music. The current research explores how experience with tone language affects discrimination of non-linguistic pitch and pitch intervals. We analyzed both discrimination accuracy and the timing of corresponding neural processes using event related brain potentials (ERP) comparing Ts and NTs on two tasks – pitch discrimination (PD) and pitch-interval (ID) discrimination. Twenty-five native speakers of Mandarin Chinese or Vietnamese and 25 non-tonal-language speakers, matched by age, musical ability and gender, judged pairs of tones (PD) and pairs of pitch intervals (ID) that either differed or not in pitch while a scalp electroencephalogram was recorded. Overall, Ts were significantly more accurate on both tasks than NTs. Ts were significantly more accurate than NTs in discriminating all pitch differences (PD), ranging from as small as 7 to as large as 200 cents. Interval discrimination was a more difficult task for both groups, Ts were significantly more accurate than NTs at discerning a difference between two pitch intervals when the difference was at least 100 cents or larger. We present parallel ERP data comparing amplitude and latency differences on the P300 and earlier negative potentials between the two groups on each task.

G123

FINE SPATIAL REPRESENTATION OF AUDITORY LOCATION BY AN OCCIPITO-PARIETAL NETWORK *Santani Teng[1], Kevin Hill[1], Lee Miller[1], David Whitney[1]; [1]UC Davis Center for Mind and Brain* – Although the spatial localization of sounds is essential for the navigation and representation of our environment, the cortical representation of auditory space in humans has only recently begun to be described in detail. Various prior neuroimaging experiments have implicated posterior superior temporal gyrus in sound localization. Here, we tested whether occipital regions, traditionally involved in unimodal visual tasks, also carry spatial information about auditory stimuli. In an event-related fMRI study, we presented normal healthy subjects and an early-blind participant with spatial auditory stimuli separated horizontally by up to 20 deg in virtual space. The task (5AFC) was to report via button press the perceived position of each stimulus. Results indicated that regions in the posterior superior temporal gyrus as well as along the occipito-parietal junction were sensitive to the spatial location of the stimuli. Spatially selective activation was also found in occipital cortical areas for both the blind and sighted subjects. These results suggest that occipital cortex may carry a representation of perceived space independent of unimodal processes, such as spatial visual attention.

G124

HEMISPHERIC DIFFERENCES IN MEG RESPONSES TO SHORT TEMPORAL GAPS IN A CONTINUOUS SOUND *Atsuhiko Toyomaki[1], Sachiko Koyama[2,3], Yuko Toyosawa[3], Fumiya Takeuchi[1], Hiroshige Takeichi[4], Shinya Kuriki[2]; [1]Graduate School of Medicine Hokkaido University, [2]Res. Institute Elect Sci. Hokkaido University, [3]RISTEX, JST, [4]RIKEN* – Short temporal gaps in continuous speech sounds play important roles for speech perception: perception of voiceless consonants, (/k/, /p/, /t/), pauses and segments in spoken sentences. Our previous ERP study showed that ERPs for onsets of short temporal gaps differ greatly for different temporal gap durations (8, 16, 32, 64, 128 and 256 ms) (Koyama et al.,2006, a poster presentation at the annual CNS meeting). In order to investigate neural sources for the gap responses, we measured EEG (Cz, T5, T6, the nose-tip reference) and MEG （a 306-channel whole-head MEG system, Elekta Neuromag Oy, Finland) simultaneously using tones (500 Hz) and short temporal gaps (16, 64, 256 ms) embedded in a continuous tone (500 Hz) from nine right-handed adults. The stimuli were presented binaurally (Inter-stimulus interval 2.8-3.2s). Subjects passively heard the sounds. N100/N100m like responses to the gaps was largely reduced compared with N100/N100m to the tones. Clear hemispheric differences were observed for the MEG responses to the gaps. For 64-ms gaps, a single peak was observed in the left hemisphere while a double peak was observed for the right hemisphere. The peak latency for 256ms-gap were shorter than that for 64-ms gap in the left hemisphere while that for 256ms-gap was very similar to that for 64-ms gap (an earlier peak) in the right hemisphere. For the 256-gap, onset N100/N100m was observed for the gap-end (tone onset). The present findings thus suggest that left and right hemispheres process short temporal gaps in a different way.

G125

FINDING THE PITCH OF THE MISSING FUNDAMENTAL IN INFANTS USING EVENT-RELATED POTENTIALS *Laurel Trainor[1,2], Chao He[1]; [1]McMaster University, [2]Rotman Research Institute* – The frequency components of complex sounds are separated on the basilar membrane and processed in tonotopic maps throughout subcortical nuclei and primary auditory cortex. They are eventually integrated, probably in secondary auditory cortex, such that a single tone with a particular timbre is perceived. This integration can be examined with sounds that are missing their fundamental (lowest) component, as this elimination does not change the perceived pitch. Our goal was to examine the development of the ability to hear the pitch of the missing fundamental in infants between 2 and 7 months using EEG recordings. Six standard trials were presented 86% of the time, each consisting of two tones where the fundamental frequency was always present and each frequency component rose from the first to second note (starting note and degree of pitch change differed across the 6 standards). The deviant trial was the same except that the components were chosen so that adults perceived a missing fundamental and a downward pitch change, even though all of the components rose between the two tones of the deviant. Adults, 7-month-olds and 4-month-olds all produced a significant mismatch (MMN) response on the second note of the deviant trials, indicating that the missing fundamental was perceived. This response diminished in amplitude and increased in latency with decreasing age. No discriminative response was seen at 3 months, suggesting that infants may not perceive the pitch of the missing fundamental at a cortical level until 4 months of age.

G126

SPEECH TARGET MODULATES SPEAKING INDUCED SUPPRESSION IN AUDITORY CORTEX *Maria Ventura[1], John Houde[1], Srikantan Nagarajan[1]; [1]University of California, San Francisco* – Previous Magnetic Source Imaging (MSI) studies have demonstrated speaking-induced suppression (SIS) in the auditory cortex during vocalization tasks wherein the M100 response to a subject's own speaking is reduced compared to the response when they hear playback of their speech. The present MSI study investigated the effects of utterance rapidity and complexity on SIS: The greatest difference between speak and listen M100 amplitudes (i.e., most SIS) was found in the simple speech task. As the utterances became more rapid and complex, the difference in SIS was reduced. These findings are consistent with a feedback prediction model of how speech feedback is processed.

G127

SPEECH PROCESSING IN THE ABSENCE OF CATEGORICAL PERCEPTION *Michael Wolmetz[1], David Poeppel[2], Brenda Rapp[1]; [1]Johns Hopkins University, [2]University of Maryland, MD* – We investigated the speech perception of an aphasic individual, DMN, with damage to the posterior aspect of the left temporal lobe. Studying this lesion site allowed us to examine the language functions of a right hemisphere largely acting alone in terms of early acoustic and pre-lexical processes. By examining DMN's identification and discrimination of speech sounds, we sought to determine the extent to which the right hemisphere is able to organize gradient acoustic stimuli into phonemic categories - a process thought to be critical for speech comprehension. We assessed DMN's ability to categorically identify and discriminate members of six CVC word and six matched pseudoword continua. Each continuum consisted of at least eight tokens and varied from a voiced endpoint (e.g. "beach") to an unvoiced endpoint (e.g. "peach"). Our results indicated that DMN did not categorically process segmental information in the context of these tasks, but rather drew on a gradient representation for speech perception, and the degree of gradient structure present was lexically dependent. We further assessed the neural correlates of this gradient representation by collecting functional imaging data of DMN during a phonemic dishabituation paradigm. The implications of non-categorical speech perception for language processing will be discussed.

G128

THE EFFECTS OF RECORDING ENVIRONMENT AND PERCEIVED ALERTNESS ON P50 SENSORY GATING *Carly Yadon[1], Michael Kisley[2], Deana Davalos[1]; [1]Colorado State University, [2]University of Colorado at Colorado Springs* – P50 sensory gating is conceptualized as the brain's ability to prevent sensory overload by filtering out repetitive auditory stimuli. The conditions under which P50 gating is recorded are somewhat varied in published literature and this has been suggested to contribute to the disparity of sensory gating measurements reported between studies. The present study investigated two aspects of P50 recording conditions: watching a muted movie versus a static fixation cross, and fluctuations in participants' level of alertness. Both of these factors may impact sensory gating measures, yet are not central to the task itself (thus they are not usually systematically investigated). Introductory psychology students were assigned to either the movie (n=25) or fixation (n=28) group; both groups completed four blocks of scalp-derived electrophysiological recordings and indicated their arousal/fatigue levels before and after each block. P50 sensory gating was significantly better for the movie group, but neither group showed a change in gating over the four recording blocks. Self-reported fatigue ratings increased significantly over time, but did not differ between groups. Results suggest that P50 sensory gating was fairly impervious to mild to moderate fluctuations in alertness. Similarly, the gating advantage for the movie group did not appear to be due to differences in alertness, but could be attributed to visual distraction. Additional results and interpretations will be presented. Understanding how the P50 complex is affected by environmental conditions is especially important given its frequent application as a clinical index.

G129

ORTHOGRAPHIC AND PHONOLOGICAL CORTICAL PRIMING EFFECTS IN CHILDREN DURING SPOKEN LANGUAGE PROCESSING *Rishi Zaveri[1], Fan Cao[1], Donald Bolger[1], James Booth[1,2]; [1]Northwestern University, Evanston, [2]Evanston Northwestern Healthcare, Evanston* – Priming (repetition suppression) effects were examined in 39 children (9 - 15 years old) during a spelling task in the auditory modality using functional magnetic resonance imaging (fMRI). An orthographic task required participants to determine if two sequentially presented spoken words had the same spelling rime. The prime-target pairs in conflicting trials either had similar orthography but different phonology (O+P-, pint-mint) or similar phonology but different orthography (O-P+, jazz-has). The prime-target pairs in non-conflicting trials had similar orthography and phonology (O+P+, gate-hate) or different orthography and phonology (O-P-, press-list). O+P+ pairs showed greater priming effects (prime-target) than O-P- pairs in bilateral superior temporal gyri and left inferior/middle frontal gyrus presumably reflecting repetition of phonology, and in left fusiform gyrus and right middle occipital gyrus presumably reflecting repeated access of similar orthographic representations. O+P+ pairs also showed greater priming effects than O+P- pairs in left fusiform gyrus due to greater activation for O+P- targets than for O+P+ targets, suggesting that greater orthographic computation is needed when different phonology corresponds to similar spellings. O+P+ pairs also showed greater priming effects than O-P+ pairs in left inferior parietal lobule due to greater activation for O-P+ targets than for O+P+ targets, suggesting that there are greater demands on conversion from phonology to orthography when similar phonology corresponds to different spellings. These results show priming effects in brain regions thought to be involved in phonological processing, orthographic processing and mapping between orthographic and phonological representations for a task that requires spelling judgments to spoken words.

G130

CONCURRENT SOUND SEGREGATION AND RELATED AUDITORY EVOKED POTENTIALS ARE ENHANCED IN MUSICIANS *Benjamin Zendel[1,2], Claude Alain[1,2]; [1]University of Toronto, [2]Rotman Research Institute* – Concurrent sound segregation is thought to involve low level processes that are independent of listeners' attention and experience. The present study examined whether musical training modulates the ability to segregate concurrent auditory objects using scalp recorded auditory evoked potentials (AEPs). Musicians and non-musicians were presented with a harmonic complex. The second harmonic was either tuned or mistuned by 1-16% of its original value. During the active listening condition, participants indicated whether they heard one sound or two sounds. The same stimuli were also presented passively (no response). Both musicians and non-musicians perceived a second auditory object at similar levels of mistuning (2-4%), however musicians were more consistent at identifying concurrent stimuli. The amplitude and latencies of the sensory evoked responses (i.e., N1, N1c, and P2) elicited by sound onset were comparable in both groups. The perception of concurrent auditory objects was paralleled by an object-related negativity (ORN) that was larger and peaked earlier in musician compared to non-musicians. This group difference in ORN was comparable in both active and passive listening, suggesting that it reflects neuro-plastic changes in brain areas related to concurrent sound segregation. The perception of concurrent auditory object was also associated with a P400, which was present only in active trials. The P400 was marginally larger and earlier in musicians compared to non-musicians. Together, behavioral and electrophysiological results suggest that musical training improves concurrent sound segregation, which is paralleled by neuro-plastic changes in the auditory cortex.

G131

EFFECTS OF VOWEL FORMANT EXAGGERATION ON EVENT-RELATED POTENTIAL MEASURES OF SPEECH PERCEPTION *Yang Zhang[1,2], Sharon Miller[1]; [1]University of Minnesota, Minneapolis, [2]Center for Neurobehavioral Development, University of Minnesota, Minneapolis* – Previous behavioral studies have shown that exaggerating the formant structure of speech sounds can facilitate rapid and robust learning of phonetic categories in infants as well as in adults. The present study used event-related potential recordings (64-channel ASA-Lab system, Advanced Neuro Technology, the Netherlands) to investigate the effects of vowel formant exaggeration on neurophysiological measures of speech perception. Twenty adult native English speakers participated in the study. The speech stimuli consisted of three point vowels, /i/, /a/, and /u/, created by using a Klatt formant synthesizer. The formant values were based on infant-directed speech data for the exaggerated form and adult-directed speech data for the non-exaggerated form. For each vowel condition, the exaggerated stimuli and non-exaggerated stimuli were binaurally presented in alternating blocks using EEVOKE software program in a sound-treated booth. Each block had 20 identical sounds presented at 60 dB SL with an interstimulus interval that varied randomly between 900 ms and 1100 ms. Repeated measures ANOVA results showed significant effects in P1, N1 and P2 responses for vowel category and formant exaggeration. In particular, the exaggerated vowels elicited uniformly stronger N1 responses across the subjects and vowel conditions. S-LORETA and MUSIC algorithms were applied for source localization on the grand average data, showing superior temporal activation patterns consistent with the waveform analysis. These results confirmed the significant effects of enriched linguistic exposure in affecting the neural responses, which may facilitate the language learning process.

G132

OBJECT-RELATED NEGATIVITY INDEXES PERCEPTION OF SOUNDS BEYOND THE ECHO THRESHOLD *Benjamin Zobel[1], Lisa D. Sanders[1], Amy S. Joh[2], Rachel E. Keen[2], Richard L. Freyman[1]; [1]University of Massachusetts, Amherst, [2]University of Virginia* – The ability to isolate a single sound source among concurrent sources and reverberant energy is crucial for understanding the auditory world. The precedence effect describes an experimental finding that when listeners are presented with identical sounds from two locations with a short onset asynchrony, they report hearing a single source with a location dominated by the lead sound. Single cell recordings in multiple animal models indicate that low-level mechanisms contribute to the precedence effect, yet psychophysical studies in humans provide evidence that top-down cognitive processes influence the perception of simulated echoes. The current study examined the levels of processing and cortical organization involved in the perception of echoes. ERPs were recorded while subjects responded to click pairs of varying onset asynchrony. On trials for which listeners reported hearing the lag sound as a separate source, click pairs elicited a negativity between 100 and 250 ms, previously termed the object-related negativity (ORN). These results indicate that the precedence effect reflects top-down cognitive influence over early neurosensory processing. Additionally, the study provides support for the claim that the ORN, initially reported for sounds perceived as two concurrent pitches, indexes auditory object perception. The effects on the ORN of repeating identical click pairs, a condition that has previously been shown to increase echo thresholds, will also be discussed in the context of listeners forming complex models of room acoustics based on what they hear in a specific setting. This study was supported by NIH DC01625 (REK and RLF) and NIH MH16745 (for ASJ).

Poster Session H

Higher level cognition: Executive functions

H1

ADJUSTMENTS IN ATTENTIONAL CONTROL BY CONGRUENT INFORMATION IN ANTERIOR CINGULATE CORTEX *Esther Aarts[1,2], Ardi Roelofs[1,2]; [1]F.C. Donders Centre for Cognitive Neuroimaging at Radboud University Nijmegen, [2]Nijmegen Institute for Cognition and Information at Radboud University Nijmegen* – According to a dominant theory of attentional control (Miller & Cohen, 2001), adjustments in control are made upon detection of response conflict by the anterior cingulate cortex (ACC). In line with this view, previous research has demonstrated reduced conflict effects in response times and ACC activity to targets after incongruent as compared to congruent trials. It is unclear, however, whether this sequential effect is induced by expected incongruency (Miller & Cohen, 2001), congruency (Gratton et al., 1992), or both. To investigate this, we ran an fMRI study using a Stroop-like task with incongruent and congruent targets following cues predicting with 75% certainty the incongruent or congruent targets or predicting the target condition with 50% certainty. We observed that conflict effects in response times and ACC activity were largest for targets following the 75%-congruent cues. Moreover, there were no conflict effects in the ACC after the 75%-incongruent or uninformative cues. However, in contrast to the conflict-detection view, the sequential effect was not due to low control induced by the 75%-congruent cues because, if anything, ACC activity was largest for these cues. Invalidly cued incongruent targets elicited more activity in the ACC than uninformed incongruent targets, whereas there was no such validity effect for the congruent targets. Taken together, these results suggest that the cues induced specific processing strategies mediated by the ACC. These strategies included a widening of attention following expected congruency and a narrowing following expected incongruency.

H2

ERROR LIKELIHOOD EFFECTS IN ANTERIOR CINGULATE CORTEX MODULATED BY AVERAGE REWARD AND REINFORCEMENT LEARNING *William Alexander[1], Joshua Brown[1]; [1]Indiana University, Bloomington IN* – The anterior cingulate cortex (ACC) is implicated in cognitive control and conflict detection. The error likelihood hypothesis suggests that activity in ACC increases proportionally to the likelihood of error, and has been recently extended to show that ACC is sensitive to the magnitude of the consequence of the predicted error (Brown & Braver, 2007). Nonetheless, previous work suggested that error likelihood effects reach a ceiling as the potential consequences of an error increase, possibly due to reductions in the average reward. We explored this issue by independently manipulating expected value of task responses and error likelihood while controlling for potential error consequences in an incentive change signal task. FMRI results replicate previous findings related to the error likelihood hypothesis and show an interaction between error likelihood effects and expected value. The results show that average reward rates modulate error likelihood effects. These findings agree with interpretations of ACC activity as signaling perception of risk. Further evidence was found to support the hypothesis that dopaminergic reinforcement signals train error likelihood effects in ACC. Specifically, the error effect in substantia nigra was found to correlate negatively with the error likelihood effect in ACC across subjects, and gambling risk taking likelihood correlated negatively with error likelihood effects in substantia nigra. These results are consistent with the assumptions of the error likelihood model, namely that pauses in dopamine cell firing due to errors may train error likelihood representations in ACC. Supported by AFOSR FA9550-07-1-0454, A NARSAD Young Investigator Award to JWB, and R03 DA023462-01.

H3

THE EFFICACY OF EXTENDED NEUROFEEDBACK TRAINING ON ENDURING STRUCTURAL AND FUNCTIONAL CHANGES IN THE MIRROR NEURON PATHWAYS OF CHILDREN WITH AUTISM SPECTRUM DISORDER *Oriana Aragon[1,2], Alicia Trigeiro[1], D. Brang[1], E. Hecht[1], L. Edwards[1], S. Carey[1], M. Bacon[1], C. Futagaki[1], D. Suk[1], J Tom[1], C. Birnbaum[1], Jaime Pineda[1]; [1]University of California San Diego, [2]Cal State University San Marcos* – Individuals with Autism Spectrum Disorders (ASD) are characterized by social isolation, lack of eye contact, poor language capacity, trouble imitating others, absence of empathy, and difficulty interpreting intentions. Recent research has shown that the Mirror Neuron System (MNS) plays an active role in these behaviors. Therefore when people with ASD have difficulty with these tasks it is argued to be at least in part due to a deficiency in their MNS. Neural structural and electrophysiological differences are further evidence of a deficient MNS in people with ASD. There are claims as to the efficacy of long term Neurofeedback Training (NFT) in treating symptoms of ASD by reengaging the MNS and its related behaviors; however there are no rigorous empirical studies to support these claims. We conducted a 10 week pilot study to test the efficacy of NFT. In this double blind study, 19 participants with high functioning autism were randomly assigned to receive NFT or to receive a placebo NFT. Post training the experimental group successfully learned to control the power of their Mu rhythms, and showed Mu Suppression Indices that resembled those of typically developed children, whereas they were clearly deficient before the training. The Test of Variable Attention showed a 70% improvement in the ability to maintain attention in the experimental group. Scores on a parental questionnaire showed encouraging changes in the experimental group's speech and language dimension; however the scores showed negative changes in their sensory and cognitive dimension. No trends emerged concerning participants' ability to imitate.

H4

OVERCOMING CONFLICT: IS GOAL ACTIVATION SUFFICIENT? *Mary Askren[1], Cindy Lustig[1]; [1]University of Michigan* – Conflict may arise either from incompatible abstract goals (e.g., review this paper or prepare for my class?) or from stimuli that provoke strong incorrect responses (e.g., writing the date on January 1). By some accounts of conflict resolution (Miller & Cohen, 2001), activating the correct goal obviates stimulus-driven conflict. To test this hypothesis, we compared performance across task-switching procedures that varied in the degree to which their stimuli engendered Stroop-like conflict. The effects of goal incompatibility were measured by comparing trials on which both task rules would lead to the same response (compatible) versus those in which the two rules led to opposite responses (incompatible). Our first experiment ($n = 48$) showed that goal incompatibility increased error rates across all stimulus types, reflecting failures to maintain the goal. For correct trials, goal incompatibility only led to slow reaction times when confounded with stimulus-driven conflict. A second experiment compared the performance of young ($n = 32$, mean age = 18.88) and old ($n = 32$, mean age = 71.03) adults. Increased age did not increase the rate of errors (goal lapses) regardless of the degree of stimulus-driven conflict. In contrast, age differences in reaction time were substantially increased when goal incompatibility was paired with stimulus-driven conflict. Taken together, these results suggest that inhibition of incorrect stimulus information plays an important role in conflict resolution, over and above that which can be ascribed to activation of the correct goal. Older age is associated with more pronounced declines in this inhibitory process.

H5

ARCHITECTURE OF COGNITIVE CONTROL IN THE HUMAN PREFRONTAL CORTEX: A VOXEL-BASED LESION MAPPING STUDY IN PATIENTS WITH PREFRONTAL LESIONS. *Carole Azuar[1,2], Emmanuelle Volle, E[1], Serge Kinkingnehun[1,3], Bruno Dubois[1,4], Etienne Koechlin[5], Richard Levy[1,2]; [1]INSERM U610, Paris, [2]Service de Neurologie, Hôpital Saint-Antoine, Paris, [3]IFR 49, SHFJ, Orsay, [4]Fédération de Neurologie, Groupe Hospitalier Pitié-Salpêtrière, Paris, [5]INSERM U742, Université Pierre et Marie Curie, Paris* – The prefrontal cortex is essential for cognitive control, the ability to coordinate thoughts or actions in relation with internal goals. Its functional architecture, however, remains debated. Using brain imaging in humans, E. Koechlin and colleagues (Science, 2003) showed that the lateral prefrontal cortex is organized in a cascade of executive processes, from premotor to anterior prefrontal regions, that control behavior ("the cascade model of cognitive control"). The cognitive control involves three nested levels of processing: sensory, contextual and episodic controls. The aim of this study is to validate this cascade model in brain damaged patients, using a novel clinical-radiological correlation method (AnaCOM) based on the principles of the voxel-based lesion mapping. The AnaCOM method allows to build cluster-by-cluster statistical maps of anatomo-clinical correlations, showing areas that are significantly associated with a given deficit in the chosen behavioral tasks. This novel approach to clinical-radiological correlation is complementary to functional imaging techniques, showing the functional weight of a given prefrontal region for a specific control function. This method has been applied in 30 patients with focal prefrontal lesions performing the three behavioral conditions described in Koechlin et al. (2003). According to the cascade model of cognitive control, the statistical maps showed that sensory control is subserved by lateral premotor regions, and that contextual and episodic controls are subserved by rostral prefrontal regions. By providing data that converge with those of functional imaging studies, these preliminary results support the cascade model of cognitive control.

H6

THE EFFECT OF BILINGUALISM ON COGNITIVE CONTROL IN THE STROOP COLOUR-WORD TASK IN LATE PROFICIENT BILINGUALS: ERP STUDY *Gjurgjica Badzakova-Trajkov[1], Karen E. Waldie[1], Ian J. Kirk[1], Branka Milivojevic[1]; [1]Centre for Cognitive Neuroscience, The University of Auckland, Auckland* – High-density electroencephalogram (EEG) was used to record visual-evoked potentials from 12 Macedonian-English (M-E) bilinguals, 12 German-English (G-E) bilinguals and 16 English monolinguals while performing a manual version of the traditional Stroop colour-word task in order to investigate the effects of bilingualism on the time course and properties of the neural activation underlying the Stroop effect. Bilinguals performed the task in both their first (L1) and second (L2) language. No differences were observed in reaction time or accuracy data between the groups or languages. The Stroop interference effect was investigated at the event-related potential (ERP) level using the incongruent-congruent condition comparison. A temporal shift around the N400 time window was observed in the difference waveform for this comparison between the groups, with bilinguals displaying delayed latencies for both languages. An amplitude difference between the incongruent and congruent condition for monolinguals and G-E bilinguals in L1 was observed across a significant number of electrodes over frontal and central sites. In contrast, this amplitude difference was observed in fewer electrodes over frontal and central sites for M-E bilinguals in both their languages and for G-E bilinguals in L2. This may be taken to reflect a reduced interference effect for M-E bilinguals in both their languages and for G-E bilinguals in L2. Overall, the results show that bilingualism may cause subtle yet measurable changes in the way we process attentional tasks, such as the Stroop task. However, these changes may be restricted to one language or both, depending on the bilinguals' language background.

H7

DISSOCIATIONS AMONG VERBAL INTERFERENCE TASKS: UNDERDETERMINED VS. PREPOTENT COMPETITION *Laura H.F. Barde[1,2], Myrna F. Schwartz[1], Sharon L. Thompson-Schill[2]; [1]Moss Rehabilitation Research Institute, [2]University of Pennsylvania* – Data from neuropsychological case studies suggest a link between semantic short-term memory (sSTM) impairment and deficits in resolving certain forms of competitive interference (Hamilton & Martin, 2007). A possible unifying framework for findings in such patients is the dissociability of two types of interference resolution: sSTM patients may be capable of resolving interference from several weakly activated yet competing representations ("underdetermined" conflict) but unable to resolve interference when an inappropriate representation is "prepotent" (cf., Botvinick et al., 2001). We tested this idea in a case-series study with three patients, each with history of left hemisphere stroke and known STM impairment. Patients BAC, CN, and DU performed four tests that putatively tap resolution of Underdetermined (Category Fluency; Verb Generation; and a variant of the Hayling Sentence Completion task) or Prepotent (a variant of the Monsell Recent Probes task) conflict. sSTM patient CN replicated the pattern described by Hamilton and Martin, showing better resolution of Underdetermined relative to Prepotent conflict. Moreover, this pattern was not specific to sSTM deficit, as phonological STM patient BAC performed similarly to patient CN. In contrast, patient DU showed the opposite dissociation (better resolution of Prepotent conflict than Underdetermined). Lesion overlap analyses revealed both CN and BAC to have similar fronto-parietal lesions, including the superior aspect of BA44, while patient DU had a frontal lesion that extended deep into white matter and also involved anterior temporal regions. These data have implications for characterizations of STM deficit, interference resolution mechanisms, and the functional organization of left prefrontal cortex.

H8

PREFRONTAL CORTEX CUE-RELATED ACTIVITY WHEN PREPARING TO OVERCOME A PREPOTENT RESPONSE *Theresa Becker[1], David Cicero[1], John Kerns[1]; [1]University of Missouri-Columbia* – Both prefrontal cortex (PFC) and anterior cingulate cortex (ACC) activity have been exhibited during cognitive control tasks. However, there has been debate in the literature regarding the specific roles of the PFC and ACC in these tasks. One view is that the PFC exerts control while the ACC monitors response conflict. In contrast, some research has found ACC activity for cues signaling upcoming difficult trials, suggesting that the ACC might also play a role in boosting attention. However, it is possible that ACC cue-related activity might be due to the preparation of multiple responses and therefore the occurrence of response conflict. In the present fast event-related fMRI study, we used a task that does not involve cue-related response conflict, the Preparing to Overcome a Prepotent Response (POP) task, to examine cue and probe-related neural activity in 26 healthy controls. On the POP task, participants exhibited significantly slower performance during the suppression of a prepotent response. At the same time, in fMRI data, participants exhibited PFC but not ACC cue-related activity, with ACC exhibiting activity for high response conflict probes. These results are consistent with previous research suggesting PFC activity when needing to prepare to overcome a prepotent response and ACC activity only during the occurrence of response conflict.

H9

GENERATING AND PREPARING FOR ONE'S OWN TASK GOALS *Sara L Bengtsson[1], John-Dylan Haynes[2], Katsuyuki Sakai[3], Richard E Passingham[4]; [1]Wellcome Trust Center for Neuroimaging, Institute of Neurology, London, [2]Bernstein Center for Computational Neuroscience, Berlin, [3]Graduate School of Medicine, University of Tokyo, Japan, [4]University of Oxford* – In the laboratory the experimenter determines the nature of the task, but in everyday life people set their own task goals. We examined the neural mechanisms, using fMRI, involved in task preparation based on free selection. On each trial we presented a word. Participants had to decide either whether the word had an abstract or concrete meaning (semantic condition), or whether it had two syllables or not (phonological condition). On some trials the participants decided in advance which condition they would perform; on others, they were instructed which condition to perform. We analysed the delay period between the task decision and word presentation. Comparing the free selection task with the instructed task, there was task set activity in the paracingulate cortex and prefrontal area 46. Common to both conditions was activity in the polar cortex, which peaked later than activity in area 46 and the paracingulate cortex. Additionally there was more activity in ventral premotor cortex (PMv) when the participants prepared for the phonological task, and in Broca's area when they prepared for the semantic task. We next examined the correlation of activity between area 46 and PMv, and area 46 and Broca's area. On the free selection task, the correlation was higher between area 46 and PMv when the participants prepared for the phonological task, and between area 46 and Broca's area when they prepared for the semantic task. In conclusion, when people generate their own task goals, activity in area 46 reflects preparation to perform a specific task.

H10

PROSPECTIVE MEMORY AND ROSTRAL PREFRONTAL CORTEX: INVOLVEMENT OF A SYSTEM MEDIATING STIMULUS-ORIENTED AND STIMULUS-INDEPENDENT ATTENDING? *Roland G. Benoit[1], Sam J. Gilbert[1], Chris D. Frith[2,3], Paul W. Burgess[1]; [1]Institute of Cognitive Neuroscience, University College London, [2]Wellcome Department of Imaging Neuroscience & Institute of Neurology, University College London, UK, [3]Niels Bohr project "interacting minds", CFIN, University of Aarhus, Århus, Denmark* – Using fMRI, we investigated whether the oft-reported rostral prefrontal cortex (PFC) activations during prospective memory paradigms (i.e., realization of delayed intentions that are not directly cued by the environment) might reflect the demands that such tasks make for selection between stimulus-oriented (i.e., environmentally prompted) and stimulus-independent (i.e., environmentally decoupled) attending. Using a 2x2 factorial design, we crossed (i) prospective memory vs. ongoing task only, with (ii) stimulus-oriented vs. stimulus-independent attending, across two tasks that differed in stimulus form and background processing requirements. In support of the hypothesis, common regions of activation within rostromedial PFC were revealed by comparing the ongoing task only with the prospective memory condition, and the stimulus-oriented with the stimulus-independent condition. However, activation related to the former contrast extended more superiorly, suggesting a functional gradient along a dorsal-ventral axis within this region. Moreover, the prospective memory compared with the ongoing task only condition recruited left rostrolateral PFC, reflecting the requirement to maintain delayed intentions. Distinct aspects of this region were also transiently activated at transitions between stimulus-oriented and stimulus-independent conditions. These results suggest that some of the rostral prefrontal signal changes previously noted during prospective memory tasks may reflect alterations in demands made upon an attentional system that mediates competition between stimulus-oriented and stimulus-independent processing. However, this is unlikely to provide a complete explanation.

H11

TRAINING AND TRANSFER EFFECTS OF EXECUTIVE FUNCTIONS IN PRESCHOOL CHILDREN *Sissela Bergman[1], Sofia Lindqvist[2], Lisa Thorell[1,2], Gunilla Bohlin[2], Torkel Klingberg[1]; [1]Stockholm Brain Institute, Karolinska Institutet, Sweden, [2]Uppsala University, Sweden* – Executive functions such as working memory and inhibition are central aspects in neurodevelopmental disorders such as ADHD and research on early interventions are greatly needed. This study investigated the possibility of improving working memory capacity or inhibitory function in preschool children with a controlled intervention. A sample of 64 pre-school children aged 4-5 received either computerized training of working memory (n=17), inhibitory functions (n=18), or training on a commercially available game (active control group, n=13). There was also a passive control group (n=16) that only took part in the neuropsychological assessment before and after the training. The training was performed at the pre-school, individually on a daily basis during 5 weeks with a researcher present. The results show that compared to controls, the children receiving working memory training improved significantly on non-trained tests of spatial working memory, verbal memory and attention. The children receiving training of inhibitory functions showed no significant improvements relative to the control groups on any of the tests. In conclusion, this study suggests that working memory training can have significant effects also in children below school age and that this type of cognitive training has the potential to serve an important role in early intervention efforts. The lack of effects in the inhibition group indicate that executive functions differ in how easily that can be trained, alternatively show a need for a different type of intervention for improvement of these functions.

H12

COGNITIVE CONTROL: ITEM SPECIFIC AND RAPID *Chris Blais[1], Evan Risko[2], Silvia Bunge[1]; [1]University of California, Berkeley, [2]University of Waterloo* – A popular index of cognitive control is the proportion congruent effect in the Stroop task where the magnitude of the Stroop effect increases as the proportion of congruent trials increases. Botvinick and colleagues offered an account of this phenomenon in the context of a neurologically inspired computational model. They argued that as the proportion of congruent trials increases the amount of conflict detected by the ACC decreases leading to a reduction in PFC mediated control. Control in this model is global such that conflict leads to an increase in attention to the relevant dimension of the stimulus. This type of account is pervasive in theories of cognitive control. Alternatively, Blais and colleagues have argued that cognitive control operates locally, on individual items. The present investigation assesses these two types of control in the context of the proportion congruent effect. We provide strong neurological and behavioral evidence showing that there is no global control mechanism that operates independently from a local control mechanism acting on specific stimuli. This has important ramifications for the field which has long assumed that a global control mechanism was responsible for the proportion congruent effect. This demonstration that control can operate item-by-item converges well with recent work showing that control can also operate trial-by-trial. We anticipate that the present results will mark the beginning of an important shift in how cognitive control is conceived thus necessitating behavioral, neural, and computational explorations of this more dynamic view of cognitive control.

H13

NOW OR LATER? AN FMRI STUDY OF THE EFFECTS OF ENDOGENOUS OPIOID BLOCKADE ON A DECISION-MAKING NETWORK *Charlotte A. Boettiger[1], Elizabeth A. Kelley[2], Lee J. Altamirano[2], Jennifer M. Mitchell[2], Mark D'Esposito[3], Howard L. Fields[2,4]; [1]Biomedical Research Imaging Center, and Curriculum in Neurobiology, University of North Carolina, Chapel Hill, [2]Ernest Gallo Clinic and Research Center, Emeryville, CA, [3]Helen Wills Neuroscience Institute, and Henry J. Wheeler Brain Imaging Center, University of California, Berkeley, [4]University of California, San Francisco* – We have previously found that distinct brain areas predict individual selection bias in decisions between small immediate ("Now") and larger delayed rewards ("Later"). In addition, we have found that such selection bias can be manipulated by endogenous opioid blockade. To test the hypothesis that blocking endogenous opioid signaling with Naltrexone (NTX) would alter brain activity during decision-making in areas that predict individual choice, we compared fMRI BOLD signal correlated with Now versus Later decision-making after acute administration of NTX (50 mg) or placebo. We tested both abstinent alcoholics (AA) and control subjects (CS) with no history of substance abuse in a randomized two-session crossover design. We defined regions of interest (ROI) as 10mm spheres centered on activation peaks that predict Now vs. Later selection bias (Boettiger et al, 2006). We found that NTX administration was associated with a significant increase in BOLD signal during decision-making in the right lateral orbital gyrus ROI ($p<0.05$), an area in which enhanced activity during decision-making predicts Later bias. An exploratory mapwise analysis identified additional loci in which BOLD signal during decision-making was enhanced (left orbitofrontal cortex, and left inferior temporal gyrus) or reduced (right superior temporal pole) by NTX. Additional analyses identified a rich constellation of cortical sites, including the right lateral orbital gyrus, in which NTX effects on BOLD signal predicted NTX effects on selection bias. Our data are consistent with the dense opioid receptor expression found in frontal and temporal cortices of humans, and indicate possible mechanisms of NTX's therapeutic effects.

H14

NEURAL CORRELATES OF OVERCOMING INTERFERENCE FROM INSTRUCTED AND APPLIED STIMULUS-RESPONSE ASSOCIATIONS *Marcel Brass[1,2], Dorit Wenke[3], Florian Waszak[4]; [1]Ghent University, Belgium, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, [3]Institute of Cognitive Neuroscience, University College London, [4]CNRS and René Descartes University, Paris, France* – One of the major evolutionary progressions of human primates in the motor domain is their ability to use verbal instructions to guide their behaviour. Despite this fundamental role of verbal information for our behavioural regulation, the functional and neural mechanisms underlying the transformation of verbal instructions into efficient behaviour are still poorly understood. To gain deeper insights into the implementation of verbal instructions, we investigated the neural circuits involved in overcoming interference from merely instructed stimulus-response (S-R) mappings and applied S-R mappings. The functional MRI data indicate that overcoming interference from an instructed S-R mapping involves the pre-supplementary motor area (pre-SMA), whereas overcoming interference from an applied S-R mapping involves the ACC, over and above the pre-SMA. These data suggest a functional dissociation between instructed and applied S-R associations. At the same time, they also demonstrate that verbal instructions lead to a sublinguistic representation that shares some functional properties with applied S-R associations.

H15

PRE-STIMULUS ACTIVATION OF THE COGNITIVE CONTROL NETWORK IS ASSOCIATED WITH CORRECT PERFORMANCE IN A STROOP TASK *Juliane Britz[1,2], Christoph Michel[1,2,3]; [1]University of Geneva, Switzerland, [2]Biomedical Imaging Center, University of Geneva, Switzerland, [3]Neurology Clinic, University of Geneva Medical School, Switzerland* – Cognitive control refers to the ability to flexibly coordinate thoughts and actions in order to correctly perform tasks. Especially under conditions of conflict, heightened control is required to perform tasks correctly. Nevertheless, irrespective of conflict, the same physical stimuli can be processed either correctly or erroneously. In the current study, we hypothesized that heightened levels of cognitive control before an event will be associated with correct performance in that trial. Subjects performed a color-word Stroop task while their EEG was recorded from 256 electrodes. Evoked potentials were computed for correct and incorrect trials for a period of -300 to 800 ms; no pre-stimulus baseline correction was performed. At around 100 ms prior to stimulus onset, we found significant differences in both scalp topography and amplitude of the averaged response. Distributed inverse solutions were computed for each time point, and statistical tests revealed significant differences the same period of the scalp potential differences. Significantly increased activation for subsequently correct vs incorrect responses was found in areas of the cognitive control network. It encompassed superior and middle frontal gyrus, anterior, rostral and caudate cingulate cortex and superior parietal cortex bilaterally. The activity was stronger left-lateralized in frontal than parietal areas. The present results indicate that pre-stimulus activity in the cognitive control network leads to correct performance in a high conflict task.

H16

CONFLICT EFFECTS WITHOUT CONFLICT IN MEDIAL PREFRONTAL CORTEX *Joshua Brown[1]; [1]Indiana University, Bloomington, IN* – The error likelihood computational model of anterior cingulate cortex (ACC) (Brown & Braver, 2005) has successfully predicted error likelihood effects, risk prediction effects, and how individual differences in conflict and error likelihood effects vary with trait differences in risk aversion. The same model makes a further prediction that apparent conflict effects in ACC may result in part from an increasing number of response cues, even when the cued responses are not mutually incompatible. The model prediction was tested with a modification of our change-signal task, in which some task conditions required two otherwise mutually incompatible responses to be generated simultaneously. In that case, the two response processes were no longer in conflict with each other. The fMRI results show that simultaneous preparation of multiple responses can lead to the increased ACC activation previously observed as conflict effects, even when no state of response conflict exists in the context of the task instructions. A second control task performed by the same subjects suggests that the increased ACC activation is due to an increasing number of external response cues rather than to an increasing number of internal response processes. The results are consistent with the predictions of the error likelihood computational model as published. Supported by: A NARSAD Young Investigator Award and R03 DA023462-01

H17

ASYMMETRIC TASK SWITCHING COSTS GENERATED BY TASK PRACTICE *Matthew S. Cain[1], Arthur P. Shimamura[1]; [1]University of California, Berkeley* – One common experimental design is to intermix trials of different types using different stimuli or instruction sets. Some tasks, such as the antisaccade task, have large, asymmetric carryover effects from one trial to the next. That is, performance on the current trial is influenced by the task demands of the previous trial. Other paradigms, such as those using arbitrary manual stimulus-response (S-R) mappings, have not shown such carryover effects. While task history and task switching effects generally have been investigated, the differences between tasks that do and do not show carryover effects have been largely unexplored. In this study, we employed two arbitrary S-R mapping tasks of equal difficulty, one in which the color of the stimulus required a button-press response and the other in which the shape of the stimulus was the relevant dimension. Participants were first trained extensively on one of the tasks. Later, they were tested with a mixed task session containing bivalent stimuli where they had to act upon either the practiced rule or the novel rule, based on an auditory cue. In the mixed block, participants were slower overall on the practiced than the novel trials. Asymmetric reaction time task switching costs also emerged, with a greater cost for switching from the novel to the practices task than from the practiced to the novel task, demonstrating that relative levels of practice are a determining factor for the presence or absence of asymmetric switch costs.

H18

DISSOCIATION BETWEEN ORBITO AND DORSOLATERAL/ HIGH MESIAL PREFRONTAL CORTEX IN EXPERIENCE OF REGRET AND ITS INFLUENCE ON DECISION MAKING *Nathalie Camille[1,4], Jerome Sallet[2,4], Pascale Pradat-Diehl[3], Angela Sirigu[4]; [1]McGill University, Montreal Neurological Institute, Montreal, [2]INSERM U846, Center for Stem Cell and Brain Research, Bron, France, [3]Service de Medecine Physique et Readaptation, Hopital de la Salpetriere, Paris, [4]Institut des sciences cognitives, Bron, France* – Adaptive goal-directed behaviour involves detection of the rewards, assessment of what we obtained in this present context and learning to predict future rewards from past experiences in order to prepare and execute goal-directed behaviour. The prefrontal cortex plays a critical role in the processing, but the specific contribution of the different brain regions still is unclear. To answer this crucial question, we tested normal subjects and both patients suffering from orbitofrontal lesion (OFC) and dorsolateral/high mesial (DL/M) lesions in a gambling task. We analyzed the emotional evaluation of what they obtained, their physiological responses and their strategic choice. Our results showed that normal subjects were able to compare what they obtained with what they might have obtained if they had chosen differently and therefore elicited regret. From their emotional experiences of their previous choices, they learned to choose wisely. OFC patients turned out to be unable to compare their gains with the gains of the non-obtained outcome. Therefore, they were unable to elicit regret, stressing the fundamental role of the orbitofrontal region in mediating the experience of regret. From their regret experience, they did not learn and continued to choose incorrectly (Camille et al., Science, 2004). DL/M patients expressed regret but however were unable to take into account the future regret in order to change their decisions on strategies, failing to choose advantageously. This last result provided evidence of the role of the DL/M in the integration of emotion in cognition processes, underling decision making mechanisms and adaptive goal-directed behaviour.

H19

LOSING CONTROL: ANARCHIC HAND SYNDROME AND MIND WANDERING *Jonathan Carriere[1], J. Allan Cheyne[1], Daniel Smilek[1]; [1]University of Waterloo* – We report a method for inducing anarchic hand-like experiences in normal individuals. Anarchic Hand Syndrome (AHS) patients describe the affected hand as "having a mind of its own" when it engages in instrumental activities independently of the intentions of its owner. Patients express feelings of transfer of control to the hand, as well as annoyance directed toward the errant hand. We draw attention to parallels between these experiences and action slips associated with mind wandering. For both AHS and everyday action slips, inappropriate instrumental acts lead to annoyance and are frequently disowned as "unintended." We designed an intermanual conflict task (ICT) with test trials (the presentation of a rare target stimulus) requiring the withholding of a frequent response for one hand and the production of an infrequent response for the other. This sort of task produces errors on test trials that have been related to everyday mind wandering and action slips. Probes immediately following test trials revealed that, following errors, individuals reported feelings of transfer of control and annoyance specific to the errant hand that had failed to withhold a response. Such action slips have been associated with functional activation of ACC, SMA, and lateral PFC. Lesions in these same areas are associated with AHS. We propose that inattention during mind wandering creates a transient dissociation syndrome, divorcing executive control from ongoing action, leading to stimulus-bound behavior similar to that of the more protracted AHS.

H20

THE FEEDBACK-RELATED NEGATIVITY IS SENSITIVE TO THE DELAYED OUTCOME *Yin-Fang Chang[1], Nai-Shing Yen[1,2]; [1]National Chengchi University, Taipei, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei* – Feedback-related negativity (FRN) is a brain potential peak at 250~300ms after feedback. In particular, FRN has been shown to reflect the evaluation of monetary loss and negative feedback. The present study is to examine whether FRN is sensitive to "delayed outcome" or to "immediate loss". The immediate feedback (to win 10 or lose 10 NT dollars) and the delayed outcome (to get 50 at positive-outcome or to lose 50 at negative-outcome condition) were manipulated in this present task. In positive-outcome condition, participants might get delayed-gain only after immediate-loss. In specific, they could get delayed-gain twice in every five immediate-loss. Thus, the outcomes of win and loss trials were 50 dollars. In negative-outcome condition, participants might get delayed-loss only after immediate-gain. In specific, they could get delayed-loss twice in every five immediate-gain. Thus, the outcomes of win and loss trials were -50 dollars. If FRN is sensitive to immediate-loss, FRN will be greater at lose-10-dollar trials in both conditions. However, if the delayed outcome is considered, FRN will be greater at win-10-dollar trials in both conditions. Win-10-dollar is worse than lose-10-dollar is because win-10-dollar cannot provide an opportunity to get extra 50 dollars at positive-outcome condition and might cause extra 50 dollar loss at negative-outcome condition. The main effect of win-loss indicates that FRN is greater at win-10-dollar trials, which suggests that FRN is more sensitive to delayed outcome. Besides, the main effect of condition reveals that FRN is greater at negative-outcome condition than at positive-outcome condition. It might be the influence of framing effect, that is, participants were more sensitive to negative outcomes.

H21

FACIAL EMG REVEALS TOP-DOWN AND BOTTOM-UP EMOTIONAL INTERFERENCE IN AN ADAPTED CONTEXT PROCESSING TASK *Kimberly S. Chiew[1], Timothy Heaven[1], Todd S. Braver[1]; [1]Washington University in St. Louis* – Affective conflict and control may have important parallels to cognitive conflict and control, but these processes have been difficult to quantitatively study with emotionally naturalistic laboratory paradigms. We developed a new paradigm that measures emotional conflict in terms of facial expression latency to and intensity emotional picture probes. The task is an analog of the AX Continuous Performance Task (AX-CPT) that has been widely used to investigate context processing in the service of controlled cognition, in typical and atypical populations. Participants were biased to automatize a high-frequency, emotionally congruent target response (e.g., frown to negative pictures). In two types of interference trials, the automatic facial expression response to the picture valence conflicted with a prior contextual cue ("SMILE" or "FROWN"). A within-subjects manipulation of delay between cue and probe allowed us to examine the impact of preparatory time on controlled emotional processing. In interference trials, expressions were slower to peak and lower in amplitude than in target and control trials. Besides providing a greater characterization of automatic and controlled emotional facial expressions, this study demonstrates that emotional interference effects may occur via emotional incongruency between probe and response ("bottom up" interference), or by context expectancy even when the probe and response are emotionally congruent ("top down" interference). These parallels to observations of facilitation and interference in the cognitive AX-CPT suggest that the present adapted paradigm may be effectively used to characterize affective conflict and control.

H22

DORSAL ANTERIOR CINGULATE ACTIVITY FOR CUES SIGNALING NEED FOR RESPONSE PREPARATION *David Cicero[1], Theresa Becker[1], John Kerns[1]; [1]University of Missouri-Columbia* – The Anterior Cingulate Cortex (ACC) is thought to play a role in cognitive control. However, the specific role of the ACC in cognitive control is still unclear. One hypothesis is that the ACC monitors for response conflict. Consistent with this, some studies with a long cue-probe interval have found that cues signaling a need for greater control do not activate the ACC, with ACC activity occurring only with high conflict probes. However, another hypothesis is that the ACC is involved in boosting attention to task-relevant stimuli. Consistent with this, some research with a short cue-probe interval have found ACC activity for cues signaling a greater need for control. However, it is possible that ACC cue-related activity might reflect ACC response conflict if participants simultaneously prepare multiple responses. The current study examined whether response conflict cue processing would engage the ACC. Participants completed an fMRI task in which they saw a cue (red or green square) that indicated whether they would have to respond quickly (<350 ms) or at normal speed (<2s). Then participants saw an arrow and had to press a response key in the direction of the arrow. fMRI analysis showed that the dorsal ACC was activated as participants saw the cue and responded to the probe. Conversely, the Prefrontal Cortex (PFC) was not activated during either part of the task. These results are consistent with other research (e.g., Cavina-Pretasi et al., 2006) suggesting that ACC cue related activity might be related to preparatory response conflict.

H23

NEGATIVE PRIMING EFFECTS ON VISUAL INFORMATION: PHENOTYPIC LEVEL OF PROCESSING DIFFERENCES DEPENDENT UPON VARYING BRAND IDENTITY *Kimberly Rose Clark[1], Jody Johnson[2], Jared Rossi[2], Christopher Mark Wessinger[2]; [1]Retail Forensics Institute, Lebanon, NH, [2]Cognitive and Brain Sceinces, University of Nevada, Reno, NV* – In many priming studies, information processing is enhanced by presentation of related information just prior to presentation response stimuli. This is known as positive priming. This processing facilitation has been linked to the initial stages of information processing. Negative priming can also occur such that processing of response stimuli is slowed by prior presentation of related material. This slowing of processing has been linked to processing of higher-order, categorical information associated with the task. Utilizing positive and negative priming we investigated categorical processing of brand logos. Since brand logos are often enhanced with a variety of episodic memories as visual stimuli they are effective stimuli that are emotionally charged and require complex processing. Such emotionally enhanced information can act to slow identification, as more cognitive processing is required to generate a categorical comparison. To investigate the effects of multiple presentations of brand logo presentations we employed a modified priming paradigm using forward and backward masking. The stimuli consisted of brand logos for different restaurants and clothing manufacturers. The data indicate that categorization type significantly influences the ability to efficiently process multiple presentations of brand logos. This effect is demonstrated by consistent facilitation or degradation in reaction time depending on the brand logo category. Increased reaction times (slower) were found for well known brand logos, while less known brands resulted in decreased (faster) reaction times. The additional time needed to properly process well known logos suggests that such logos require the involvement of higher order frontal processing regions.

H24

PATTERN CLASSIFICATION OF FMRI DATA TO PREDICT VALUATION FOR PROBABILISTIC AND INTERTEMPORAL OUTCOMES *John A. Clithero[1,2,3], R. McKell Carter[2,3], Scott A. Huettel[2,3,4]; [1]Duke University, Economics, [2]Duke University, Center for Cognitive Neuroscience, [3]Duke University, Brain Imaging and Analysis Center, [4]Duke University* – Economic preferences, or the relative values assigned to different decision options, can be identified, albeit imperfectly, from behavioral data. One core goal of neuroeconomics is to improve the accuracy of preference measures, and thus predictions of choices, by incorporating neural data. Here, we combine functional magnetic resonance imaging (fMRI) with a pattern classification technique (support vector machines, SVM) to predict the character of decisions made by subjects in an economic valuation task. SVM provides access to local patterns of activation, which allows identification of candidate regions that may be involved directly in differences in computation. Our task consisted of two types of trials: decisions about probabilistic gambles and decisions about delayed rewards. These two forms of choice under uncertainty both share common phenomena and evince potential differences in computational requirements. Subjects evaluated a succession of delayed or risky prizes by indicating their current and certainty equivalent, as elicited by an incentive-compatible auction structure. Using SVM, we analyzed data from thirteen different regions of interest that have previously been implicated in decision making. Preliminary results identified a subset of regions whose local pattern of activity, even after main effects of the entire region were excluded, predicted whether a subject was making a decision under risk or under delay. These included posterior parietal cortex, posterior cingulate, and dorsolateral prefrontal cortex, all of which provided significantly above-chance predictions. Additional analyses investigated covert representations of value across both forms of decisions.

H25

AN FMRI STUDY OF HYPNOTIC MOTOR PARALYSIS *Yann Cojan[1], Lakshmi Waber[1], Alain Forster[2], Laurent Rossier[3], Patrik Vuilleumier[1]; [1]LabNic, University of Geneva, [2]Anaesthesiology, HUG, [3]University of Fribourg* – Gruzelier (1998) proposed that the neural bases of hypnotic phenomena involved an unconscious and constant inhibition of motor pathways by fronto-limbic inhibitory processes, as hysteric conversion. Recent brain imaging studies have provided inconclusive data in support of this idea (Halligan 2000, Ward 2003). To investigate motor inhibition during hypnosis, we designed a go/nogo task that distinguished brain activity during both preparation and execution (or inhibition) of simple motor actions, while volunteers were in three possible conditions in a 3T scanner: (i) normal state, (ii) hypnotic paralysis of the left arm, and (iii) simulation of left paralysis. Premotor areas showed equivalent activity during preparation of movements in all the conditions, but hypnosis increased the bold signal in two networks: (i) somatosensory and medial parietal regions for left/paralysed hand and (ii) in visual areas whatever the hand prepared. Hypnotic suggestion also modified activity in two networks normally involved in behavioural inhibition: (i) a right sided network including inferior parietal and inferior frontal cortices was always active under hypnosis and (ii) a left sided network including middle temporal gyrus, inferior parietal and inferior prefrontal areas switched from an inhibitory function to a left hand response under hypnosis. We conclude that hypnosis changes the neural activity in executive frontal networks: hyperactivity of the right prefrontal cortex is responsible for a greater selective attentional and modifies monitoring process. Furthermore, hypnosis changes the task setting and rules are related to the left hand instead of inhibition.

H26

MEDIAL FRONTAL CORTEX DIRECTS ATTENTION ALONG MULTIPLE PATHWAYS TO RESOLVE PERCEPTUAL DECISION DIFFICULTY *Michael W. Cole[1,2,3], Sudhir Pathak[1,2], Walter Schneider[1,3,2]; [1]Center for Neuroscience, University of Pittsburgh, [2]University of Pittsburgh, [3]Center for the Neural Basis of Cognition* – Attention increases both discrimination accuracy of incoming information (Cameron et al., 2002) and the influence of goal-relevant information (Desimone, 1998). However, it remains unclear how these two mechanisms of attention are coordinated in response to the need for cognitive control in humans. We found that both mechanisms originate in a single source via different pathways. Using Granger causality and controlling for motor processing in a perceptual decision-making task, we demonstrate that posterior medial frontal cortex (PMFC; including anterior cingulate and pre-supplementary motor area) directs attention to enhance incoming information (via reticular formation and V1) and amplify goal-relevant information (via dorsolateral prefrontal and visual association cortex). These two pathways are also verified anatomically using diffusion spectrum imaging (DSI), generalizing their innate connectivity beyond our study's particular behavioral context. We conclude that PMFC plays a pivotal role in directing attention via subcortical and cortical pathways modulating early and late perceptual processing.

H27

COCAINE AND EXECUTIVE CONTROL: EVIDENCE FOR A ROLE OF DOPAMINE IN INHIBITING THOUGHTS AND ACTIONS *Lorenza Colzato[1,2], Wery van den Wildenberg[3], Bernhard Hommel[1,2]; [1]Leiden University, Institute for Psychological Research, [2]Leiden Institute for Brain & Cognition, [3]University of Amsterdam* – Chronic use of cocaine is known to impair the functioning of dopaminergic D2 receptors in prefrontal cortex, with negative consequences for cognitive control processes. Increasing evidence suggests that cognitive control is also affected in recreational cocaine consumers. In a set of three studies that were strictly controlled for age, race, gender, level of intelligence, and alcohol consumption, we were able to link recreational use to striatal dopaminergic functioning and deficits in the inhibition of stimulus representations and action plans. First, we found that the spontaneous eyeblink rate, a marker of striatal dopaminergic functioning, is significantly higher in recreational users than in cocaine-free controls. Second, we observed that inhibition of return, a reflexive inhibitory mechanism that delays attention from returning to a previously attended location, is eliminated in recreational users. Third, we found that users and non users are comparable in terms of response execution but users need significantly more time to inhibit responses to stop-signals. Taken together, these observations point to a crucial role of dopaminergic D2-related pathways in the inhibitory control of perception and action.

H28

THE INFLUENCE OF MONOAMINE OXIDASE A GENE PROMOTER VARIATION AND NEGATIVE LIFE EVENTS ON NEURAL ACTIVITY UNDERLYING INHIBITORY CONTROL IN HEALTHY ADULTS *Eliza Congdon[1], Klaus-Peter Lesch[2], R. Todd Constable[3], Turhan Canli[1,4]; [1]Stony Brook University, Stony Brook, NY, [2]Molecular and Clinical Psychobiology, University of Würzburg, Würzburg, [3]Yale MRRC, Yale University, New Haven, [4]Graduate Program in Genetics, Stony Brook University, Stony Brook, NY* – There is evidence that a functional polymorphism in the promoter of the monoamine oxidase A gene (MAOA-uVNTR) interacts with early life stressors to influence an aggressive, antisocial phenotype. Inhibitory control is a major component of aggression, and indeed, recent studies combining genetic and imaging data have provided support for the influence of MAOA-uVNTR on neural circuits underlying not only inhibitory control, but also emotional arousal. However, these studies have used tasks that do not allow for the clear separation of inhibitory control processes, nor have they considered the role of negative life experiences. The present study was therefore undertaken in healthy adults to investigate the influence of MAOA-uVNTR and life stressors, and the interaction between them, on neural activity underlying inhibitory control. Using an event-related fMRI design, we scanned thirty-six healthy adults while performing a Stop-signal task, which allows for the separation of successful from failed inhibition, while controlling for difficulty level. Focusing our analyses on trials of failed inhibition, we found significant differences in activation between MAOA-uVNTR genotype groups in regions involved in inhibitory control and error processing. Examination of the relationship between negative life experiences and activation during inhibitory control between MAOA-uVNTR groups also revealed group differences. These results are in line with previous reports, which suggest that the risk group fails to engage regions necessary for successful task performance and instead engage additional regions as a compensatory response, thereby resulting in increased activation. These results may also aid in understanding the mechanisms of gene by environment interactions.

H29

NEURAL CORRELATES OF DECEPTION DETECTION: A BOLD IMAGING STUDY *Adam Craig[1], Yuliya Komarova[1], Jennifer Vendemia[1], Stacy L. Wood[1]; [1]University of South Carolina* – While deceptive advertising has been shown to engender distrust, negative affect, and engage defensive stereotyping of subsequent advertisements from both the same source and second-party sources (Darke and Ritchie 2007; Schul et al. 2004), little is known about the cognitive system by which deceptive persuasive claims are processed. In the present research, these mechanisms were examined in an advertisement viewing task. College students (N=25) viewed 15 advertisements for new products that varied in their level of believability (as determined by pretesting). Each advertisement was assigned to one of three categories (based on pretesting with N=180 college students from the same population as the subsequent imaging study): "high believability," "moderate believability," and "low believability" in regards to the advertising claims. Low believability claims might include "guaranteed to increase your energy and mental performance throughout the day" as compared to high believability, "wool socks will keep your feet warm." Interspersed between the advertisements were 5 blank screens to prevent carryover effects from one ad to another. Participants were asked to merely focus on the screen during these presentations. The advertisements consisted of a product description and descriptive paragraphs similar to a catalog format. During the session the participants' BOLD activations were recorded for the 4-level block design. Evidence for the processing of deceptive persuasive attempts (particularly in relation to insula and BA 9 activity) will be provided and discussed in relation to traditional consumer behavior literature on the effects of deceptive claims (Darke and Ritchie 2007; Barone et al. 1999, 2004).

H30

DISSOCIABLE EFFECTS OF ACUTE TRYPTOPHAN DEPLETION ON DIFFERENT VARIETIES OF IMPULSIVITY *Molly Crockett[1,2], Luke Clark[1,2], Oliver Robinson[1,2], Trevor Robbins[1,2]; [1]Behavioural and Clinical Neuroscience Institute, University of Cambridge, [2]University of Cambridge* – Serotonin (5-HT) has long been implicated in a range of emotional and behavioural control processes, and impaired 5-HT function has been associated with impulsive behaviour in both animals and clinical populations. However, recent work investigating the role of 5-HT in impulsivity in healthy volunteers has produced conflicting results. In this study, we induced central 5-HT depletion using an acute tryptophan depletion (ATD) procedure in healthy volunteers to investigate the relationship between 5-HT function and "reflection impulsivity," or the tendency to gather information before making a decision. In the reflection impulsivity task (Clark et al., 2006), participants were instructed to gather as much information as they wished before making a decision; gathering more information led to an increased likelihood of a correct decision. Participants gained points for correct decisions and lost points for incorrect decisions. We also assessed the effects of ATD on a separate measure of impulsivity, delay-discounting. Following ATD, participants gathered more information before making a decision, compared to the placebo control drink. The more cautious decision-making style observed following ATD may result from an over-weighting of potential losses compared to potential gains, which would be consistent with recent findings demonstrating that ATD enhances punishment but not reward prediction (Cools et al., 2007), as well as with previous theorizing that central 5-HT carries a prediction error for future punishment but not future reward (Daw et al., 2002). By contrast, ATD did not affect delay discounting, suggesting that manipulations of 5-HT affect only certain forms of impulsivity.

H31

ACTIVATION OF SUPPLEMENTARY MOTOR AREA DURING TASK SWITCHING: AN EVENT RELATED FNIRS INVESTIGATION *Simone Cutini[1], Pietro Scatturin[1], Enrica Menon[1], Patrizia Bisiacchi[1], Luciano Gamberini[1], Marco Zorzi[1], Roberto Dell'Acqua[1]; [1]University of Padova, Padova, Italy* – Introduction: In task switching subjects switch between two tasks that are typically performed on a set of stimuli. Switching between tasks is usually associated with a decrement in performance. It is often assumed that lateral prefrontal cortex (LPFC) is important for switching between rules. However, activation associated with rule switching is less reliably observed in LPFC than in the supplementary motor area (SMA). The LPFC seems to be involved in rule retrieval and maintenance. In contrast to LPFC, the SMA has been consistently engaged during task switching. Aim and hypotheses: The purpose of this study was to investigate task switching performance with functional near infrared spectroscopy (fNIRS) in healthy subjects. We expected to find a stronger activation of SMA in switch compared to repetition trials, while no difference was expected in LPFC. Method: Ten volunteers participated at the experiment. An event related task switching paradigm was used. The ISI was 13 s, and the number of trials was 120. Switch and repetition trials were balanced to prevent frequency effects. The fNIRS instrument was an ISS Imagent, with 20 pairs of channels. Sources and detectors were positioned to record hemodynamic response in LPFC and SMA. Results: Compared to baseline the left motor cortex, bilateral LPFC, SMA and PMd were active. Comparing Switch Vs Repetition trials, only the left SMA and PMd were active. Conclusion: Our results confirm that SMA is tightly involved in task set reconfiguration, while the LPFC seems to be involved in rule retrieval and maintenance.

H32

PHYSICAL ACTIVITY AND BDNF POLYMORPHISMS INTERACT TO MODULATE COGNITIVE PERFORMANCE IN A TASK-SWITCHING PARADIGM *Matthew Davidson[1], John Fossella[2]; [1]University of Massachusetts, Amherst, [2]Mt. Sinai School of Medicine, New York* – There is a growing body of evidence that shows an active lifestyle can lead to numerous health benefits, including improvements in both physiological and psychological health. Cognitive benefits have been found in various domains but appear to be strongest for higher-order cognitive functions, including task-switching abilities (e.g., Kramer et al., 2006). Mechanisms shown to underlie these improvements include changes in brain plasticity as a result of increased neurotrophin synthesis and release. Of particular interest in the current study was Brain Derived Neurotrophic Factor (BDNF), which was identified in animal models (Neeper et al., 1997) and has been shown to increase following physical activity in human adults (Ferris et al., 2007). We predicted that physical activity would improve cognitive abilities and, further, that the extent of this improvement would be modulated by the presence of specific BDNF polymorphisms (val/val vs. val/met or met/met of the val66met polymorphism). Preliminary results with 65 young adults show reductions in task-switching costs as a function of physical activity, with a significantly greater reduction for the participants possessing at least one met polymorphism (val/met and met/met combined). In the control condition these participants show significantly greater switch costs, in-line with other results suggesting relative inefficiencies for these polymorphisms (e.g., Hariri et al., 2003). However, the greater improvement in performance for the met group suggests that physical activity may provide a means for overcoming these inefficiencies, and could serve as an intervention to improve cognitive abilities in people with these polymorphisms.

H33

FLEXIBLE CONTROL OVER INSTRUMENTAL ACTION - ASSOCIATIVE AND NEURAL MECHANISMS *Sanne de Wit[1], Roshan Cools[2], Anthony Dickinson[1], Phil Corlett[1], Paul Fletcher[1]; [1]University of Cambridge, [2]F.C. Donders Centre, The Netherlands* – There are two types of instrumental action: Goal-directed action has the advantage that it is immediately sensitive to our current needs and desires, while habitual action is far less flexible but requires little cognitive effort. To study goal-directed and habitual actions, we developed a task that can be solved using either strategy. We found that a goal-directed strategy is adopted unless the encoding of the goals of one's actions causes response conflict. In the latter case, healthy volunteers were able to switch to a habitual strategy (de Wit et al., 2007). In recent research, we used the discrimination task to investigate the neural systems underlying goal-directed and habitual action. We investigated the role of dopamine in these two types of instrumental behaviour by testing patients with Parkinson's disease whilst either ON or OFF dopaminergic medication. Preliminary analyses suggest that dopaminergic dopaminergic medication promoted habitual control at the expense of goal-directed control over behaviour. In another line of research, we investigated the neural substrates of goal-directed action in healthy volunteers using magnetic resonance imaging, and identified a critical region in the ventromedial prefrontal cortex.

H34

INVOLVEMENT OF PREFRONTAL CORTEX IN LEARNING AND EXECUTING MULTIPLE TASK RULES *Iroise Dumontheil[1,2], Russell Thompson[2], John Duncan[2]; [1]Institute of Cognitive Neurosciences, University College London, [2]Medical Research Council, Cognition and Brain Sciences Unit, Cambridge* – Learning the multiple rules of a new task is closely related to general intelligence (Duncan et al. in press). Both monkey and fMRI studies suggest that new task rules may be coded in part in the prefrontal cortex (PFC) (e.g. Freedman et al Science 2001; Braver et al. 2003). An fMRI study was designed to investigate learning and execution of multi-rule tasks. In the scanner, subjects learned and carried out 12 tasks in turn (involving different stimuli, rules and response keys). Between tasks we manipulated the number of rules specified in task instructions, and within tasks we manipulated the number of rules operative in each trial block. Data were analyzed both during presentation of instructions (new task learning) and during later task execution. A sustained increase in BOLD signal for blocks with more operative rules was found in lateral rostral PFC (similarly to Braver et al. 2003), along with dorsolateral PFC, the intraparietal sulci, premotor cortex and pre-supplementary motor area. Except for anterior PFC, these same regions showed event-related activity for trials within blocks. During the instructions, BOLD signal changes were consistent with those observed during task execution. A sustained component increased gradually as additional task rules were learnt. The results show that new learning of task rules recruits frontal and parietal regions similar to those found during subsequent task execution.

H35

INCREASING RELIANCE ON COGNITIVE CONTROL SYSTEMS FOR WORD RECOGNITION WITH DECLINING STRUCTURAL INTEGRITY OF SPEECH SYSTEMS *Mark Eckert[1], Adam Walczak[1], Jayne Ahlstrom[1], Stewart Denslow[1], Amy Horwitz[1], Judy Dubno[1]; [1]Medical University of South Carolina* – Speech recognition can be demanding for older adults, even those with normal hearing. Age-related declines in speech-related temporal lobe and attention-related frontal lobe systems have been hypothesized to underlie declines in speech recognition, particularly in challenging listening conditions. This study examined age-related BOLD activation changes in 15 normal hearing adults (21-75 years) when they performed a word recognition task that was made challenging by decreasing word intelligibility. Although there were no age-related changes in word recognition, there were age-related changes in middle frontal gyrus (MFG) and anterior cingulate cortex (ACC) activation. Older adults engaged MFG and ACC when words were more intelligible, while younger adults engaged the same regions when words were less intelligible. Across subjects, anterior temporal lobe regions were increasingly responsive with increasing word intelligibility. Declining gray matter volume within these regions significantly predicted left MFG activity, even after controlling for total gray matter volume. These results suggest that age-related structural declines in speech systems lead to the recruitment of frontal regions in relatively easy listening conditions.

H36

CONFLICT AND EXPECTANCY RECRUIT INDEPENDENT COGNITIVE CONTROL RESOURCES *Tobias Egner[1], Caitlyn Lia[2], Christopher Summerfield[3,4]; [1]Cognitive Neurology & Alzheimer's Disease Center, Northwestern University, [2]Ossining Highschool, [3]INSERM, Université Pierre et Marie Currie, [4]Ecole Normale Supérieure* – 'Cognitive control' describes the ability to flexibly adjust one's behavior in the pursuit of internal goals. One well-documented instance of cognitive control is reflected in enhanced attentional performance following a difficult (incongruent) trial in conflict tasks, such as the Stroop protocol ('conflict adaptation effects'). Another well-known example of cognitive control consists of the use of probabilistic information to improve attentional task performance ('expectancy effects'). An important question concerns whether cognitive control constitutes a single 'general resource' for flexible performance adjustment that can be triggered in different ways (that is, by conflict or by expectancy), or whether there exist independent, context-specific cognitive control resources. We adjudicated between these two hypotheses by devising a Stroop task where the task-irrelevant stimulus information (word-meaning) was predictive (with 80% validity) of whether the subsequent stimulus was congruent or incongruent. This allowed us to cross the factors of previous trial congruency (congruent versus incongruent) × previous trial expectancy (expected versus unexpected) × current trial congruency × current trial expectancy, in order to assess whether conflict-driven and expectancy-driven adjustments in performance were interactive or additive in nature. The results revealed that the conflict adaptation effect did not depend on whether the congruency of a current stimulus was expected, and that the expectancy effect did not vary as a function of conflict (congruency) on the previous trial. Instead, previous trial conflict and current trial expectancy produced additive performance benefits, suggesting that conflict- and expectancy-driven effects are mediated by independent cognitive control resources.

H37

IS PERFORMANCE-MONITORING IN OCD MODULATED BY THE SIGNIFICANCE OF AN ERROR? *Tanja Endrass[1], Beate Schürmann[1], Norbert Kathmann[1]; [1]Humboldt-Universität zu Berlin, Germany* – Studies in patients with obsessive-compulsive disorder (OCD) revealed evidence for overactive performance monitoring in these patients. In neuroimaging studies OCD patients show hyperactivity of fronto-medial and striatal brain regions; in ERP studies incorrect responses elicit increased error-related negativity (ERN) amplitudes. Previous research indicated that the ERN amplitude is enhanced by the error significance, e.g. when accuracy is emphasized over speed, or when correct reactions are rewarded. Accordingly, larger ERN amplitudes in OCD patients might express their attempt to respond correctly. The present study aimed to investigate whether performance monitoring in OCD is modulated by the significance of an error. 22 OCD patients and 22 healthy controls performed a modified flanker task in two conditions: one standard condition and a second condition in which committing an error caused a monetary loss. In healthy controls ERN amplitudes were significantly increased in the monetary loss condition compared with the standard condition. OCD patients had significantly larger ERN amplitudes than controls in the standard condition. Furthermore, ERN amplitudes of OCD patients were not modulated by the expectation of a monetary loss. Our results support the view that increased ERN amplitudes in OCD patients are due to a trait-like overactive performance-monitoring system. Importantly, the ERN could not be enhanced with experimentally induced higher error significance. Thus, this over-activity might actually reflect their increased effort to avoid errors.

H38

THE ROLE OF EXECUTIVE AND DEFAULT NETWORKS IN THE RESTING STATE *Jonathan Erez[1], Kalina Christoff[2,3,4]; [1]Cognitive Systems Program, [2]Department of Psychology, [3]Neuroscience Program, [4]Brain Research Centre* – It has been proposed that during rest a “default mode” of mental functioning may emerge, involving loose monitoring of one’s internal emotional and physiological states (Raichle, 2001). A prominent part of the default mode network is the medial prefrontal cortex, also known to become involved when subjects experience anxiety (Simpson et al., 2001) or attend to their internal emotional states (Lane et al., 1997; Ochsner et al. 2004). On the other hand, it has been proposed that complex thought and memory retrieval processes occur spontaneously during rest in the form of mind-wandering - something which is supported by findings of lateral prefrontal, as well medial and lateral temporal activations (e.g., Andreasen et al., 1995; Christoff et al., 2004; Stark et al., 2001). The purpose of the present study was to investigate what determines the extent to which these two types of resting mental state occurs during scanning and to determine whether acclimation to the scanner has an effect on resting thought processes. Subjects were scanned while performing a verb generation task on practiced and unpracticed set of words, as well as while resting. Heart rate was measured as an indicator of acclimatization. Results show a shift in activation from medial PFC during the initial scanning sessions to lateral PFC during the later periods of the experiment. This suggests that resting thought processes are not limited to the “default mode” of brain function and that acclimation to the scanning environment may have an important influence upon the conscious resting state.

H39

SOCIAL CONTEXT AND PREFRONTAL FUNCTION IN PRESCHOOLERS *Kimberly Andrews Espy[1], Sandra Wiebe[1], Tiffany Sheffield[1], Matthew Moehr[1]; [1]University of Nebraska-Lincoln* – There is renewed interest in the impacts of social contexts on neural function. In young school-age children, executive task performance differs in lower SES children (Noble et al., 2005), where the home literacy orientation and preschool attendance amount were related to better working memory. Given the protracted prefrontal development in preschoolers, the impact of the child’s social context might differ. Drawing our measurement work (Wiebe et al., in press) where a single latent factor best modeled lexecutive control (EC) performance, the impact of the social context (Relationship Support, Adverse Stressors, Home Quality) on laboratory-measured EC task performance and on parent-rated, everyday effortful behavior (Interference Control, Impulsive Reactivity, Information Maintenance, Emotional Control) was investigated in a large (N=242), socio-economically diverse sample of children of 3- to 6-year-olds using structural equation modeling. The latent laboratory-measured EC factor was related to the first three dimensions of everyday effortful behavior (λ=.43-.50). Contextual factors were not related directly to laboratory-measured EC (λ=.03-.10), but were to everyday effortful behavior, where Relationship Support was related to Interference Control (λ=.39), Information Maintenance (λ=.39), and Emotional Control (λ=.33); and Adverse Stressors to Information Maintenance (λ=.29). At least in preschool children whose prefrontal systems are rapidly developing, laboratory-measured EC is not isomorphic with everyday effortful behavior in the real world. In fact, effortfully-regulated everyday behavior appears to be the expression of variation in laboratory-measured EC, where this expression depends on the support provided by salient relationships in the child’s social context.

H40

THE HIERARCHICAL ORGANIZATION OF SCRIPTS- EVIDENCE FROM FRONTOTEMPORAL DEMENTIA AND ALZHEIMER ’S DISEASE *Christine Farag[1], Vanessa Troiani[1], Peachie Moore[1], Murray Grossman[1]; [1]University of Pennsylvania* – While often thought to be organized linearly, recent work suggests that scripts are instead organized hierarchically. We assessed the organizational structure of scripts by examining the differential ability of patients with FTD and AD to perceive the hierarchically-organized nature of a script. Pilot work quantified the associative strength of 6 events within each of 22 scripts, allowing us to develop hierarchical tree structures for each script. We identified consecutive pairs of events from the same hierarchical-cluster (WithinHierarchy) and consecutive pairs from two different hierarchical-clusters within the script (DifferentHierarchy). FTD patients (N=26), AD patients (N=8), and elderly controls were presented a script title and two written events, and asked to judge the correctness of ordered events within the script. Relative to elderly controls (93%correct), FTD patients were significantly less accurate (83%correct) and slower in response for all judgments (p<.05) while AD patients were merely slower in response (p<.05). Within FTD, patients were significantly less accurate when presented with DifferentHierarchy pairs (80%correct) than when presented with WithinHierarchy pairs (86%correct) (p<.05). FTD patients demonstrated overall difficulty identifying appropriately sequenced events within scripts, reflecting compromised action sequence processing and impaired executive functioning. Moreover, they displayed differential difficulty with consecutive pairs of events distinguished only by their hierarchical relationship within a script; such results are consistent with a deficit appreciating hierarchically organized material such as scripts. Conversely, AD patients displayed similar performance among various hierarchically organized scripts, reflecting preserved recognition of hierarchically organized material which corresponds to their relatively preserved script processing abilities.

H41

MINDFULNESS MEDITATION IS ASSOCIATED WITH ALTERED RECRUITMENT OF CORTICAL REPRESENTATIONS OF BODY STATE *Norman Farb[1], Zindel Segal[2], Helen Mayberg[3], Jim Bean[4], Deborah McKeon[4], Zainab Fatima[5], Adam Anderson[1]; [1]University of Toronto, [2]University of Toronto and Centre for Addiction and Mental Health, [3]Emory University, [4]St Joseph's Health Centre, University of Toronto, [5]Institute of Medical Science, University of Toronto* – Mindfulness meditation has shown promising effects in reducing the risk of relapse in major depression. In a preliminary fMRI study of self-referential processing, Farb et al. (2007) demonstrated that mindfulness training (MT) improves participants' ability to maintain awareness of the present moment supported by a right lateralized network centered around the viscerosomatic cortices. However, the precise cognitive-affective mechanisms altered by MT are unknown. The present study used fMRI to examine neural changes associated with processing in distinct domains thought to be developed in MT: keeping information out of mind, holding information in mind, and increased body awareness. Tasks tapping these abilities were compared between two groups, one of which had just completed an 8-week course in MT and a wait-listed control group (Novices). The MT group showed task-related differences from Novices in BOLD response. First, MT participants showed increased bilateral insula activity during a breath monitoring task, suggesting altered viscerosomatic recruitment. Second, MT participants showed increased right lateral orbitofrontal activation in a cognitive suppression task, suggesting altered inhibitory control. Third, MT participants showed increased dorsolateral prefrontal cortical activation in a 1-back working memory task, suggesting altered attentional control. These results suggest MT may increase voluntary deployment of attention to enhance access to viscero-somatic representations of the self.

H42

THE N2B AS AN ELECTROPHYSIOLOGICAL MARKER OF MONITORING FOR PERCEIVED ERRORS IN A SEQUENCE LEARNING TASK *Nicola K. Ferdinand[1], Axel Mecklinger[1], Jutta Kray[1]; [1]Saarland University* – An important electrophysiological marker of error monitoring is the error-related negativity (ERN/Ne), a component in the response-locked event-related potential, visible after subjects commit an error. In a recent model, Holroyd and Coles (2002) suggested that the ERN/Ne is caused by a phasic drop in dopamine when an event is evaluated as "worse than expected" and plays an important role during reinforcement learning. In a former sequence learning study (Ferdinand, Mecklinger, & Kray, in press), we found a negativity (the N2b) in response to perceived errors (i.e. deviants inserted into a repeating sequence) showing similar characteristics as the ERN/Ne in reinforcement learning tasks. In two further sequence learning studies, we wanted to explore the functional characteristics of the N2b in more detail. We examined a) whether expectancy changes, induced by successful learning modulate the N2b and b) what kinds of expectancy violations cause an N2b. We found that changes in expectancies are directly reflected in N2b amplitude. When a stimulus appears unexpectedly, an N2b is elicited; when it gets predictable through learning, the N2b is absent and a P3b is elicited instead. Moreover, we found that only those expectancy violations that are relevant for sequence learning elicit an N2b, while other task-relevant violations do not. These results suggest that violations of expectancies that are formed by learning are detected by the error monitoring system as events that are "worse than expected". These perceived errors are reflected in an enhanced N2b and are used to adapt behaviour to current task demands.

H43

AN FMRI STUDY OF COGNITIVE DEMAND AND CONTROL DURING SKILL ACQUISITION *Jon Fincham[1], Qin Yulin[1], Anderson John[1]; [1]Carnegie Mellon University* – The current work explores changes that occur in neural activity as a function of practice during a simple cognitive skill acquisition task that had differential within-subject control demands. Particular focus was given to brain areas involved in cognitive control (anterior cingulate cortex, BA 32/24), problem representation (parietal cortex, BA 40/7), declarative memory retrieval (prefrontal cortex, BA 9/46), visual encoding (fusiform area) and manual execution (primary motor cortex, BA 4). Participants performed two portions of their training within an fMRI scanner, where functional images were acquired using a slow event-related methodology. The first imaging session occurred early in training. The second imaging session occurred after completion of two additional days of behavioral practice. Control was manipulated by presenting either Pure blocks where all rules were computed in a consistent direction, or Mixed blocks where rules were practiced in both directions. Retrieval, representational, visual and manual areas all showed significantly decreased activity after practice, reflecting decreased demands for each of those resources with practice. Anterior cingulate showed a more complex pattern of activity change with a significant Day by Control interaction. Activity in the Mixed condition was greatest early in training and decreased late in training while activity in the Pure condition increased slightly after training. Implications of these results with respect to learning and cognitive control are discussed.

H44

GAMMA OSCILLATORY ACTIVITY AS A MARKER OF CONTEXTUAL PROCESSING OF AUDITORY AND VISUAL PREDICTIVE STIMULI. *Noa Fogelson[1], Frederique Bonnet-Brilhault[1,2], Jeffrey Lewis[1], Mark Kishiyama[1], Robert Knight[1]; [1]The Helen Wills Neuroscience Institute, University California, Berkeley, [2]Inserm, U619, Universite Francois-Rabelais de Tours, CHRU, Hopital Bretonneau, Tours* – We investigated how changes in local context influenced the ability to detect target stimuli. Local context was defined as the occurrence of a short predictive series of stimuli before a delivery of a target event. EEG was recorded in 12 subjects during auditory and visual sessions. Stimuli were presented centrally and consisted of 15% targets (downward facing triangle or 1000 Hz tone) and 85% of equal amounts of three types of standards (triangles facing left, upwards and right or 1500 Hz, 2000 Hz and 2500 Hz tones). Recording blocks consisted of targets preceded by either randomized sequences of standards or by sequences including a predictive sequence. Subjects pressed a button in response to the targets. Event-related time frequency analysis was used to study oscillatory activity in 4 conditions: targets after predictive (predicted target) and non predictive sequences (random target), random preceding standards (standards) and the last most-informative standard of the predicting sequence (predictive sequence). We observed a significant increase in gamma activation (50-80Hz) over posterior sites, in the predictive sequence condition compared to standards, 300-400ms and 600-700ms post-stimulus presentation in the auditory and visual modalities, respectively. A significant gamma increase was also observed in predicted targets compared to random targets, 300-400ms and 700-800ms post-stimulus presentation in the auditory modality. These findings suggest that gamma activation may reflect processes associated with the contextual processing of informative stimuli in both the auditory and visual modalities.

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H45

EFFECTS OF COGNITIVE CHANGE TRAINING ON PERFORMANCE AND EMOTIONS OF MILITARY AVIATION TRAINEES *Marie-Pierre Fornette[1,2], Camille LeFrancois[2,3], Jacques Fradin[2,3], Rene Amlberti[1], Farid El Massioui[2,3]; [1]Institut de Médecine Aérospatiale du Service de Santé des Armées, Brétigny, [2]"Cognition & Use" Laboratory, Paris 8 University, Saint-Denis, [3]Cognitive Neuroscience Department, Institute of Environmental Medicine, Paris* – Cognitive, behavioural and emotional adaptation mechanisms are based on executive functions. We hypothesized that military aviation trainees (cadets) will benefit from a training program teaching them how to develop their executive functions (cognitive flexibility, hypothesis-generation, cognitive change for emotion regulation, etc.) to cope with highly dynamic, complex and potentially dangerous situations and with stress.

Participants included 22 pilot trainees: 11 took part in the cognitive training program (Experimental Group EG) and 11 formed the Control Group (CG). During 16 weeks, in-flight performances, anxiety and mood scores (Spielberger's STAI-Y and McNair's Profile of Mood States questionnaires) and modes of stress management change were compared between experimental and control groups. A significant improvement of in-flight performance of EG's lowest ranking trainees (2nd half of the class) was observed from the beginning to the end of the training course. Compared to the CG, EG's trainees mentioned having significantly changed their mode of stress management. 64% of them stated that the training program had been useful to gain a better understanding of events and reduce stress. However, the anxiety and mood scores showed no difference between the two groups throughout the study. The EG's trainees have most likely enhanced their awareness of stress-signals, which would explain why, despite equivalent testscores between the two groups, the experimental group has in fact become less stressed. Future studies, that include physiological measurements of stress and additional indicators of performance, are expected to help specifying the effects of this cognitive training program.

H46

PERSUASIVE MESSAGES AGAINST RISKY BEHAVIOR INCREASE RISK AVERSION-RELATED ACTIVITY IN THE ANTERIOR CINGULATE CORTEX AND INSULA *Rena Fukunaga[1], Adam Krawitz[1], Joshua W. Brown[1]; [1]Indiana University, Bloomington, IN* – A previous functional magnetic resonance imaging (fMRI) study of the Iowa Gambling Task (IGT) revealed significant activation in the medial prefrontal cortex when making risky decisions (Fukui et al., NeuroImage, 2004). In the present study, we investigated the neural basis of risk perception and how neural activity representing risk can be modulated by persuasive messages. Here the IGT was modified to include conditions with positively or negatively framed messages aimed at helping subjects maximize their net scores by providing guidance about the long-term value of specific decks. We addressed potential confounds between decision-related and outcome-related signals by including a variable delay between the choice and the display of resulting reward or loss, allowing independent analysis of choice and outcome-related brain activity. We found greater activity in the anterior cingulate cortex (ACC) and the anterior insular regions during the decision-making period when participants made disadvantageous choices. We also found that providing messages aimed at helping subjects maximize their average score led to greater ACC and insula activation during the decision-making period for disadvantageous but not advantageous deck choices. Additionally, an individual difference measure of risk taking was found to correlate negatively with ACC activity when making disadvantageous decisions. Taken together, these results suggest that medial prefrontal and insula regions are involved in risk perception and aversion during decision-making, and that persuasive messages may enhance risk aversion in choice behavior by modulating ACC and insula activity. Supported by a NARSAD Young Investigator Award to JWB, T32 MH019879, R03 DA023462-01

H47

STRATEGIC LEARNING IN CHILDREN WITH ATTENTION DEFICIT DISORDER *Jacquelyn Gamino[1], Sandra Chapman[1], John Hart[1], Lori Cook[1], Sandra Vanegas[1], Molly Burkhalter[1]; [1]The University of Texas at Dallas Center for BrainHealth* – The ability to strategically select and integrate important information while disregarding or inhibiting irrelevant information is believed to be a fundamental process underlying successful learning and comprehension. Thus, adept strategic learning ability is postulated to be a contributor to academic success. Children with attention deficit hyperactivity disorder (ADHD) often struggle academically despite having normal intelligence. There is no known evidence regarding strategic learning in children with ADHD. This study investigated the ability of 40 children with ADHD to strategically learn important information from a text compared to 40 typically developing control children. We hypothesized that children with ADHD would demonstrate strategic learning deficits. The children read narrative texts and then produced summaries of the information. Trained raters scored the summaries according to selection of important information. Our findings suggest that while children with ADHD remember a comparable amount of facts overall, they demonstrate a significantly reduced ability to strategically select important facts over unimportant details. The results suggest that children with ADHD show a pattern of decreased selectivity in learning new information. Implications of these findings are: 1) the potential for developing therapeutic intervention to train children with strategic learning deficits, 2) modification of educational curriculum to enhance strategic learning, and 3) enhancement of detection of strategic learning deficits in impaired populations

H48

FEEDING AN INDIVIDUAL AFFECTS THE KINEMATICS OF A SEQUENCE OF ACTIONS *Maurizio Gentilucci[1], Francesca Ferri[1], Filippo Barbieri[1], Riccardo Dalla Volta[1], Claudia Gianelli[1]; [1]Università di Parma, Parma* – Does the intention to interact with an individual affect the kinematics of a sequence of actions? We compared the kinematics between sequences directed to animate and unanimated targets. Participants in experiment 1 reached-grasped and placed a piece of food into the mouth of (i.e. fed) an individual and executed the same sequence directed to the "mouth" of a human body shape. In experiment 2 the final target of the sequence was a mouth shape placed on the individual's shoulder or on the "shoulder" of the body shape. In experiment 3 the apparatus and procedure were the same as in experiment 2 except that the position of the reaching-grasping target was closer to the individual and body's shape. The intention to interact with an individual modified the kinematics of the sequence. Placing was slowed down by moving in the peripersonal space of the individual as compared to moving close to the human body shape. However, temporal parameters were lengthened when feeding and kinematics landmark decreased when placing an object on the individual's shoulder. The latter effects decreased when moving closer to the individual's body this discarding the possibility that the human body was an obstacle during the movement. Feeding the individual affected also the reaching-grasping action by lengthening temporal parameters and decreasing maximal finger aperture. Summing up, interacting with an individual induced an increase in the accuracy requirement during the movement by affecting either the final chunk or both the chunks of the sequence according to the degree of interaction.

H49

IQ AND BOLD FMRI ACTIVATION – IMPLICATIONS FOR RESEARCH IN PATIENT POPULATIONS *Steven Graham[1], Ayna Baladi Nejad[1], Yeh Ing Berne[2]; [1]National University of Singapore, [2]National University Hospital, Singapore* – INTRODUCTION Many fMRI studies that examine functional differences in clinical populations are potentially complicated by the oftentimes lower intelligence scores (IQ) found in patients compared to their healthy controls. We therefore investigated executive function related brain activity in two groups of healthy subjects that differed only in their average IQ scores. METHOD 28 healthy volunteers (15 females; mean age 25) were divided into two groups based on their Wechsler Abbreviated Scale of Intelligence score (IQ). Other factors such as age and years of education were matched between groups. All subjects performed a cognitive set shifting task (similar to the Wisconsin Card Sort Test) to examine executive function during BOLD fMRI (TR=3s; FOV=192x192; 780 volumes; 32x3mm slices acquired parallel to AC-PC). Using BrainVoyagerQX (v1.99), functional images were processed (slice scan time, motion correction, spatial smoothing) and transformed into Talairach space prior to computation of random effects GLM and group-wise analyses. RESULTS_&_DISCUSSION BOLD signal differed significantly ($p<0.0001$) between the groups in several regions including caudate nuclei, superior frontal gyrus and precuneus in which hypoactivation was observed for the lower IQ subjects. Further analysis indicated that the pattern of caudate activation differed radically between groups – perhaps reflecting early response planning in High IQ but not

Low IQ participants. CONCLUSION In clinical populations with lower IQ than their healthy controls, it is possible that fMRI differences may be due to IQ differences rather than the clinical disorder per se. Caution is therefore needed when interpreting studies of patients in whom IQ may be affected.

H50

DIFFERENT INHIBITORY PROCESSES IN PARKINSON'S DISEASE *Alessia Granà[1,2], Nadia Gamboz[3], Emanuele Biasutti[2], Carlo Semenza[1]; [1]University of Trieste, Italy, [2]Institute of Physical Medicine and Rehabilitation, Gervasutta Hospital, Udine, Italy, [3]Suor Orsola Benincasa University, Napoli, Italy* – Inhibition is the ability to suppress irrelevant stimuli and impulses. It is a fundamental executive function, essential for normal thinking and for successful living. Recent studies have proposed that inhibitory processes reflect a family of independent functions rather than a single unitary construct (Miyake et al., 2000). The necessity to be more specific when discussing and measuring inhibition-related functions has been therefore advocated. The present study aimed at distinguishing these processes in a population of patients diagnosed with Parkinson's disease (PD), a neurological disorder that involves, among other problems, a decline in inhibitory abilities. To this purpose we systematically assessed whether PD, triggering executive deficits, causes a generalized inhibitory breakdown or whether it selectively affects only specific inhibitory processes. Twenty-five non-demented PD patients were compared to twenty-five healthy controls on different experimental tasks assumed to measure different inhibitory-related functions. Results revealed that PD selectively affected prepotent response inhibition, as indicated by patients' longer times to inhibit an ongoing response compared to controls. This deficit was independent of general slowing and cognitive impairment. In contrast, the other two inhibitory-related functions, the resistance to distractor interference and resistence to proactive interference was equivalent in the two groups. These results complement earlier evidences of the non unitary nature of inhibitory functions and suggest that PD mainly affects the inhibition processes subserved, at least in part, by basal ganglia.

Linguistic processes: Semantics

H51

ELECTROPHYSIOLOGICAL INSIGHTS INTO THE PROCESSING OF NOMINAL METAPHORS *Abigail Swain[1,2], Sophie De Grauwe[1,3], Tali Ditman-Brunye[1,2], Phillip Holcomb[1], Gina Kuperberg[1,2]; [1]Tufts University, [2]Massachusetts General Hospital, [3]University of Groningen* – We used event-related potentials (ERPs) to examine the time courses of processing metaphorical and literal sentences in the brain. In two experiments, ERPs were measured to the same critical words (CWs), counterbalanced across nominal metaphorical sentences ("A is a B"), cloze-matched literal sentences and semantically anomalous sentences, each of the same syntactic form. Participants judged the plausibility of all sentences. In Experiment 1, the CW fell at the sentence-final position, cuing participants to 'wrap-up' the sentence's final meaning. A Late Positivity effect was seen to the metaphorical (relative to the literal) CWs. Anomalous (relative to the literal) CWs, however, evoked a prolonged negativity effect commonly seen to sentence-final anomalies. In Experiment 2, the CWs were followed by 2-3 additional words. These mid-sentence metaphorical (relative to the literal) CWs failed to evoke an N400 effect, but evoked a delayed Late Positivity effect that extended over subsequent words. By the sentence-final word of these metaphorical sentences, however, no ERP effect was evoked (relative to the sentence-final words of literal sentences). Anomalous (relative to literal) mid-sentence CWs evoked an anteriorly-distributed N400 effect and an extended Late Positivity effect. However, as in Experiment 1, the sentence-final word of these anomalous sentences evoked a prolonged negativity (relative to the sentence-final words of the literal sentences). Taken together, these findings suggest that, although there may be some immediate access to both literal and metaphorical meanings of a CW, the successful interpretation of a sentence's metaphorical meaning involves a reanalysis of its context.

H52

THE NEURAL UNDERPINNINGS OF SPATIAL SCHEMATIC REPRESENTATIONS *Prin Amorapanth[1], Page Widick[1], Anjan Chatterjee[1]; [1]University of Pennsylvania* – Little about the interface between spatial and linguistic representations is known, despite compelling arguments for their interaction. The hypothesis that relatively abstract cognitive structures, or spatial schemas, intervene between visuospatial perceptions and language is well-developed within cognitive science. However, neural bases for such schemas have not been investigated. We developed schematic stimuli based on relevant parameters and obtained agreement data on these images with a group of normal controls. We then probed for the recognition of schemas in a population of patients with either left (n=17) or right (n=17) hemisphere damage (LHD, RHD), as well as in a patient with bilateral occipital/parietal damage (EE555) employing picture-schema and word-schema matching tasks. We hypothesized that left hemisphere damage that impairs the linguistic representation of spatial relations might similarly compromise their schematic representation. Behaviorally, LHD patients were more impaired than both RHD and control groups at both tasks, while RHD patients were only mildly impaired. EE555 performed at or above the level of normal controls. Voxel based lesion symptom mapping using permutation analyses found that the ability to recognize schemas from pictures and words dissociates in the left hemisphere, with fronto-parietal networks involved with pictures and perisylvian cortices with words. In the right hemisphere, common areas within the temporal lobe seem involved and may in part represent the schemas themselves. Posterior superior occipital and parietal areas do not seem necessary for this processing, supporting theoretical accounts of spatial schemas as representations that abstract away details of perceptual information.

H53

THE ROLE OF SEMANTIC VISUAL FEATURES IN WORD MEANING COMPUTATION: AN ELECTROPHYSIOLOGICAL INVESTIGATION *Ben Amsel[1], George Cree[1]; [1]University of Toronto, Scarborough* – Current neurocognitive theories of object concept representation fall under three main theoretical classes: modality-specificity, correlational structure, and domain-specificity. Previous event related potential (ERP) studies have shown that living thing and non-living thing representations are associated with partially separable neural signals, both in terms of latency and scalp topography. These results have been interpreted as supporting both domain and modality-specific theories. To discriminate between these possibilities, we systematically manipulated the number of visual features (e.g., form, color, and motion) associated with 50 living and 50 non-living thing word concepts, as derived from a large normative data set, creating equal high and low visual feature conditions for both living and non-living categories. Relevant lexical and conceptual variables were equated across conditions (11 variables), and across 100 abstract word concepts (6 variables). Participants performed a speeded concrete-abstract decision task while the electroencephalogram (EEG) was recorded across 64 scalp electrodes. Mean area measures, scalp topographies, and spectral power analyses were analyzed in two time windows (250-500, 500-750 ms), corresponding to previously suggested phases of word meaning computation. Electrophysiological and behavioral results suggest a complex spatiotemporal pattern of representation and computation, in which semantic feature type and domain interact dynamically during concrete word meaning computation.

H54

GRASPING MEANING FROM ACTION OBSERVATION *Michael Andric[1], Ana Solodkin[1], Giovanni Buccino[2], Giacomo Rizzolatti[2], Susan Goldin-Meadow[1], Steven Small[1]; [1]The University of Chicago, [2]Universita degli Studi di Parma* – Emblems are a unique class of intended manual gestures that carry symbolic meaning independent of accompanying language (e.g. "thumbs up" to indicate "It's Good"). Interpretation of an emblematic gesture may require both observation of the directed action and understanding its corresponding (linguistic) semantic meaning. Another type of directed action, grasping, does not have a direct linguistic association, and may rely more on visual and spatial information of the scene to understand. In an event-related fMRI experiment using spiral BOLD acquisition at 3T we investigated the differential neural response to (a) hand observation when used for symbolic representation (emblems) versus transitive goal-directed action (grasping actions); and (b) expression of symbolic meaning with manual gestures (emblems) compared to oral speech (language). Participants were presented with video clips of an actor performing emblematic gestures, grasping of common objects, and audiovisual speech corresponding to an emblem. Whole-brain group analyses suggest both shared and differential responses across conditions. Although observing both emblems and grasping activated visual motion areas and dorsal premotor cortex more than speech, observing emblems but not grasping activated right intraparietal sulcus and right supramarginal gyrus. Importantly, activation of the right posterior superior temporal sulcus and gyrus was common across conditions, while the right anterior superior temporal gyrus was active uniquely for emblems and speech. These results suggest that unlike grasping movements, emblematic gestures carry unique semantic meaning and activate shared cortical language areas involved in interpreting these same meanings when they are presented as audiovisual speech.

H55

LESIONS TO MOTOR CORTEX AFFECT WORD-PICTURE MATCHING WHEN BODY PARTS ARE INVOLVED *Analia Arevalo[1], Nina Dronkers[1,2]; [1]Center for Aphasia and Related Disorders, VA Northern California Health Care System, Martinez, CA, [2]University of California, Davis, and University of California, San Diego* – Embodiment theory has suggested that mental imagery and observations of actions may recruit motor and pre-motor regions of cortex normally associated with action execution. To our knowledge, only one study (Arévalo et al., 2007) has evaluated the effect of motor and pre-motor lesions on the processing of linguistic stimuli involving body parts. In this study, we asked whether word-picture matching would be affected by motor/pre-motor lesions when body parts were involved. A group of twenty-one patients with left-hemisphere strokes and a group of ten controls were asked to match pictures and words of objects and actions involving the use of either the hand, mouth, foot, or neutral items. Relative to control participants, the patient group made significantly more errors on items involving body parts relative to neutral items, particularly involving the hand and foot. The control group, while at ceiling for both types of stimuli, showed a reaction time advantage for body part items. Results suggest that motor associations to body parts may facilitate lexical semantic processing in neurologically-intact individuals while introducing a dimension of difficulty in patients with brain injuries. Furthermore, voxel-based lesion symptom analyses revealed that motor/pre-motor patients had more difficulty with hand and foot items than did patients without such lesions. Together, these findings support the notion that motor and premotor areas do play a role in the processing of semantic information.

H56

HEMISPHERIC ASYMMETRIES IN FIGURATIVE LANGUAGE PROCESSING AN ELECTROPHYSIOLOGY STUDY USING DIVIDED VISUAL FIELD PARADIGM. *Yossi Arzouan[1], Abraham Goldstein[1,2], Miriam Faust[1,2]; [1]Gonda Brain Research Center, Bar-Ilan University, Israel, [2]Bar-Ilan University, Israel* – To investigate the distinct roles of the left (LH) and right (RH) hemispheres in processing metaphoric expressions, we selectively controlled the order of hemisphere processing through the application of the divided visual field paradigm (DVF). In the current study, electrophysiology signals were recorded from twenty nine right handed native Hebrew speakers, while the semantically judges 240 two-words Hebrew expressions that consisted of four categories: Unrelated: "window joke", Literal: "new day", conventional metaphors (CM): "bright student", and novel (NM) metaphors expressions drawn from poetry texts: "crystal river". The analyses of behavioral measures and Language related ERP (event related potentials) components showed that the hemispheres are differently engaged during the comprehension of NM. The behavioral findings indicate that direct projection of NM to the RH resulted in more accurate and faster responses as compared to those projected to the LH. The N400 amplitude elicited by NM presented to the RH was larger than that for LH. And the latency-to-peak of the P600 component was modulated by visual filed of presentations only for figurative (CM and NM) stimuli. A faster semantic encoding time was obtained in the RH for CM pairs that were familiar but semantically unrelated than for NM pairs that were both unfamiliar and semantically unrelated. For LH presentation, latency-to-peak of the P600 component for CM and NM did not differ. This implies that as compared with CM, the RH role in NM processing required extended processing time that could reflect expression -level integration and memory retrieval.

H57

COMPUTING AND RECOMPUTING DISCOURSE MODELS: AN ERP STUDY. *Giosuè Baggio[1], Michiel van Lambalgen[3], Peter Hagoort[1,2]; [1]F.C. Donders Center for Cognitive Neuroimaging, Radboud University Nijmegen, [2]Max Planck Institute for Psycholinguistics, Nijmegen, [3]Institute for Logic, Language and Computation, University of Amsterdam* – While syntactic reanalysis has been extensively investigated in psycholinguistics, little is known about reanalysis in the discourse-semantic domain. We used event-related brain potentials (ERPs) to keep track of semantic processes involved in understanding short narratives such as "The girl was writing a letter when her friend spilled coffee on the paper". We hypothesize that these sentences are interpreted in two steps: (1) when the progressive clause is processed, a discourse model in which the goal state will be attained (a complete letter) is computed; (2) when the subordinate clause is processed, the initial representation is recomputed to the effect that, in the final discourse structure, the goal state cannot be satisfied. Critical sentences elicited larger sustained anterior negativities (SANs) compared to controls, starting around 400 ms after the onset of the sentence-final word and lasting for approximately 400 ms. The amplitude of the SAN is correlated with the frequency with which participants, in an off-line button-press task, responded that the goal state was not attained. Our findings suggest that the human brain supports some form of non-monotonic computation in order to integrate information which invalidates previously held assumptions.

H58

VOXEL-BASED LESION ANALYSIS OF CATEGORY-SPECIFIC NAMING DEFICITS *Juliana Baldo[1], Analia Arevalo[1], David Wilkins[1], Nina Dronkers[1,2,3]; [1]VA Northern California Health Care System, [2]University of California, Davis, [3]University of California, San Diego* – Case studies have reported individual patients who show striking dissociations in their ability to name items from distinct categories (e.g., living versus non-living things). Functional neuroimaging studies have attempted to delineate the brain basis of such category dissociations. Some of these studies have reported specific brain regions associated with discrete categories, while other studies have reported largely overlapping networks. In the current study, we analyzed naming performance in a large group of left hemisphere patients (n=92), using voxel-based lesion symptom mapping (VLSM) to identify brain regions associated with specific categories of items (animals vs. tools, natural kinds vs. artifacts, manipulable vs. non-manipulable items). The VLSM maps were largely overlapping for the six categories, with significant regions in left anterior temporal, inferior temporal, middle temporal, and superior temporal cortex. A few dissociations were apparent, however, such as larger regions of significance in the posterior middle temporal gyrus for artifacts and tools. We also examined our dataset for individuals demonstrating a dissociation, defined as a 40% difference in naming across two categories. Out of 92 patients, there were four individuals who met this criterion: One patient who was relatively impaired at naming animals and natural kinds, two patients who were impaired at naming artifacts, and one who was impaired at naming tools. These findings suggest that a network of regions within the left temporal lobe is critical for naming across different semantic and feature-based categories but that individual patients can be shown to exhibit both behavioral and neural dissociations across item categories.

H59

ARE WORD MEANINGS "WEBS OF SENSATIONS"? COUNTEREVIDENCE FROM AN FMRI STUDY OF MOTION AND NON-MOTION WORDS. *Marina Bedny[1,2], Alfonso Caramazza[3], Emily Grossman[4], Alvaro Pascual-Leone[1], Rebecca Saxe[2]; [1]Beth Israel Deaconess Medical Center, Harvard Medical School, [2]Massachusetts Institute of Technology, [3]Harvard University, [4]University of California, Irvine* – How are the meanings of words organized in the mind and brain? According to the sensory-motor hypothesis word meanings are distributed throughout the sensory-motor cortices through which they were acquired. For example, the meaning of the word "kick" is partially represented in the visual motion regions activated during the observation of kicking. An alternative proposal suggests that word meanings are abstracted away from specific sensory-motor experiences. To distinguish between these hypotheses we used functional magnetic resonance imaging to localize brain regions involved in perception of motion and body movement, and investigated the response of these regions during word comprehension. Participants made relatedness judgments on word-pairs from six categories (action, thought, change-of-state, and bodily-function verbs; nouns referring to animals, tools and inanimate natural kinds) that varied in their association with motion and body movements, as previously determined in a behavioral study. Critically, none of the visual motion areas responded more to high-motion than low-motion words. We replicated previous findings showing greater activity in posterior-lateral-temporal cortices for action-verbs than for animal names. However, regions that responded to action verbs did not overlap with motion perception regions, and did not respond more to-high-motion than-low-motion words. We conclude that word meanings are abstracted away from their associated sensory experiences.

H60

CROSS-MODAL PRIMING BETWEEN THE GESTURE AND THE LANGUAGE MEANING SYSTEMS *Paolo Bernardis[1], Elena Salillas[2], Nicoletta Caramelli[3]; [1]Scuola Superiore di Studi Umanistici, University of Bologna, Italy, [2]University of Trieste, Italy, [3]University of Bologna, Italy* – Aim of the present study was to assess the relationship between the gesture and the language meaning systems at both the behavioural and the neuro-physiological levels. By means of a priming paradigm, two groups of fifteen participants each were presented with forty video-clips of different types of iconic gestures followed by the target words (nouns or verbs), which could be related or unrelated in meaning to the priming gestures. The meaning of half of the forty gestures referred to objects (nouns), while the other half referred to actions (verbs). In the first group of participants RTs were recorded. In the second group ERPs time-locked to the presentation of the target word were recorded. Behavioral results showed an interference effect between the meaning of iconic gestures and that of words when their meanings mismatched. The analysis of ERPs showed two main results: a modulation produced by the type of word (noun vs verb) and an effect of meaning. Compared with the data reported in the literature, nouns and verbs revealed a reversed pattern of results. Nouns generated a stronger P200 than verbs in the frontal electrodes of the right hemisphere, and verbs generated a stronger N400-like component in the frontal, central, and parietal electrodes of the right hemisphere. The N400-like component generated by the meaning factor, highlighted the interaction between the meanings of the gesture and language systems with the scalp distribution showing a localization of the generators different from that producing the classical N400 with only verbal stimuli

H61

DISCOURSE AND SENTENCE CONTEXTS MODULATE SEMANTIC PRIMING DURING SPOKEN LANGUAGE COMPREHENSION: AN ERP STUDY *Megan A. Boudewyn[1,2], C. Christine Camblin[3], Peter C. Gordon[4], Tamara Y. Swaab[1,2]; [1]University of California, Davis, [2]Center for Mind and Brain, University of California, Davis, [3]Division of Social, Behavioral and Global Studies, CSU, Monteray Bay, [4]UNC Chapel Hill* – This study examined the effects of associative priming in discourse and sentence contexts when participants listened to naturally produced connected speech. In the discourse context experiment, we aurally presented short, three-sentence passages that were created from associative word pairs culled from existing norms. The terminal word in the third sentence varied in terms of overall discourse congruence and lexical association with a preceding prime word (e.g., "Luckily Ben had picked up some salt and pepper/basil"), preceded either by a context in which Ben was preparing marinara sauce (congruent discourse) or dealing with an icy walkway (incongruent discourse). Within a stimulus set, final sentences were identical up until the critical word, and were locally congruent when read in isolation. The preceding discourse context, however, made the critical final word congruous or incongruous at the discourse level. In the sentence context study participants were presented with only the final sentences of the previously described stimuli. In this experiment, all the sentence-final words were congruent, but associated or not with a preceding word in the sentential context. In the discourse context experiment ERP results show early main effects of discourse congruence, and delayed effects of association. In the sentence context study the effects of association were also strongly modulated, this time by the sentential context. These results are consistent with the idea that both discourse and sentence contexts have robust effects on lexical association during normal spoken language comprehension.

H62

"GRASPING AN IDEA": PATTERN OF CORTICAL ACTIVATION DURING PROCESSING OF IDIOMS COMPOSED OF ACTION WORDS *Véronique Boulenger[1,2], Olaf Hauk[1], Friedemann Pulvermüller[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, [2]L2C2 - Institut des Sciences Cognitives CNRS/UCBL, Bron, France* – The cortical language system has been recently proposed to be intimately interwoven with the sensory-motor system. Neuroimaging studies have indeed shown activation of motor and premotor cortex during processing of action-related words and sentences. However, the crucial question regarding how action-related language is processed at a more abstract level has not been addressed. In the present study, we used event-related functional Magnetic Resonance Imaging (fMRI) to examine the pattern of activation during the reading of IDIOMATIC and LITERAL sentences that include ARM- and LEG-related action words. A common fronto-temporal network was involved in processing both sentence types, with IDIOMS eliciting greater activity than LITERAL sentences, especially in the left inferior frontal and middle temporal cortex and in the right cerebellum. Importantly, and crucial for this study, regions along the motor strip were somatotopically activated during IDIOMATIC as well as LITERAL reading, depending on which body part the embedded action words referred to. While ARM-related sentences recruited lateral motor/premotor areas, activity in more dorsal areas was observed for LEG-related sentences. Interestingly, this semantic somatotopy was shown for both IDIOMATIC and LITERAL sentences in the premotor cortex, while it emerged only for LITERAL sentences in the motor cortex along the central sulcus. Overall, these results demonstrate that the motor system is involved in the understanding of action words even at an abstract IDIOMATIC level, possibly reflecting its involvement in representing aspects of word and sentence meaning.

H63

INTEGRATING NOVEL VS. FAMILIAR MEANINGS: N400 SUPPORT FOR AN EMBODIED VIEW OF LANGUAGE COMPREHENSION *Dorothee J. Chwilla[1]; [1]NICI Radboud University Nijmegen* – We demonstrated (Chwilla et al. 2007) that novel meanings not stored in long-term memory are immediately integrated into sentential context and that N400 is sensitive to these novel meanings. The N400 effect to novel meanings that are not associatively and/or semantically related and were matched to novel senseless contexts in terms of familiarty and semantic relatedness by LSA, support embodied theories and challenge abstract symbol theories of meaning that can only discover meaningfulness by consulting stored symbolic knowledge. The N400 effect reveals that there is also knowledge not stored in semantic memory but that nevertheless affects the ease with which the meaning of a sentence is captured. This information is stored in the knowledge that we have about our body. To access and retrieve embodied knowledge, we have to project ourselves into a situation and simulate the perceptual and action details required by a situation. In the present experiment I used N400 to directly compare the integration of novel sensible meanings with the integration of familiar meanings in the same subjects. Context-setting sentences were followed by a test sentence to which ERPs were recorded that described a familiar situation, a novel sensible situation or a novel senseless situation (e.g., "After wading barefoot in the lake, Erik used his towel/shirt/glasses to dry his feet."). The main result was that next to the standard N400 effect to familiar meanings again an N400 effect to novel sensible meanings was obtained. The ERP data are discussed within the embodied framework of language comprehension.

H64

EMOTIONAL VALENCE AND SEMANTIC NEIGHBORHOOD *Hila Cohen[1], Avishai Henik[1]; [1]Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev* – Research has shown that the emotional valence of words affects their processing. For example, in a lexical decision task it was found that emotional words are processed faster than neutral ones. However, the negative information which arises from the negative words draws more attention and is processed more thoroughly. This raises the question whether a word's valence influences its spreading of activation in the semantic network. In the current study, participants were asked to memorize positive or negative words, with a large or small number of associative neighbors (N), for a subsequent recognition test (did this word appear in the previous list or not). The types of miss and false alarm (FA) errors for words with large and small N were tested, with N as an indication for spreading of activation in the semantic network. It was found that there was no influence of N on negative words. However, for positive words with large N there were more misses and less FA mistakes (i.e., more "No" responses) than for words with small N. It seems that for positive words there was an automatic spreading of activation in the semantic network, which wasn't controlled or filtered. This activation disturbed the participants' certainty that the word was previously presented to them. For negative words the automatic spreading of activation in the semantic network was controlled and filtered. This leads to the conclusion that the emotional valence of words influences their processing in the semantic network.

H65

IS ACCESS TO WORD MEANING OBLIGATORY? AN FMRI STUDY OF TASK EFFECTS ON SEMANTIC ACTIVATION AND REPETITION PRIMING OF SPOKEN WORDS *Matthew H. Davis[1], Beth Parkin[1], Jack C. Rogers[1]; [1]MRC Cognition and Brain Scienecs Unit, Cambridge* – Neuropsychological deficits following stroke suggest a role for posterior inferior temporal regions in comprehension of spoken language. However, though these regions activate for written words, fMRI evidence for their role in spoken word recognition is mixed. Here we test the hypothesis that infero-temporal contributions to word meaning processing are task dependent. Eighteen participants were scanned using sparse imaging on a 3T Siemens MRI system while making phonological (one/two syllables), semantic (living/non-living) or auditory (normal/attenuated presentation) decisions on spoken concrete nouns. These three language tasks were separated into different scanning runs alternating with a non-linguistic baseline task matched for stimulus-response characteristics (speech-envelope, speech-spectrum buzz/noise discrimination). Presentation of words compared to non-speech baseline elicited increased activity in bilateral regions along the middle/superior temporal gyri, equivalent for all three tasks. Although, weak inferior frontal and fusiform activation was observed during acoustic decisions, this activation was significantly elevated during both semantic and phonological decisions confirming the task-dependence of inferior temporal responses to spoken words. In a second scanning phase, the same language tasks were performed with words heard previously and novel words. Semantic judgements showed significant repetition priming for words on which semantic or phonological decisions had been made previously, though not for words presented for auditory decisions. This behavioral pattern is reminiscent of neural activity during the initial scanning phase, suggesting a link between inferior temporal activity, access to meaning and subsequent repetition priming. This hypothesis will be tested using univariate and multivariate analysis of fMRI data from the second scanning phase.

H66

THE HUMAN MIRROR NEURON SYSTEM AND ACTION WORD MEANING REPRESENTATIONS: AN FMRI STUDY *Greig de Zubicaray[1], Natasha Postle[1], Katie McMahon[1], Matthew Meredith[1], Roderick Ashton[1]; [1]University of Queensland, Australia* – In monkeys, a class of visuomotor neurons called mirror neurons fire when actions are both executed and observed. They are proposed to provide a neural mechanism for understanding the actions of others. A homologous mirror neuron system (MNS) is also thought to exist in humans. Neuroimaging evidence to date indicates this MNS comprises two important nodes for hand/finger actions: Brodmann area (BA) 44 in the inferior frontal gyrus (IFG) - considered a homologue of monkey area F5, and the anterior inferior parietal lobule (aIPL). Recently, it has been proposed that the MNS might play a key role in the processing of action word meanings. We tested this hypothesis using fMRI. Participants first silently read words associated with hand actions or actions associated with other effectors, concrete words unrelated to body parts, and phonologically regular nonwords. A baseline condition involving viewing visual characters (hashes) was also included. Next, participants viewed then imitated simple intransitive hand movements to locate the aforementioned nodes of the MNS. Our results indicate that the left hemisphere BA44 and aIPL regions involved in executing and observing hand movements do not show differential activation during perception of words associated with hand actions compared to other classes of lexical stimuli. However, effector-related words, unrelated words and non-words all showed increased activation compared to hashes in BA44, consistent with prior research on lexical processing in this region. We conclude that the human MNS is unlikely to be a key neural mechanism responsible for processing of action word meanings.

H67

LOGICAL SEMANTICS IN LANGUAGE PROCESSING: AN ERP STUDY *John Drury[1], Veena Dwivedi[2], Karsten Steinhauer[1]; [1]McGill University, [2]Brock University* – Event-related potentials have been used (Shao & Neville 1998/Drenhaus et al. 2006) to study the processing of negative polarity items (NPIs) – i.e., words like "ever" or "any" which must be licensed by the occurrence of certain logical-operators (e.g., negation: John hadn't/*had EVER arrived). However, these first studies confounded [+/--violation] with lexical/contextual variables and yielded inconsistent results (LAN-P600/N400-P600, respectively). Our previous work (Steinhauer et al. 2007) controlled for both factors and showed unlicensed NPIs elicit P600s followed by late LANs ("L-LANs"), a pattern that Shao & Neville also report for cases of logical contradiction, and which we have found for another case of logical-semantic anomaly (i.e., the

"Definiteness-Effect": There was A/*THE man in the room; Drury et al. 2006). However, we also found an N400-effect for the complex NPI "at-all", but not for simplex NPIs "ever/any" (note: Drenhaus et al's N400 findings were for the morphologically complex German NPI "jemals" = "ever-time"). Here we focus on complex NPI/non-NPI contrasts (e.g., "John thought there was SOMEBODY/*ANYBODY in the room"). Also, we examine three theoretically distinct kinds of NPI-licensing operators, (negation/yes-no-questions/"only", e.g., John didn't think.../Did John think.../Only John thought...there was SOMBODY/ANYBODY...) as well as cases of the DE (e.g., "...there was SOMEBODY/*EVERYBODY in the room") to replicate the P600/L-LAN pattern for both the DE and unlicensed-NPIs within-subjects. The results of past studies and the present (ongoing) experiment will be discussed in terms of what we may hope to learn about the neurocognitive bases of sentence-level logical-semantic processing from ERP studies.

H68

THE PROCESSING OF PICTURES AND WORDS DURING A SEMANTIC GENERATION TASK: EVIDENCE FOR A GRADED SEMANTIC STORE *Carrie Esopenko[1], Ron Borowsky[1,2], Jacqueline Cummine[1], Gordon Sarty[1]; [1]Cognitive Neuroimaging Lab, University of Saskatchewan, [2]Division of Neurosurgery, College of Medicine, University of Saskatchewan* – We examined semantic processing of objects presented in picture and word format, both behaviourally and neuroanatomically. Neuroanatomical research has shown that semantic processing of action-related language activates the premotor, motor, and sensory cortices somatotopically during a variety of tasks (e.g. Tettamanti et al., 2005; Hauk et al., 2004). Behavioural research has shown a response advantage in lexical decision for words with complex semantic representations (i.e., multiple definitions) that diminishes with decreased semantic complexity (e.g., Borowsky & Masson, 1996; Pexman, et a., 2002). Experiment 1 used fMRI to examine somatotopically organized activation in the premotor cortex for an overt semantic generation task ("describe how would you interact with this") using picture or word stimuli that naturally involve either arm or leg interactions. Experiment 2 evaluated whether the semantic generation response times for pictures and words produce a semantic complexity advantage (i.e., faster reaction times for more complex objects). Results for Experiment 1 are in keeping with previous research in showing that semantic processing related to object interaction involves the motor, premotor and sensory cortices in a somatotopic fashion, and are novel in that there are unique and shared regions of activation for pictures and words that differ across arm and leg stimuli. Experiment 2 demonstrated that objects presented in word format produce a complexity advantage, whereas there was no complexity relationship for objects presented in picture format. These results support the notion of graded semantics (e.g.,Plaut, 2002), as opposed to strictly amodal (Caramazza et al., 1990) or modular (Shallice, 1988) semantic representations.

H69

INCREMENTAL LEARNING OF WORDS IN CONTEXT:EFFECTS ON MFN, N3 & N400 EVENT-RELATED POTENTIALS *Gwen Frishkoff[1], Charles Perfetti[1]; [1]University of Pittsburgh* – Word knowledge is acquired gradually, over many exposures. Thus, at any time, a learner may have graded and incomplete knowledge of meanings for some words. To examine incremental learning of word meanings, we presented rare words (such as "kippage") in several sentence contexts. Each word was assigned to contexts that were either highly semantically constraining, providing strong cues to the target word meaning, or low constraint, that is, relatively uninformative with respect to the target word meaning. After each sentence, the target word appeared with a cue to respond: subjects were asked to generate a synonym for the target at the cue. To probe immediate and delayed effects of learning, ERPs recorded during learning and were time-locked to words presented just before each sentence, immediately after the sentence, and in isolation, after a 30-minute delay. Individual knowledge of words meanings was tested before and after training, using a multiple choice synonym-judgment task. Pre- and post-test assessments showed a ceiling effect for familiar words, as expected. Rare words that appeared in high-constraint contexts showed greater gains than words that appeared in low-constraint contexts. During the training task, words that appeared in high vs. low constraint contexts evoked an enhanced left anterior N3 and a reduced MFN. In the delayed post-task, there was N400 reduction for trained words that occurred in high-constraint contexts. We suggest that frontal MFN effects may index early stages of learning, while N400 effects may indicate robust learning of new words.

H70

REPLICATING THE RECOGNITION POTENTIAL IN A SENTENCE PARADIGM *Linzi Gibson[1], Lindsay Daniels[1], Joseph Dien[1]; [1]University of Kansas* – There has been increasing interest in the Recognition Potential. The effect was originally thought to reflect only orthographic-level processing, but more recent evidence has suggested that it can reflect semantic-level processing as well (Dien, Frishkoff, Cerbone, and Tucker, 2003; Martin-Loeches, Hinojasa, Casado, Munoz, Fernandez-Frias, 2004). However, with only two studies the effect could be due to confounds. The current study replicated this effect with entirely new stimuli using a 128-channel high-density array.

H71

CAN MUSICAL SOUNDS PRIME SEMANTIC ASSOCIATIONS? *Julia Grieser Painter[1], Petr Janata[2], Stefan Koelsch[1]; [1]Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, [2]Center for Mind and Brain, University of California, Davis* – The purpose of our study was to investigate whether musical sounds (timbres) presented outside of a musical context can prime semantic associations. In Experiment 1 subjects had to perform a lexical decision task in which the prime stimulus could be a sound (selected from a wide array of natural and unnatural musical timbres) or a word. The target was either a word or non-word. Relatedness between sounds and words was determined via a rating in which subjects had to compare sounds and words. As expected, the sound-word condition revealed a significant effect of relatedness in reaction times. A second experiment was conducted using EEG in which subjects were presented with related and unrelated word-word, sound-word, word-sound and sound-sound pairs and had to perform a memory task. There was a weak effect of target relatedness on ERP amplitude in the time window from 400 ms to 600 ms after stimulus onset, mainly at frontal electrodes. The results suggest that semantic associations are primed not only by musical pieces with a certain structure (rhythm, melody etc.), but also by discrete musical sounds. However, the exact nature of this priming effect, i.e. the way in which sounds elicit meaningful associations and under which circumstances remains to be investigated more closely.

H72

A COMMON INDEPENDENT COMPONENT OF THE P3B, N400, AND P600 ERP COMPONENTS *David Groppe[1], Scott Makeig[2], Marta Kutas[1]; [1]University of California, San Diego, [2]Swartz Center for Computational Neuroscience, University of California, San Diego* – Two of the most reliable and most studied neural correlates of language comprehension are the N400 and P600 ERP components, canonically elicited by semantically and grammatically anomalous words (respectively). While these phenomena have provided valuable information about the nature and time course of language comprehension, their utility has been limited by the fact that they are most likely composed of multiple, functionally and anatomically distinct subcomponents whose contributions to the N400 and P600 overlap in time and space. For example, interpretation of the N400 and P600 is complicated by their uncertain relationship to the P300 ERP component elicited by a wide range of deviant stimuli. In order to identify a possible P300-like subcomponent common to the N400 and P600, all three ERP components were elicited from the same experimental participants in the same recording session using their canonical paradigms. Independent component analysis (ICA) was then applied separately to the N400/P600 data and P300 data to define subcomponents of these effects. ICA found what appears to be a midline central subcomponent (MCe) that is common to all three ERP components (it accounts for around 50% of the variance of each component). This MCe subcomponent is characterized by a late positivity that is enhanced to rare/anomalous stimuli, habituates over the course of the experiment, and tends to peak later for stimuli that presumably take longer to evaluate. In light of these characteristics, we tentatively link the MCe subcomponent to the allocation of attentional resources.

H73

N400 PRIMING STUDY OF CATEGORY EXEMPLAR TYPICALITY *Jill Grose-Fifer[1], Diana Deacon[2]; [1]John Jay College of Criminal Justice, CUNY, [2]City College, CUNY* – An initial N400 study demonstrated that non-associated, categorically related stimuli produced priming when presented to the right hemisphere (RH) but not to the left (LH). Furthermore, significant priming only occurred when the prime and target shared considerable semantic feature overlap (e.g., MOSQUITO-FLEA). This finding supports our hypothesis that concepts are represented in RH networks on the basis of their semantic features. However, the necessity of generating many stimulus pairs resulted in the use of low typicality exemplars from any given category. This may have limited the contribution of LH in the task since mediated priming could potentially occur through spreading activation from the prime to the target via the category label, provided that there were strong enough associative links between them. A second N400 study investigated the effects of exemplar typicality in categorical priming within the cerebral hemispheres. A divided field paradigm was used to present both prime and target to one visual field or the other, on a random basis. Prime-target pairs were either unrelated or categorically related with low semantic feature overlap (e.g., LION-PIG). Related primes and targets were chosen from the Battig and Montague category norms for their high response frequency (typicality). Our results showed that increasing prime and target typicality did not increase the incidence of priming in the left or right hemisphere. Thus, we surmise that typicality of category exemplar does not provide a strong enough associative link to elicit mediated LH priming and RH priming is based on semantic feature overlap.

H74

NOUN AND VERB GENERATION IN A MINIMAL SENTENCE CONTEXT: TESTING THE SENSORY-MOTOR HYPOTHESIS OF SEMANTIC REPRESENTATIONS *Patrick Khader[1], Kerstin Jost[1], Michelle Mertens[1], Frank Rösler[1]; [1]Experimental and Biological Psychology, Philipps-University Marburg* – Are nouns represented in visually and verbs in motor-related brain areas, as predicted by the "sensory-motor hypothesis" of semantic representations? In an event-related fMRI study, seventeen participants generated nouns with strong visual associations and verbs with strong motor associations. In contrast to previous studies, the to-be-generated target words were highly constrained by a preceding minimal sentence context, (e.g., "carpenter cuts ?…wood" or "carpenter wood ?…cuts"). Consistent with the sensory-motor hypothesis, noun generation activated occipital-temporal areas more than verb generation, indicating stronger recruitment of visual representations. However, when compared to a non-semantic control task, in which a rhyme had to be generated, also verb generation elicited activation in occipital-temporal areas, indicating that semantic generation of both nouns and verbs triggered visual associations or visual imagery. Furthermore, stronger activation for verbs was not found, as expected, in the motor cortex, but in the left prefrontal cortex. This presumably reflects processing differences due to the grammatical status of the two word categories. Therefore, the results provide only partial support for the sensory-motor hypothesis of word representations.

H75

THE SOUND OF CONCEPTS: THE LINK BETWEEN AUDITORY AND CONCEPTUAL BRAIN SYSTEMS *Markus Kiefer[1], Eun-Jin Sim[1], Baerbel Herrnberger[1], Jo Grothe[1], Klaus Hoenig[1]; [1]University of Ulm, Germany* – The organization of the conceptual system is a matter of a debate. Classical models assume that conceptual knowledge is represented in a unitary system in an amodal format distinct from the sensory and motor systems. More recent models, however, propose that concepts are embodied in the sense that interactions with objects form their conceptual memory traces in distributed modality-specific brain areas, which typically process sensory or action-related object information. In support of modality-specific models, previous neurophysiological studies showed that conceptual tasks activate brain areas involved in the processing of visual and action-related information. Here, we investigated the neural representation of acoustic conceptual features (to ring) using fMRI and ERPs. Participants performed a lexical decision task on visually presented object names that referred to objects with ("telephone") or without acoustic conceptual associations ("book") as well as on pseudowords as distracters. Words with acoustic conceptual associations elicited in comparison to words without acoustic associations stronger activity in the left middle and superior temporal gyrus (BA 21, 22). This area in auditory association cortex was also activated during an auditory localizer task when participants listened to natural sounds in comparison to acoustic noise. ERP analysis revealed differences between words with and without acoustic associations as early as 150 ms suggesting that these effects reflect rapid access to acoustic conceptual features rather than post-conceptual processing. In line with models of embodied conceptual representations, our results suggest that acoustic conceptual features are coded in a modality-specific fashion in the corresponding sensory cortex.

H76

ERP CORRELATES OF VERB-ACTION AND SENTENCE-SCENE ROLE RELATIONS INCONGRUENCE IN A SENTENCE-PICTURE VERIFICATION TASK *Pia Knoeferle[1], Thomas P. Urbach[2], Marta Kutas[2]; [1]Center for Research in Language, University of California San Diego, [2]Cognitive Science, University of California San Diego* – Previous behavioural and ERP studies have shown that scene events can rapidly inform sentence comprehension in real time. In contrast, little is known about the potential cost (e.g., when aspects of language and scene are incongruent) associated with their use, a key element in predicting their rapid use in online sentence comprehension. In two experiments, event-related brain potentials (ERPs) were recorded during sentence word by word reading of NP1-VERB-NP2 sentences after participants had inspected a scene that either matched or mismatched aspects (e.g., a verb or thematic relations) of the sentence. Participants' task was to verify whether or not the sentence matched the prior visual scene. Verification response latencies, as well as mean amplitude of ERPs were more negative from 300 to 500 ms after verb onset when the verb did not match versus matched the depicted action event. Reliable correlations between response latencies and mean N400 amplitude were consistent with an interpretation in terms of processing cost. Direct comparison of verb-action mismatches with scene-sentence role relations mismatches revealed earlier ERP effects of the role relations mismatch. Together our findings show a clear cost for integrating scene and language that varies with which aspects of scene and sentence are incongruent. Theories of comprehension that postulate rapid use of visual context must incorporate a cost function to more accurately predict the time course and importance of visual context for online language comprehension.

H77

AN EVENT-RELATED POTENTIAL STUDY OF COMPLEMENT COERCION *Gina Kuperberg[1,2], Neil Cohn[1], Arim Choi[1], Martin Paczynski[1], Tali Ditman[1], Phillip Holcomb[1], Ray Jackendoff[1]; [1]Tufts University, [2]Massachusettes General Hospital* – Traditional linguistic theories and processing models hold that the build-up of sentence meaning derives primarily from syntactic relationships that combine the meanings of lexically-stored items. Syntactic composition, however, does not always dictate sentence meaning. For example, to comprehend "The author began the book", the meaning of "book" must be semantically 'coerced' so that it is interpreted as an event, e.g. "writing the book". Psycholinguistic studies using reading times, speed-accuracy tradeoff, eye-movements and MEG suggest that this type of coercion incurs an immediate online processing cost. We used event-related potentials (ERPs) to further examine the neural nature of this cost. ERPs were recorded to critical nouns (CNs) that, depending on their preceding verbs, were non-coerced ("The author wrote the book…"), semantically (animacy) violated ("The author disgusted the book…"), or coerced ("The author began the book…"). The non-coerced and coerced sentences were matched in terms of their plausibility (using prior ratings) and lexico-semantic association between the CN and its preceding content words (using a Latent Semantic Analysis). Animacy violated, relative to non-coerced, nouns evoked an N400 effect and, consistent with previous observations on animacy violated verbs, also a P600 effect. The coerced (relative to the non-coerced) nouns evoked an N400 effect that was equal in magnitude to that evoked by the anomalous nouns. These findings support the theory that the neural cost of such complement coercion is semantically-driven. They also underscore the sensitivity of the N400 to multiple types of semantic representation and processes, including semantic composition.

H78

ALL FOR ONE AND ONE FOR ALL: HOMOGENEITY OF SEMANTIC ACCESS FOR ALL WRITTEN INPUTS *Sarah Laszlo[1], Kara D. Federmeier[1]; [1]University of Illinois, Urbana-Champaign* – Models of single word reading based on neuropsychological data implicate two functionally and neurally separable processes in the recognition of written inputs, depending on whether those inputs adhere to common spelling-to-sound translation rules (i.e., are orthographically regular). Competing models, based on behavioral data, instead allow all written inputs to undergo functionally identical computations regardless of their spelling-to-sound regularity. In this study, we followed up on growing event-related potential (ERP) evidence supporting single-process models by determining whether familiar, but orthographically illegal acronyms (e.g., VCR) could elicit classic N400 congruity effects similar to those elicited by words, despite their irregular spelling-to-sound correspondences. The electroencephalogram (EEG) was acquired while participants read sentence frames ending with expected or unexpected words, expected or unexpected acronyms, or meaningless (and, hence, unexpected) illegal strings of letters. Characteristic N400 effects of congruency (smaller amplitude responses to expected as compared with unexpected items) were observed in response to both words and familiar acronyms, supporting single-process models of visual word recognition. Interestingly, clear N400 potentials were also observed in response to meaningless illegal strings for what is, to our knowledge, the first time in the literature. That unfamiliar and illegal letter strings elicit electrophysiological responses linked to semantic access is interpreted as evidence that attempts at semantic access can be obligatory and not gated by stimulus properties such as orthographic regularity or familiarity.

H79

EFFECTS OF IMAGEABILITY WITHOUT AWARENESS IN THE ATTENTIONAL BLINK: AN ERP STUDY *James Loomis[1], Tamara Swaab[2]; [1]UCSD, [2]UC Davis, Center for Mind and Brain* – High imageable words (cigar) are easier to understand than low imageable words (belief). This imageability effect has been attributed to the possibility that high imageable words draw on both image and verbal codes, whereas low imageable words activate only verbal codes. However, it is not known whether image codes are accessed without awareness of the semantics of words. In two experiments we recorded Event-Related Potentials to words inside and outside of the attentional blink, a period during which participants cannot attend to a stimulus. There were two key manipulations: 1) the semantic relationship of the prime and target (related or unrelated); and 2) the imageability of the words (high or low). The task of the participants was to detect whether a string of digits was odd or even and whether a probe word was related or not to the prime (experiment 1), or whether a probe word was high or low imageable (experiment 2). Whereas behavior was impaired in the attentional blink, ERP data show dissociable effects of priming and imageability in both experiments, both inside and outside of the attentional blink. These results are consistent with the idea that effects of imageabilility can be obtained even when participants are not aware of the target words.

H80

THE ROLE OF THE TEMPORAL LOBES IN THE COMPREHENSION OF METAPHORIC AND NON-METAPHORIC TEXTS *Nira Mashal[1], Miriam Faust[2], Mark Jung-beeman[3]; [1]The University of Chicago, [2]Bar-Ilan University, Israel, [3]Northwestern University, Evanston* – Much evidence from neuroimaging studies indicates that the processing of text is subserved by both left and right temporal lobes. Yet, few studies have compared brain activation of metaphoric and non-metaphoric texts, beyond simple word pairs. We used fMRI to examine brain activation patterns in the bilateral superior temporal gyri while 15 healthy participants read either four-line metaphoric texts or non-metaphoric texts. The metaphoric texts were rated as more difficult to understand than the matching non-metaphoric texts allowing us to test the hypothesis that right hemisphere involvement is associated with increased difficulty level. Surprisingly, metaphoric texts resulted in significantly lower activation than non-metaphoric texts in the left and right anterior superior temporal gyri. However, item analysis revealed that difficult metaphoric texts elicited stronger activation than easy metaphoric texts in right anterior superior temporal gyri. The results are interpreted as indicating that bilateral anterior superior temporal gyri contribute to the integration of text elements into a coherent message.

H81

SARCASM COMPREHENSION: AN EVENT RELATED POTENTIALS INVESTIGATION *Marguerite McQuire[1], Stephanie Fisher[1], Christopher Lovett[1], Seana Coulson[1]; [1]University of California, San Diego* – Sarcasm is a form of figurative language where the non-literal meaning opposes its literal meaning. Sarcasm typically consists of a positive statement that expresses negative intent, as in exclaiming, "Perfect day for a picnic!" during a torrential rainstorm. To examine how the brain processes this non-literal form of language, we recorded event-related potentials (ERPs) of sixteen healthy, native English speakers as they listened to stories that ended with a visually presented phrase. The final word in each utterance determined the condition of each phrase as being sarcastic or literal and was balanced for valence. For example, a story describing an encounter with a hostile indigenous tribe would be completed with "All the people we met there were so KIND" (sarcastic criticism) or "All the people we met there were so WARLIKE" (literal criticism). Alternatively, the story described an encounter with friendly villagers which was completed with "All the people we met there were so KIND" (literal compliment) or "WARLIKE" (sarcastic compliment). Results from this study suggest a greater cognitive load for processing sarcasm, as shown by a late positive complex (LPC) for sarcasm relative to literal endings. The data also suggest an interaction between valence and sarcasm. Individual differences such as gender, working memory and self-reported use of sarcasm will be discussed as predictors of sarcasm comprehension.

H82

INDIVIDUAL DIFFERENCES IN INFERENCE GENERATION *Heather Mirous[1], Mark Jung-Beeman[1]; [1]Northwestern University* – When people comprehending stories hear a premise state (John was wearing jeans) and later a changed state (John is wearing a tuxedo), they bridge this gap by inferring a causal connection (John changed). People draw such inferences when they are necessary to maintain story coherence, but the component processes and brain bases of these inferences are not well established. Prior work in cognitive neuroscience has shown differential semantic activation in the right and left hemisphere during inference generation, with the right hemisphere showing more activation at an early or predictive time point in the text, and the left hemisphere showing more activation at a later or bridging time point. Individual differences in working memory, background knowledge, and motivation also can affect inference processing, though the mechanisms are not fully explicated. This study examines the influence of individual differences, namely trait anxiety, mood, and working memory capacity on inference processes in both hemispheres, by contrasting priming of inference-related target words presented to each visual hemifield. Current results show stronger inference-related priming in the RH early in the course of drawing inferences. Working memory as well as trait and state affect modulation of inference-related priming across time points in both hemispheres will also be discussed.

H83

THE EFFECT OF RHYME ON SEMANTIC EXPECTANCY *Fereshteh Modarresi[1]; [1]University of Ottawa* – This paper investigates the range of linguistic situations in which the N400 component is observed. Although the main characteristic of N400 is its high sensitivity to semantic processes (Kutas & Hillyard, 1980), there is evidence that it is also modulated by phonological variables. This paper examines the interaction between auditory rhyme and semantic information during sentence processing and their overall effect on ERP indices, notably the N400. The experiment uses both behavioural reaction times (RT) and Electrophysiological (ERP) measures. The participants listen to sentences in the Persian language that consist of both rhyme and semantic primes. Participants must judge the congruency of the target item. This will allow us to determine how the rhyme can affect "lexical expectancy" and "lexical activation" in memory. The experiment design is inspired by a Persian language game, in which the presence of a non-word prime (presented before the question) interferes with access to the semantically appropriate word (in the answer). The sentence stimuli were presented auditorily and consisted of questions and answers (targets) in a 2 by 2 design. The target item either rhymes or does not rhyme with the non-word prime preceding the question, and is semantically related or not related to the highly expected true responses. The highly expected correct answer has been used as the base line with which other sentences will be compared. Behavioural results suggest a speed-accuracy trade-off while preliminary ERP results suggest that the N400 is much affected by sentential phonological congruency.

H84

UNDERSTANDING PHYSICAL EFFORT THROUGH LANGUAGE *Claire Moody[1], Veronika Chuang[1], Silvia Gennari[1]; [1]University of York - United Kingdom* – This study investigates how we understand actions as described by language. It presented participants with sentences describing actions that were more or less effortful or involved no physical effort, for example, "The delivery man is pushing the piano", "The delivery man is pushing the chair", "The delivery man has forgotten the piano". It was hypothesized that sensory-motor brain regions encoding properties of actions such as supplementary motor cortex (middle frontal gyrus - MFG) would be sensitive to the effort manipulation. Moreover, because to understand the difference in implied effort the same verb ("push") must be semantically integrated with different objects (chair vs. piano), areas responsible for such semantic integrations such as left inferior frontal gyrus (LIFG) may also be sensitive to the effort manipulation. It was found that MFG and LIFG showed activation consistent with a positive linear trend as a function of physical effort. The same trend was also found in the posterior middle temporal gyrus, an area often associated with verbs and actions. Results indicate that understanding actions through language requires interactions between sensory-motor regions and LIFG with all these areas being sensitive to the degree of semantic information (effort) implied by the sentence.

H85

CORRELATES OF FRONTAL LOBE FUNCTION: VERBAL FLUENCY, PHONOLOGICAL LOAD, AND ABSTRACT WORD PROCESSING *Gail Moroschan[1], Chris Westbury[1], Constance M. Clarke-Davidson[1]; [1]University of Alberta* – Neuroimaging studies and lesion evidence have implicated frontal lobe function during an array of phonological and semantic language processing tasks. Binder, Westbury, McKiernan, Possing, and Medler (2005) showed that in particular, abstract words were more reliant than concrete words on inferior frontal lobe regions that have been strongly implicated in phonological processing and verbal short-term memory. A well known measure of frontal lobe function is verbal fluency – how many words one can produce in a minute when given the first letter. If phonological and concreteness information are mediated through the frontal lobes, then we would expect to see a.) evidence of an interaction between phonological load and concreteness in aphasic subjects, especially in the auditory modality that stresses phonology, and b.) verbal fluency scores that correlate highly with measures of phonological load and abstract word processing. We tested these hypotheses by using data from the Alberta Language Function Assessment Battery (Westbury, 2006) for 38 mixed aphasics. We found an interaction effect between phonological neighborhood size and concreteness in auditory, but not visual, lexical decision. Correlations of verbal fluency with lexical decision scores were reliable and higher for words with many neighbors than words with few neighbors, but only in the auditory modality. Correlations of verbal fluency scores with synonym judgment scores were reliable and higher for abstract than concrete words in both the auditory and visual versions of the task. These results provide behavioral evidence of convergent processing of abstract words and phonological load in frontal regions.

Memory: Working memory

H86

BRAIN ACTIVITY RELATED TO UPDATING OF VERBAL WORKING MEMORY: AN ERP STUDY *Satoshi Abe[1], Hirokazu Bokura[1], Shuhei Yamaguchi[1]; [1]Shimane University School of Medicine* – The central executive function in working memory involves mental process, which performs ongoing revision of working memory stores. This memory updating is understood as a type of switching between the activity for maintaining the current string of a fixed number of items, and the activity for changing this list. Converging evidence indicates that dorsolateral prefrontal cortex is involved in this executive process. In this study we recorded ERPs during a running memory task, in which subjects dynamically revised memory store, to clarify the spatial-temporal pattern of brain activity for memory updating. Subjects were presented with lists of a varying length from four to eight words composed of two syllables. After each list, a recall of the four most recent list words was required. We compared ERPs elicited by first four words (control trials) and those by words after the fifth in the list (update trials). The difference wave between control and update trials showed potential shift over the frontal scalp site with left hemisphere dominance, beginning at the latency of about 200 ms. The shift increased after about 1000 ms, and lasted after that. Another potential shift started to show up over the temporal-parietal site at the latency of 800ms. The present study suggests that updating of verbal working memory is triggered by prefrontal cortex and involves the distributed network including prefrontal and posterior association cortices.

H87

HUMAN RECREATIONAL (MDMA) USE AFFECTS FMRI BRAIN ACTIVATION DURING WORKING MEMORY. *Jane Allendorfer[1,2], Martine Lamy[1,2], James Eliassen[2,3]; [1]University of Cincinnati Neuroscience Graduate Program, [2]University of Cincinnati Center for Imaging Research, [3]University of Cincinnati* – Recreational ecstasy (MDMA) use is associated with memory impairments. Animal studies have shown MDMA to have neurotoxic effects on serotonergic neurons and to impair memory performance. Due to the variability of drug exposure, the functional consequences of human recreational ecstasy use remains unclear. To demonstrate the effects of ecstasy use, we studied 7 current ecstasy users and 7 non-ecstasy drug users as comparison subjects matched to the ecstasy users by age, education and cannabis use. Since neurotoxic effects of MDMA are thought to underlie memory impairments in ecstasy users, we hypothesized that ecstasy users will exhibit abnormal activation during a working memory task in brain regions that receive dense serotonergic innervation. During fMRI, participants performed an N-back task (0-back, 1-back and 2-back) in which they pressed the button corresponding to the number either on the screen (0-back), one screen prior (1-back), or two screens prior (2-back). We found no differences in accuracy or reaction time between groups. However, during working memory conditions (1-back and 2-back), ecstasy users showed increased activation in the right parahippocampal gyrus and the anterior cingulate but decreased activation in the right inferior frontal gyrus (IFG) compared to comparison subjects. The right IFG becomes more active during working memory, but this level of activation is diminished in ecstasy users. The increased activation observed in ecstasy users during working memory may indicate compensatory activation to deal with increasing task demands and may account for the lack of observed differences in behavioral performance between groups.

H88

MEASURING AGE-BOUND CHANGES IN MENTAL CAPACITY: THE ROLE OF MISLEADING CUES *Marie Arsalidou[1], Juan Pascual-Leone[1], Janice Johnson[1]; [1]York University, Toronto* – The n-back paradigm is commonly used in neuropsychological research on working memory (WM). This task is not well scaled in terms of complexity, however, limiting its usefulness in developmental research. We adapted the 1-back paradigm to create two versions of a task designed to measure mental-attentional (M-) capacity. M-capacity corresponds to the maximal number of schemes one can effortfully attend to simultaneously. This number grows with age in childhood and is a causal component of WM. The Color Matching Task (CMT) was designed to be suitable for use with fMRI. Mental demand is increased gradually by manipulating the number of stimulus features participants must consider in order to determine whether the current stimulus matches the previous one. The CMT-Balloon task contains segregated cues, whereas CMT-Clown contains integral cues making the latter more misleading. Behavioural data were collected from 7-8, 9-10, 11-12, 13-14 year olds and adults (N=149). We found significant model-predicted differences in performance between the CMT versions. Both versions correlated highly with a well established measure of M-capacity (i.e., Figural Intersection Task; FIT). Overall, CMT-Clown behaved better as a measure of M-capacity; it yielded the theory-predicted M-capacity scores for all age groups and these scores were very close to those predicted and obtained with the FIT. Results support the theoretical prediction that misleading tasks provide better measures of capacity. In future work we plan to implement the CMT-Clown in fMRI. We expect in this way to delineate brain areas responsible for age-appropriate performance as developmental stages are assessed cross-sectionally.

H89

THE LIMITS OF VISUAL MEMORY AND ITS ALLOCATION ACROSS EYE MOVEMENTS *Paul Bays[1,2], Masud Husain[1,2]; [1]Institute of Cognitive Neuroscience, University College London, UK, [2]Institute of Neurology, University College London* – Visual working memory is a limited resource. Previous attempts to characterise this limit have sought to identify a fixed number of items that can be held simultaneously in memory. Here we investigate the precision with which visual information from multiple items is maintained, both within a single fixation and across eye movements. Testing memory for item locations and orientations, we find no evidence for a fixed item limit, but rather a dynamic allocation of visual memory resources, whereby increasing numbers of items are encoded with decreasing precision. Memory for item locations is not disrupted by an intervening saccade, implying that the entire contents of visual memory are predictively updated to account for the change in gaze position. Although a saccade did not affect overall performance, the item that was the target of the eye movement was recalled with greater precision than non-target items, demonstrating preferential allocation of resources to the saccade target. Crucially, in a sequence of eye movements, this privileged memory was observed only for the most recent saccade target, and not for targets of previous saccades. Thus visual memory resources appear to be reallocated prior to each new eye movement, effectively wiping out information stored in earlier fixations.

H90

THE IMPACT OF ATTENDING TO DISTRACTORS: A STUDY OF LOW-LEVEL VISUAL WORKING MEMORY *Anne Berry[1], Aaron Rutman[1], Wesley Clapp[1], Theodore Zanto[1], Adam Gazzaley[1]; [1]University of California, San Francisco* – Top-down modulation is characterized by differential enhancement or suppression of neural activity in sensory cortical regions. One's ability to attend to pertinent sensory information and ignore irrelevant stimuli is often correlated with this neural modulation. In a previous study, electroencephalography (EEG) was recorded as subjects participated in a single face delayed-recognition task in which face distractors were introduced during the delay period. The degree to which the distractors were attended impacted their performance as reflected in the modulation of the P100 and N170 components for the distractors. The present study used the same paradigm, but utilized coherent motion stimuli to test whether early neural modulation exists for lower-level visual stimuli, and what impact distraction has on performance. In a delayed-recognition paradigm, subjects were asked to maintain their memory for motion direction over a delay period in which there either was an attended visual distractor (swirling dots), an unattended visual distractor, or no distractor. A passive viewing condition served as a baseline to measure relative enhancement and suppression. Working memory accuracy when the distractor was attended to correlated with measures of enhancement in N170 latency and amplitude for the distractor. Also, the impact of distraction on response time correlated with enhancement in N170 latency to distracting stimuli, such that subjects who showed the greatest enhancement for the attended distractors demonstrated the poorest working memory performance. This study suggests top-down modulation of early visual processing correlates with the impact distraction has on working memory performance for lower-level visual stimuli.

H91

IMPROVED WORKING MEMORY WHEN INDIVIDUALS WITH ALZHEIMER'S USE A BROAD ATTENTIONAL FOCUS *Giselle Braganza[1], P.M. Greenwood[2], J.A. Levy[3], R. Parasuraman[2]; [1]The Catholic University of America, [2]George Mason University, [3]University of Utah* – Although there is increasing evidence of a processing overlap between visuospatial attention and working memory (WM), it is not known whether that overlap is affected in Alzheimer's Disease (AD). Individuals with AD are impaired in WM, but also experience some reduction in their ability to change the scale of the attentional focus in visual search (Greenwood et al., 1997). This raises the question of whether WM in AD benefits from a narrower attentional focus as has been seen in healthy individuals.

Based on our observation that APOE-e4 homozygotes benefit from an expanded rather than a constricted attentional focus in a WM task (Greenwood et al., 2005), we hypothesized that AD individuals would show a similar pattern. Spatial precues to location varied in size in a spatial WM task in Young, healthy Older, and AD groups. To examine effects at different levels of processing, precue size also was varied in detection and discrimination tasks. In the WM task, with a 3-second delay between precued target and test, small cues provided the greatest benefit in Young and Old. AD individuals showed the opposite effect, with better memory performance following the largest precue ($p<.05$). These results indicate that the influence of the spatial scale of attention on WM takes a different form in AD. A constricted attentional focus improves memory in healthy Old but a broad attentional focus improves memory in AD. If confirmed, these results indicate that WM in AD patients might benefit from training to expand the attentional focus.

H92

RELATIONSHIP BETWEEN WORKING MEMORY ABILITY AND ATTENTIONAL CONTROL IN NORMAL CONTROLS AND YOUNG ADULTS WITH ADHD *Gregory C. Burgess[1], Marie T. Banich[1,2,3], Erik Willcutt[1,4]; [1]University of Colorado, Boulder, [2]University of Colorado, Health Sciences Center, [3]Institute of Cognitive Science, University of Colorado, Boulder, [4]Institute for Behavioral Genetics, University of Colorado, Boulder* – Working memory (WM) ability has been associated with higher levels of attentional control in neurologically normal individuals (e.g., Kane & Engle, 2003) and has been suggested to contribute to attention problems in attention deficit / hyperactivity disorder (ADHD) (Barkley 1997). This study investigated the relationship between WM and neural activity during the attentionally-demanding Stroop color-word task in adults with ADHD (N=23) and normal controls (N=23). WM ability was indexed using forward and backward digit and spatial span tasks. Neural activity was indexed using fMRI during performance of a hybrid blocked / event-related Stroop task. Task blocks were incongruent, congruent, or neutral, and contained an equal proportion of block-specific trials (e.g. incongruent) and neutral trials that were constant across all blocks. Regarding behavior, greater WM ability in ADHD was associated with increased behavioral facilitation, an association not observed in controls. This finding suggests that greater WM ability in ADHD led to more word reading, which is counterproductive to task demands. With regard to neural activity, a greater increase in bilateral DLPFC for the contrast of incongruent vs. congruent blocks was associated with higher WM scores in the ADHD group but lower WM scores in the control group. Furthermore, during individual task blocks, the control group deactivated default mode regions (i.e., posterior cingulate) less as WM ability increased. These results suggest that greater WM ability in the control group is associated with increasing neural efficiency, but with ineffective activation of attentional control regions in the ADHD group.

H93

INABILITY TO EFFECTIVELY SUPPRESS ANTICIPATED IRRELEVANT INFORMATION IN HEALTHY OLDER ADULTS. *Wesley Clapp[1], Rachel Litke[1], Nikhil Murthy[1], Adam Gazzaley[1]; [1]University of California San Francisco (UCSF)* – Previously we showed that when relevant and irrelevant information were presented quickly and randomly to older adults, they have a deficit in suppressing irrelevant information. The present experiment tested the ability of older adults to suppress anticipated irrelevant information. EEG was recorded from 16 healthy older subjects (age: 60-82) as they participated in a single face delayed-recognition task, comprised of four conditions; No Distractor, Ignore-Distractor (ID), Attend-Distractor (AD), and Passive View. In the distractor conditions, the degree to which one must attend to distracting information (a face in the delay period) was manipulated. In the ID condition, subjects were cued to anticipate the irrelevant distractor, while in the AD condition they were directed to attend to the distractor (i.e. make a simple decision about it). Behaviorally, subjects' working memory performance declined in the presence of distraction. Recently, we found that young subjects participating in the same experiment exhibited a N170 latency earliest for relevant stimuli (attended distractors), followed by passive view, and latest for irrelevant stimuli (ignored distractors). In older subjects, the N170 peaks earliest for attended stimuli, but responses to irrelevant stimuli peak at a similar latency as passively viewed stimuli, suggesting a selective inability to suppress irrelevant information even when the distractor could be anticipated. Supportive behavioral evidence of an inability to suppress distractors was obtained. Similar to younger subjects, this neural measure of suppression correlated with working memory accuracy, revealing that older subjects that exhibit N170 latency suppression of irrelevant information perform better at the task.

H94

THE MAINTENANCE OF SPATIAL WORKING MEMORY, COVERT ATTENTION, AND MOTOR INTENTION IN THE HUMAN FRONTAL EYE FIELD *Clayton Curtis[1,2], Akiko Ikkai[1], Riju Srimal[2]; [1]New York University, [2]New York University, Center for Neural Science* – Frontal eye field (FEF) neurons are traditionally thought to transform visual signals into oculomotor commands. However, it is becoming increasingly apparent that the FEF is critically involved in higher-level visuomotor cognition. FEF activity has been reported during a variety of working memory, attention, and saccade preparation experiments. Here, we present fMRI data from three scan sessions of the same humans performing psychophysically demanding spatial working memory, covert attention, and motor attention tasks. These tasks were as similar as possible in terms of difficulty and design (e.g., stimulus eccentricity, perceptual and response modality, and timing). When subjects either a) maintained a location in working memory, b) covertly attended to a cued location, or c) prepared a saccade to a visually-cued location, FEF activity persisted throughout the entire long and variable delay periods. These signals persisted regardless of whether the task required memory, attention, or intention and they persisted regardless of whether a saccade was ever made. These data argue that the FEF do not simply code for the metrics of saccades, but may more generally represent the most salient locations in the visual field. Moreover, the FEF may utilize a common mechanism to support memory, attention, and intention. An important implication of this model is that functional role of the FEF generalizes to support each of these diverse processes not through a different mechanism but through its different interactions with other brain areas.

H95

RELATIONAL 'MATCH' AND 'MISMATCH' SIGNALS IN THE HUMAN HIPPOCAMPUS ARE DIFFERENTIALLY MODULATED BY ACTIVE MAINTENANCE AND PERCEPTUAL NOVELTY. *Katherine D Duncan[1], Lila Davachi[1,2]; [1]New York University, [2]Center for Neural Science, New York University* – Determining whether an incoming event 'matches' or 'mismatches' a stored representation is proposed to lie at the core of the hippocampus' ability to switch between memory retrieval and encoding. Previous work has shown that 'match' enhancement for item information found in the perirhinal cortex depends on matches to actively maintained information. On the other hand, the corresponding 'mismatch' signals occurred irrespective of active maintenance (Miller, 1995). To investigate whether the theoretically important relational 'match' and 'mismatch' signals in the hippocampus are modulated by active maintenance, we fully crossed whether a probe stimulus 'matches' or relationally 'mismatches' a perceived or actively maintained image. Subjects performed two working memory tasks where they either responded 'yes' to probes that were identical to the previous sample scene, or performed a relational manipulated the scene and responded 'yes' only to a probe that is identical to this perceptually novel image. Using conventional fMRI (3x3x3 voxel size) we found evidence for relational 'match enhancement' within the hippocampus that was selective for matches between the probe and the actively maintained stimulus, but not influenced by perceptual novelty. We also found evidence for a complementary 'mismatch enhancement' signal in the MTL that was selective for mismatches between the probe and what was seen before, but was not modulated by active maintenance. We will also present preliminary findings using high-resolution imaging from a similar paradigm to investigate how these memory signals map onto the subfields of the hippocampus.

H96

HORMONAL AND GENETIC INFLUENCES ON PREFRONTAL CORTICAL FUNCTION. *Jacobs Emily[1], Cools Roshan[2], D'Esposito Mark[1]; [1]Helen Wills Neuroscience Institute, UC Berkeley, [2]Cambridge University* – Dopamine transmission within the prefrontal cortex is critical for tasks dependent on working memory. The PFC is extremely sensitive to fluctuations in DA—both insufficient and excessive dopaminergic activity impairs PFC function. Taking into account an individual's basal level of PFC DA is essential for predicting DA's effect on cognitive processes. Individual differences in PFC DA stem in part from genetic polymorphisms that alter the efficiency of DA's metabolic pathway. A polymorphism within the COMT gene produces an enzyme with four times greater activity. Individuals with the less active enzyme (met/met) have increased PFC DA relative to individuals with the more active enzyme (val/val). Estrogen also impacts the DA system by amplifying DA transmission. Thus, performance on tasks that depend on precise levels of PFC DA may vary throughout the cycle as estrogen levels rise and fall. Importantly, these effects may not be measurable unless individual variation in baseline DA levels is accounted for. This study investigates the effects of estrogen on the performance of DA-dependent tasks as a function of COMT genotype. Female subjects were pre-selected for COMT genotype and tested on two occasions, when estrogen levels are at their peak and trough. Subjects completed two WM tasks during an fMRI scan. For both genotypic groups, estrogen had a negative affect on performance when the task had no demand on WM. However when WM demands were high estrogen had a beneficial effect specifically for met/met subjects. Preliminary analyses suggest hormone by genotype interactions at the behavioural and neurobiological level.

H97

MULTIVARIATE ANALYSES OF SINGLE-SUBJECT VS. GROUP FMRI DATA FROM A VERBAL WORKING MEMORY TASK *Eva Feredoes[1,2], Todd S. Woodward[2,3], Bradley R. Postle[1]; [1]University of Wisconsin-Madison, [2]University of British Columbia, [3]Riverview Hospital* – Univariate analyses of single subject (SS) data sets indicate considerable intersubject anatomical variability of brain regions involved in verbal working memory storage (Feredoes & Postle, 2007). These analyses also implicate multiple brain regions in storage, although they do not permit us to infer which of these regions act in concert as part of a functional network. Additionally, repetitive transcranial magnetic stimulation (rTMS) indicates that, among these regions, those located in left posterior perisylvian cortex and sensorimotor cortex make necessary contributions to storage, whereas a left PFC region identified via spatially normalized group-averaged (SNGA) analysis of the same data does not (Feredoes et al., 2007). In the present study we investigated functional connectivity in these data sets with a method based on constrained principal components analysis (cPCA), which could be applied specifically to the delay period from these delayed letter-recognition data. We tested three predictions. First, SS data sets analyzed with cPCA would reveal that many of the anatomically distinct brain regions identified with SS analyses would be functionally connected in a network supporting verbal short term storage. Second, in each subject, the region we targeted with rTMS in our previous study would comprise a node of this network. Third, cPCA of the SNGA data from this sample would not identify any regions in PFC as nodes in a verbal storage network. Preliminary results indicate that within individuals, there are multiple, separate brain regions located primarily in posterior regions, some of which include regions identified by our previous univariate SS analyses.

H98

ESTROGEN-MODULATED PERFORMANCE ON SEX-ADVANTAGED COGNITIVE TASKS *Lena Ficco[1], Matthew C. Davidson[1]; [1]University of Massachusetts, Amherst* – Differences in spatial and language abilities have been observed across the estrus cycle in healthy young females (Broverman et. al, 1981; Hampson, 1990). Estrogen (i.e., 17 β-estradiol) is hypothesized to be the primary gonadal hormone involved in these differences; however, few studies have quantitatively measured 17 β-estradiol levels in females at time of testing. We hypothesized that high levels of 17 β-estradiol would enhance performance on articulatory tasks (e.g., counting, list reading, and color naming) and would impair performance on a visuo-spatial working memory task. To test these hypotheses, performance on these tasks was compared at two times, which coordinated with the menses (i.e., low 17 β-estradiol, low progesterone) and late follicular (i.e., high 17 β-estradiol and low progesterone) phases of the estrus cycle. Participants included naturally cycling (e.g., those not using synthetic hormone regulation or replacement) healthy young females. Saliva samples were collected at time of testing and processed via high sensitivity 17 β-estradiol and progesterone enzyme immunoassays. Preliminary results provide support for the first hypothesis, improved articulation, and suggest that fluctuations in 17 β-estradiol underlie the variations in cognitive abilities observed across the estrus cycle.

H99

EFFECTS OF WORKING MEMORY LOAD ON THE BOLD AND ERP RESPONSE IN YOUNGER AND OLDER ADULTS. *Brian Gordon[1,2], Nils Schneider[1,2], Eunsam Shin[1,2], Carrie Brumback[1,2], Yukie Lee[2], Ed Maclin[2], Gabriele Gratton[1,2], Monica Fabiani[1,2]; [1]University of Illinois, [2]Beckman Institute* – Increasing age is accompanied by a decline in working memory (WM) performance. This age-related change is exacerbated at higher memory loads, and may originate from impairments in supra-span memory processing, necessary with increasing task demands. To examine differential WM performance, we recorded behavioral, BOLD, and electrophysiological data on 15 young and 30 old adults during a Sternberg memory task, with memory set sizes of 2-6items. As expected, older adults were less accurate and slower than younger adults, especially at the higher set sizes. Within the fMRI data, linear trend analyses were performed separately for set sizes 2-4 and 4-6. An analysis of the percent signal changes by load revealed a linear increase in the BOLD response in visual cortex (B17/18) and superior parietal cortex (B7) for young adults with increasing memory set sizes, with the greatest effects occurring in the 4-6 comparison. The old adults showed linear effects for set sizes 2-4, but no further increases at set sizes 4-6. These differences suggest altered WM processing in older adults. ERP data revealed a linear increase for the old during the presentation of the memory set, up to set size 6. The ERP slopes for set sizes 4-6 did not differ between young and old adults. These results suggest that, although neuronal activation (as represented by the ERPs) linearly increased in the old adults up to set size 6, the blood flow may already have reached ceiling at lower set sizes, indicating potential changes in neurovascular coupling.

H100

SHORT-TERM MEMORY FOR SIGN LANGUAGE: ANALYSIS OF SERIAL AND FREE RECALL ERRORS IN DEAF AND HEARING PARTICIPANTS *Marta Gozzi[1], Carlo Geraci[1], Carlo Cecchetto[1], Costanza Papagno[1]; [1]University of Milano, Bicocca* – Phonological similarity and length effects detected in American Sign Language (ASL) short term memory (STM) tasks suggest that signs are retained in a system analogous to verbal STM. However, sign span is lower than word span with both ASL/English material and Italian Sign Language (LIS)/Italian material, even when controlling for articulation rate. Our studies investigated two factors potentially causing this discrepancy: (a) difficulty in maintaining sequential information with signs; (b) signs' weight. In Study 1, we tested serial recall in 12 deaf and 12 matched hearing participants with 20 sequences that were one item longer than their span, using LIS signs for deaf participants and visually and auditorily presented Italian words for hearing participants. All were able to correctly recall at least one sequence, confirming that the task was feasible. There were no significant differences between groups in the proportion of item or order errors. Deaf people made significantly more item than order errors, ruling out the possibility that lower span for signs is due to hypothesis (a). In Study 2, 16 deaf and 16 hearing participants were presented with 8-item sequences for free recall. In addition to the standard serial position curve, we calculated the recency index (Postman and Phillips, 1965). Deaf participants showed a recency effect, but their recency index score was lower than that of hearing people. Since recency represents the output of the phonological store without the contribution of rehearsal, this suggests that signs are "heavy" and need more "space" to be stored, supporting hypothesis (b).

H101

USING MORSE CODE TO UNDERSTAND VERBAL WORKING MEMORY REPRESENTATIONS *Sara Guediche[1,2], Maryam Khatami[1], Jody Manners[1], Julie Fiez[1,2]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition, University of Pittsburgh* – In this study, we use Morse code to probe the nature of the representations that are maintained during verbal working memory. In participants who are fluent in Morse, we compared verbal working memory performance on a serial recall task using acoustically presented letters in speech and Morse code. Previous work has suggested that sentence comprehension ability is linked to verbal working memory performance. Therefore, we also assessed participants' ability to listen to full sentences in Morse code and then copy the sentences. Participants who performed well on this task had equivalent verbal working memory performance for speech and Morse across the entire serial position curve whereas participants who were unable to maintain Morse sentences in memory performed better with speech. Preserved recall for final list items is especially noteworthy since some theories of verbal working memory have posited that a speech-specific acoustic store, the echoic store, contributes to recall of the final item. These results have two implications: 1) strong recency effects can be observed with stimuli that don't have the spectro-temporal properties of speech, and 2) they provide further evidence for links between working memory and sentence comprehension. Future experiments will examine suffix effects on recency to permit further characterization of echoic representations in working memory.

H102

DELAY-PERIOD NEURONAL OSCILLATIONS ARE MODULATED BY 10 HZ RTMS: A SIMULTANEOUS RTMS/EEG STUDY *Massihullah Hamidi[1], Heleen Slagter[1], Giulio Tononi[1], Bradley Postle[1]; [1]University of Wisconsin, Madison* – Several recent studies have demonstrated that repetitive transcranial magnetic stimulation (rTMS) leads to behavioral facilitation during tasks requiring spatial working memory. Specifically, we have previously shown that 10 Hz delay-period rTMS of the parietal, but not prefrontal, cortex produces improvements in working memory performance. To determine the possible mechanism behind this facilitation, we repeated this study with simultaneous rTMS and electroencephalography (EEG). Healthy, young adult subjects performed two types of working memory tasks: one requiring memory of shapes, another requiring memory of locations. In half the trials, 10 Hz rTMS (110% of motor threshold) was applied during the delay-period to the superior parietal lobule (SPL) and, as a control, the somatosensory cortex of the post-central gyrus (PCG). We replicated the behavioral effect that rTMS to the SPL results in facilitation of memory of locations, but we found no change with memory of shapes. Preliminary EEG results revealed that during location memory trials, rTMS to the SPL resulted in a large increase in alpha-band (8.5-13 Hz) power in the posterior electrodes during the delay-period, whereas with memory of shapes, this change was not evident. rTMS of the PCG did not significantly affect alpha-band power with either memory task. Oscillatory changes in other frequency bands, as well as changes in cross-frequency coherence were also assessed.

H103

COMMON OR DISTINCT NETWORKS FOR PERCEPTUAL AND REFLECTIVE SELECTION? EVIDENCE FROM VIEWING AND REFRESHING FACES AND SCENES *Matthew Johnson[1], Marcia Johnson[1]; [1]Yale University* – People can selectively highlight information for preferential processing in one of two ways: either perceptually, via direction of covert or overt attention in the presence of the stimulus, or reflectively, by preferentially mentally reviewing certain information after the original stimulus has disappeared from the environment. In this fMRI experiment, we compared the neural correlates of perceptual and reflective selection. On each trial, a face and a scene were shown simultaneously. Participants were cued either before presentation to look only at one of the pictures (overtly) and ignore the other (Attend condition), after presentation to think back to, or visualize, only one of the pictures (Refresh condition), or after presentation to simply press a button and not think of either picture (Act condition). Both overlapping and distinct patterns of activation were observed for perceptual (i.e., Attend-related) and reflective (i.e., Refresh-related) selection in brain areas associated with working memory, attention, and cognitive control. In addition, both types of selection were associated with modulation of activity in face- or scene-specific perceptual areas, with both enhancement and suppression of activity occurring in these areas relative to the control Act condition.

H104

HIPPOCAMPAL INVOLVEMENT IN BETWEEN-DOMAIN BUT NOT WITHIN-DOMAIN ASSOCIATIONS *Roy P.C. Kessels[1,2], Carinne Piekema[3], Mark Rijpkema[3], Guillén Fernández[3]; [1]NICI, Radboud University Nijmegen, [2]Radboud University Nijmegen Medical Centre, [3]F.C. Donders Centre for Cognitive Neuroimaging, Radboud University Nijmegen,* – The medial temporal lobe, and specifically the hippocampus, is important for associative memory in general. Furthermore, previous studies have shown that the human hippocampus is more involved in binding item information to spatial locations than other forms of item-context binding. These findings may be explained by the distinction between within- and between-domain associations. Presumably, the hippocampus is activated more in between-domain associative memory than in within-domain associative memory, operating as a binding device that integrates information processed in distinct brain regions. In an fMRI study, we investigated this hypothesis directly. Nineteen participants performed a 3-pair delayed-match-to-sample task in the scanner (Siemens Sonata 3T; 37 axial slices, TR = 2.18 s, TE = 25 ms), where associations had to be made between items processed within the same neocortical region (within-domain associations; house/house and face/face associations) and between items that are processed in different neocortical regions (between-domain associations; house/face associations). This setup allowed us to directly compare the neural correlates of within-domain and between-domain associations. We show significantly more activation in the parahippocampal gyrus bilaterally (right local maximum at [34 -32 -16], $t(16)=4.59$, $p=0.011$; left local maximum at [-26 -20 -16], $t(16)=3.78$, $p=0.028$) and the right hippocampus (local maximum at [26 -16 -16], $t(16)=4.13$, $p=0.019$) when between-domain associations have to be made, compared to within-domain associations. These results support the notion that both the hippocampus and parahippocampal gyrus are involved in the binding of information processed in distinct neocortical regions, and not only during spatial binding.

H105

THE RELATIONSHIP BETWEEN WORKING MEMORY AND FILTERING EFFICIENCY REVERSES WITH TASK DEMANDS: AN ERP AND BEHAVIORAL STUDY *Maria Kharitonova[1], Tim Curran[1], Akira Miyake[1], Yuko Munakata[1]; [1]University of Colorado, Boulder* – Greater working memory capacity leads to better filtering of irrelevant information (e.g. de Fockert et al., 2001; Vogel, McCollough & Machizawa, 2005), potentially by enabling more efficient allocation of memory resources.

However, this finding comes from tasks with clear demands for filtering, where subjects were instructed to filter irrelevant information and filtering was reliably advantageous for performance. In situations where it might ultimately help performance to represent currently irrelevant information, greater working memory capacity might support less filtering. To test this possibility, we assessed working memory capacity and filtering in tasks with differing filtering demands. In the high-filtering-demand task, participants made same/different judgments for visual arrays that contained 2 task-relevant and 2 irrelevant objects (as in Vogel et al., 2005). Filtering the irrelevant objects was advantageous for reducing memory demands. The low-filtering-demand task consisted of a task-switching paradigm, in which the features that were irrelevant on one trial became relevant on the subsequent trial. Filtering the currently irrelevant information could thus hurt performance. In both cases, filtering efficiency was measured as the difference in performance across trials where irrelevant information was present (or was important for the subsequent trial) and when it was absent (or irrelevant for subsequent trials). As in previous work, under high filtering demands, working memory capacity (measured both with ERPs and behaviorally) and filtering efficiency (measured behaviorally) were positively correlated. However, this effect reversed under low filtering demands, demonstrating that greater working memory capacity can support less filtering under conditions where filtering is harmful for overall performance.

H106

PROBING WORKING MEMORY REPRESENTATIONS WITH PATTERN CLASSIFICATION *Jarrod Lewis-Peacock[1], Bradley Postle[1]; [1]University of Wisconsin, Madison* – We describe a fMRI imaging study of humans engaged in long-term and working memory tasks. A pattern-classification algorithm identified patterns of cortical activity associated with viewing and making judgments about three categories of pictures (famous people, famous locations, and common objects). Although perceptual processing was necessarily involved in this task, the study of these stimuli also relied on the processing of long-term semantic and episodic memories. The classifier was then used to track the reappearance of category-specific activity patterns during a delayed paired-associate recognition task. Results show that a given category's activity pattern reappears and is maintained during the delay-period when a stimulus from that category was (1) presented at the beginning of the trial (a retrospective representation) or was (2) the probe stimulus anticipated to appear at the end of the trial (a prospective representation). This result is consistent with the hypothesis that working memory is supported by the temporary activation of long-term memory representations. Having established this theoretically important result, we next investigated the nature of these delay-period representations by comparing classification performance under several conditions: (1) whole-brain activity vs. a 'feature selected' subset of voxels, and (2) simple 2-layer network vs. a 3-layer network capable of identifying conjunctive representations of the input. Additionally, we explored the contribution of several local regions -- canonical cortical regions associated with category-specific representation (fusiform face area, parahippocampal place area, and lateral occipital cortex); and PFC -- by masking them and classifying activity from the remaining cortical regions.

H107

VISUAL CHUNKING ALLOWS EFFICIENT ALLOCATION OF MEMORY CAPACITY *Andrew McCollough[1], Edward Vogel[1]; [1]University of Oregon* – The ability to group information into "chunks" is a well know phenomenon in verbal working memory paradigms. However, the effects of chunking in the visual domain has not been well described. Here, we investigate the effects of visual chunking on working memory capacity, or K, utilizing gestalt principles to bias subjects to group individual items into larger, virtual objects. Subjects were presented with groups of three "pacmen", elements of Kaniza figures, that were either coherently organized to form illusory Kaniza triangles or randomly oriented, and asked to remember the orientation of the individual pacmen. Subjcts performed a change detection task on a single pacman probe after a brief delay, indicating whether the pacman probe was in the same or different orientation as the sample. We then measured memory capacity based on the number of chunked objects versus individual elements in the display. Memory capacity was greater in the Kaniza triangle condition than the random condition. ERPs were also recorded during the experiment. In particular, the contralateral delay activity is an ERP component sensitive to the number of items held in memory during the delay activity of a visual working memory task. The effects of visual chunking on this component will be discussed.

H108

AN INVESTIGATION OF WORKING MEMORY CORTICAL NETWORKS USING INDEPENDENT COMPONENT ANALYSIS *Shashwath Meda[1], Bradley Folley[1,5], Vince Calhoun[1,2,4], Michael Stevens[1], Godfrey Pearlson[1,2,3]; [1]Olin Neuropsychiatry Research Center, Institute of Living at Hartford Hospital, Hartford, [2]Yale University School of Medicine, New Haven, [3]Johns Hopkins University, Baltimore, [4]The MIND Institute, Albuquerque, [5]Vanderbilt University, Kennedy Center, Nashville* – Background: Human working memory (WM) is a multi-regional task involving "temporary storage and manipulation" of information. We used independent component analysis (ICA) to identify different spatiotemporal networks involved in a Sternberg WM fMRI paradigm. Methods: Healthy controls (N=57) (Age- Mean+Stdev: 36.96+11.2 yrs; 31 male, performed a modified version of the Sternberg task, (Johnson et. al. 2006). Exclusion criteria included present/past DSM-IVAxis I disorder or psychotic first-degree relatives. Functional images were preprocessed using SPM2 and imported into the GIFT toolbox for ICA analysis. Resulting component networks were then correlated to the encoding and recognition phases of the experiment using multiple regression, to determine individual association (beta) values for each phase. Further, we performed paired sample t-tests on the beta values to identify component-related differences between conditions. Results: ICA revealed 15 task-related neural networks. Non-cognitive networks included: Motor, cerebellum, extrastriate visual, default mode. 5/15 networks were cognitive-related task components: C1. Superior frontal-frontal eye fields (FEF) (p=3.3*10-7) C2. FEF- parts of DLPFC-anterior cingulate (ACC) (p = Not significant) C3. DLPFC-ACC-basal ganglia-STG-Broca (p=0.0003) C4. Superior and Inferior parietal (p=0.0003) C5. Anterior STG-Fusiform-Inferior Temporal-Hippocampus/parahippocampus (p=0.0009) All components except C2 differed significantly between the two experimental conditions (Related p values indicated in brackets). Specifically, components C3 and C4 were more associated with the recognition phase and C1 and C5 with encoding. Conclusion: For the first time, we have demonstrated the usefulness and sensitivity of ICA in delineating different WM networks. Further, we determined specific associations between cognitive networks and WM task conditions.

H109

BRAIN REGIONS MEDIATING WORKING MEMORY COMPONENT PROCESSES *Michael Motes[1,2], Bart Rypma[1,2]; [1]University of Texas at Dallas Center for BrainHealth, [2]University of Texas Southwestern Medical Center* – Exploration of the component processes that comprise delayed-response working-memory (WM) tasks is difficult due to the chronology of the component processes and the temporal resolution of FMRI. Assumptions about the shape of the BOLD response for each component process must be made, and sequential overlapping BOLD responses may not be able to be uniquely identified via traditional regression modeling. Resolving controversies regarding the role of prefrontal cortex (PFC) in encoding and maintaining information in WM (see Rypma, 2006) requires isolating component-related BOLD responses. "Partial-trial paradigms" (Ollinger et al, 2001) can obviate these problems. In the present study, we used the partial trial paradigm to examine brain regions mediating WM encoding, maintenance, and retrieval processes involved in a delayed-response WM task. Participants completed full trials that involved encoding one or six letters, maintaining the memory-set over a delay, and then searching WM to determine whether a probe was in the memory-set. Participants also completed encoding only, encoding and maintenance, and encoding and retrieval partial trials intermixed with the full trials. For the encoding only and encoding and maintenance trials a cue was given to terminate the trial and lead the participants to terminate the processes. Using this method, we were able to identify PFC regions that mediate WM encoding, maintenance, and retrieval component processes involved in remembering sub- and supra-capacity memory sets.

H110

TESTING COMPUTATIONAL PREDICTIONS OF THE ROLE OF BASAL GANGLIA DOPAMINE IN WORKING MEMORY: PARKINSONISM AND MEDICATION EFFECT *Ahmed Moustafa[1], Scott Sherman[2], Michael Frank[2]; [1]Rutgers University, [2]University of Arizona* – Computational models suggest that the basal ganglia, in particular striatal dopamine, play a critical role in working memory (WM) (O'Reilly & Frank, 2006; Moustafa & Maida, 2007). The models suggest that the basal ganglia trigger the updating of prefrontal cortical WM representations, and that phasic dopamine amplifies the updating of task-relevant information relative to distractors. To test these ideas, we tested Parkinson's patients both off and on their dopamine medications on a modified version of the AX-CPT task. In this task, knowing when and when not to update information are both important for successfully performing different aspects of the task. The task also includes distractor, attentional shifting, and learning phases that assess the role of striatal dopamine in WM. Preliminary results suggest that Parkinson's patients are more impaired in comparison to matched controls and that striatal dopamine modulates working memory processes. We will discuss the results of this study pointing out the successes and failures of the neuro-computational models.

H111

NEURAL MECHANISMS OF RETRIEVAL FROM SHORT-TERM MEMORY *Derek Nee[1], John Jonides[1]; [1]University of Michigan* – Theories of short-term memory (STM) are divided regarding architecture. Much of the controversy surrounds the capacity of STM, and whether information within STM shares an equal status, or whether there are distinct states of STM. One prominent proposal posits that within STM, a single item within the focus of attention is available for immediate cognitive operation that is distinct from other information in memory. At the present, neuroimaging studies investigating STM have not carefully examined this issue. Here, we used event-related fMRI to examine the neural correlates of STM retrieval while subjects performed a 3-item recognition paradigm. The rapid presentation of materials minimized rehearsal, permitting the ability to contrast retrieval of the presumed focus of attention versus retrieval of other items in STM. We found that relative to the focus of attention, retrieval of other items in STM elicited increased activation in regions of left ventrolateral prefrontal cortex (BA 45), left dorsolateral prefrontal cortex (46/9), and left parahippocampal gyrus. By contrast, inferior temporal cortex demonstrated increased activation to recognition probes matching the focus of attention relative to other items in STM. Many of these regions also demonstrated significant correlations with behavioral measures of retrieval speed. These results support a distinction between the focus of attention and other information in STM.

H112

LEARNING AND AWARENESS IN MULTIPLE SCLEROSIS: DISSOCIATING AGE-RELATED EFFECTS FROM COGNITIVE PERFORMANCE *Geoffrey O'Shea[1], Kimberly Sena Moore[2], Dave Peterson[3], Benjamin A. Clegg[2], Gerald C. McIntosh[2,4], Michael Thaut[2]; [1]SUNY-Oneonta, [2]Colorado State University, [3]University of California San Diego, [4]Poudre Valley Hospital, Fort Collins, CO* – Multiple sclerosis (MS) patients exhibit retrieval deficits from short-term memory (STM) while performing comparable to controls on implicit learning tasks involving motor skill acquisition and word priming. These studies are paradoxical in that MS patients can form long-term representations despite STM retention difficulties. The present investigation assessed implicit learning in MS patients using the Hebb Digits (HD) task, which involves the incidental learning of a repeating nine-digit sequence. In the HD task, implicit learning is indexed through gradually improved memory for a repeating pattern of digits compared to a random series of digits. In contrast to other implicit learning tasks, such as the serial reaction task, performance in the HD task requires less motor responding and more reliance on working memory processes. The results of our investigation revealed that MS patients demonstrated HD learning. However, recall of both the repeating and random series was significantly greater in an age-matched control group compared to the MS participants suggesting a global memory deficit associated with MS. The results of a post-experimental recognition test revealed HD learning in both groups to be reliant on explicit awareness of digit repetition. In summary, our results provide evidence for explicit, but not implicit learning in both MS patients and age-matched controls suggesting that global memory deficits in MS may limit working memory capacity, but not the ability to learn through repetition. Furthermore, these results suggest that the implicit learning capabilities of MS individuals are a function of the working memory component of the task.

H113

MEDIAL TEMPORAL LOBE AND THE LEFT INFERIOR FRONTAL GYRUS JOINTLY SUPPORT INTERFERENCE RESOLUTION IN VERBAL WORKING MEMORY *Ilke Öztekin[1], Clayton Curtis[1,2], Brian McElree[1]; [1]New York University, [2]Center for Neural Science, New York University* – Functional magnetic resonance imaging (fMRI) was used to investigate the role of left inferior frontal gyrus (LIFG) and medial temporal lobe (MTL) regions in resolving proactive interference (PI) in verbal working memory. Participants were presented 6-item study lists, and a recognition probe after a short distracter task. PI was manipulated with a release from PI paradigm: study lists were constructed from the same semantic category (e.g. animals), and the category was switched (e.g. fruits) after three consecutive trials. Interference from episodic familiarity was examined by comparing recent negative (RN) probes (lures studied in previous trial) to distant negative (DN) probes (lures not presented within a block). Both proactive and episodic interference effects resulted in enhanced activation in LIFG and MTL regions. However, the two effects interacted: In the absence of PI, RNs resulted in more activation than DNs in both LIFG and MTL; in the presence of PI, DNs engendered more activation than RNs in both regions, reversing the classical episodic familiarity effect. These findings suggest that LIFG supports the successful resolution of PI induced by semantic similarity, in addition to its well-established role in resolving misleading episodic familiarity. Results also indicate that LIFG and MTL jointly contribute to the resolution of interference in verbal working memory. Both regions may do so by mediating controlled retrieval processes that provide access to detailed episodic information (e.g. list-specific information or source memory).

H114

DISENTANGLING THE WORKING MEMORY IMPAIRMENT IN ADHD. *Joanne Park[1], Sarah Seth[2], David Coghill[2], Sinead Rhodes[1]; [1]University of Stirling, [2]University of Dundee* – Attention Deficit Hyperactivity Disorder (ADHD) is characterised by pervasive inattention, hyperactivity and impulsivity and is prevalent in around 3-5% of children. Dysfunction of executive neuropsychological functioning e.g. working memory (WM), mediated by the prefrontal cortex, has been the central focus of recent ADHD research. Previous research conducted by our group has suggested that children with ADHD may be impaired in executive (manipulation) and non-executive (maintenance) aspects of working memory. The aim of the current study was to characterise WM functioning in ADHD using tasks specifically designed to tap both verbal and visuo-spatial executive and non-executive components of WM. Twelve drug-naïve children (all boys) with ADHD (mean age: 9.75, age range:7-13) and sex and age-matched controls participated in the study. All children were assessed on a vocabulary task (BPVS II), verbal and spatial WM tasks and on a range of standardized neuropsychological WM tasks from the CANTAB battery. Children with ADHD were impaired on visuo-spatial but not verbal WM tasks. Impairment was particularly marked on the spatial executive WM task, requiring the ability to manipulate spatial locations in WM. Performance on standardized neuropsychological verbal and spatial WM tasks from the CANTAB battery corroborated these findings. The current data adds to evidence of WM impairment in ADHD suggesting that children with the disorder may have particular difficulties in executive aspects of visuo-spatial WM.

H115

CONSTRUCTING AN INTEGRATED WORLD IN THE MIND: REFRESHING A SCENE IN THE PPA AND RSC *Soojin Park[1], Marvin M. Chun[1], Marcia K. Johnson[1]; [1]Yale University* – Constructing a rich and coherent visual experience involves maintaining visual information that is not perceptually available in the current view. Recent studies suggest that briefly thinking about a stimulus can modulate activity in category specific visual areas. Here, we tested the nature of such perceptually refreshed representations in the parahippocampal place area (PPA) and retrosplenial cortex (RSC) using fMRI. We asked whether a refreshed representation is specific to a restricted "view" of a scene, or more abstract and view-invariant. Participants saw a panoramic scene and were asked to refresh part of the scene after it disappeared. In half of the trials, the refresh cue appeared twice on the same side (e.g., left refresh-left refresh), and other trials, the refresh cue appeared on different sides (e.g., left refresh-right refresh). A control condition presented physical halves of the scene twice on same sides (e.g., left repeat-left repeat) or different sides (e.g., left repeat-right repeat). When scenes were physically repeated, both the PPA and RSC showed greater activation for the different side repetition than the same side repetition, suggesting view-specific representations. However, when participants refreshed scenes, the PPA showed view-specific activity just as in physical repeat conditions, whereas the RSC showed an equal amount of activation for different and same side conditions. This finding suggests that, in the RSC, refreshed representations were not restricted to a specific view of a scene, but extended into the whole scene and thus could provide a mechanism for integrating multiple views.

H116

MEMORY DEMAND-INDUCED INCREASES IN ALPHA-BAND POWER CORRESPOND TO DYNAMIC NETWORK CHANGES *Lisa Payne[1], John Kounios[1]; [1]Drexel University* – Accumulating evidence supports that the phenomena of working memory (WM) is a result of synchronous oscillations between distant foci of activity. To elucidate WM network dynamics, scalp EEG was recorded while 10 participants performed a modified Sternberg task. Coherence was then measured between the electroencephalogram at different sites. In each trial, participants judged whether a probe consonant was one of the memory set of 2, 4, or 6 consonants. Analysis of the 2.8 s retention period confirmed previous findings of a parietal-occipital alpha frequency (8 – 12 Hz) peak that systematically increased with the number of items held in WM. Alpha frequency coherence increased between electrode PZ and left-lateralized parietal-temporal sites only between set sizes 2 and 4. There was no change in alpha coherence from 4 to 6 consonants. Interestingly, coherency between parietal electrode PZ and left temporal electrode T7 showed the most significant enhancement. Further analysis revealed that, although there was no change in theta band (4 – 7 Hz) power, theta coherence between T7 and frontal-central sites increased between set sizes 4 and 6 while simultaneously decreasing with parietal-occipital sites. These findings demonstrate that the WM network responds to initial increases in demand with enhancement of alpha band coherence, but higher demand is reflected by changes in theta band coherency. The changes in theta coherence confirm its expected, but previously undiscovered, involvement in increasing WM load. The increase in alpha coherence affirms its direct participation in the WM network, and combined with the theta results, indicates an inhibitory role.

H117

DISTINGUISHING VISUAL SEARCH AND WORKING MEMORY VIA CORTICAL AND HEART-RATE RESPONSES *Pandelis Perakakis[1], Jaime Vila[1], Walter Machado-Pinheiro[2], Pedro Guerra[1], Aydamari Faria Jr[2], Isabel DePaula Antunez[2], Lourdes Anllo-Vento[1,3]; [1]University of Granada, Spain, [2]Federal Fluminense University, Niteroi, Brazil, [3]University of California, San Diego* – In this study, we investigated the spatio-temporal dynamics of visual search (VS) and visual-spatial working memory (WM) with cortical potentials (ERPs) and phasic heart-rate changes. Previous studies demonstrated that these cognitive operations were associated with distinct heart-rate response patterns. Thirty volunteers carried out VS or WM tasks in counterbalanced order. Each trial included two visual displays separated by 900 ms. In the WM task, subjects held in working memory the colors of 4 squares in the visual field signaled by a central arrow cue(1). During VS, subjects searched the cued visual field to detect a line crossing one of the squares. Following the second display, subjects reported either a color change in one of the squares (WM), or a change in line orientation (VS). Continuous EEG, horizontal EOG, and ECG were recorded throughout the experiment. RTs and percentage of correct responses were obtained following change and no-change trials. Percentage of correct responses did not differ across tasks. The amplitude of the N2pc component, a neural index of VS and filtering of irrelevant stimuli, was greater in the VS task, while the CDA, a contralateral parietal wave reflecting WM load, was similar under both conditions. Evoked heart-rate changes were significant under VS but not WM conditions. These findings demonstrate that, though tightly coupled, VS and WM constitute distinct cognitive and neural operations. (1) Vogel & Machizawa, 2004, Nature, 428: 748-51

H118

THE INTERACTION BETWEEN STIMULUS FAMILIARITY AND RECENCY IN PROACTIVE INTERFERENCE RESOLUTION *Ranjani Prabhakaran[1,2], Sharon L. Thompson-Schill[1,2]; [1]University of Pennsylvania, [2]Center for Cognitive Neuroscience, University of Pennslyvania* – Proactive interference (PI) refers to interference from previously encountered items in memory. Resolution of PI involves rejecting a familiar but incorrect probe item and often results in increased reaction times and error rates in working memory (WM) tasks. Although previous studies have investigated the role of familiarity in terms of the short-term recency of the probe item, the interaction between a long-term memory manipulation in the form of stimulus familiarity and short-term recognition memory has not been investigated. The goal of this study was to determine the effect of stimulus familiarity on PI resolution in WM. In addition, this study aimed to tease apart the contributions made by fast assessments of familiarity versus slower recollective processes to recognition memory performance through the manipulation of response deadline (see Oztekin & McElree, 2006). A behavioral experiment was conducted in which subjects performed an item recognition task. Long-term stimulus familiarity was manipulated through the use of famous and nonfamous faces as stimuli. Response deadline was manipulated as a between-subjects variable, where half of subjects were presented with the probe item for 500 ms and the other half of subjects were presented with the probe item for 3000 ms. An interaction between recency and stimulus familiarity was found only in the shorter response deadline condition due to a larger interference effect in terms of both reaction time and false alarm rate for the famous compared to nonfamous faces. These data implicate a role for stimulus familiarity in the resolution of PI in WM.

H119

NEURAL SYSTEMS INVOLVED IN WORKING MEMORY FOR SEMANTICALLY RELATED OBJECTS: AN FMRI STUDY *Yakeel T. Quiroz[1], Karin Schon[1], Chantal Stern[1,2]; [1]Center for Memory and Brain, and Center for Excellence in Learning, Education, Science, and Technology, Boston University, Boston, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown* – The role of cortical structures, particularly the dorsolateral prefrontal cortex (DLPFC), in working memory (WM) is well known. Recent reports have also indicated an important role for the basal ganglia (BG) and medial temporal lobe (MTL) regions in WM. In the present study, we investigated the role of the BG, MTL, and DLPFC, in working memory for semantically related objects vs. semantically unrelated objects. The stimuli consisted of 210 pictures of everyday objects. Objects came from 12 semantic categories, and subjects were pre-trained on the stimuli the day before scanning. Sixteen young, healthy, subjects performed a Sternberg task while in a 3T Trio scanner. There were two task conditions. The Semantic Category condition (SC) included only items from the same category, and the Random Category condition (RC) included only semantically unrelated items. Each trial consisted of three sequentially presented events: encoding of 6 consecutively presented pictures (SC or RC), followed by a brief delay (maintenance), and then probe (retrieval). During retrieval, subjects indicated via button-press whether the probe picture matched one of the pictures seen during encoding. Results contrasted SC and RC trials. SPM analyses revealed significant bilateral BG and right MTL activations during encoding, bilateral BG and left DLPFC activations during maintenance, and frontal pole activation during retrieval. Our findings are consistent with previous studies that have reported BG activity during non-spatial WM tasks and extend previous findings by suggesting a role for this system in the encoding and maintenance of semantically related objects. Funded by NSFSBE-0354278.

H120

DYNAMICS OF BRAIN OSCILLATORY NETWORKS INVOLVED IN WORKING MEMORY FROM MEG SIGNALS *Sreenivasan Rajamoni Nadar[1], Fred Carver[1], Tom Holroyd[1], Richard Coppola[1]; [1]MEG Core Facility, National Institute of Mental Health, NIH, Bethesda* – We characterized the functional organization of large-scale oscillatory networks involved in prefrontal, parietal, anterior cingulate cortex (ACC) and other areas involved in working memory task. Twelve subjects performed n-back working memory task, while MEG recordings was sampled at 600Hz with a 275-sensor radial gradiometer system. The MEG sensor data were mapped onto the MRI brain volume using Synthetic Aperture Magnetometry (SAM), an adaptive beamformer technique, to look at the variance between active states (1-back, 2 back) vs. control (0-back) and identified statistically significant areas. Then we extracted the single-trial time series for the brain regions that we obtained from SAM images and computed coherence, Granger causality spectra using Bivariate Autoregressive models for all pairwise combination of the source areas. The coherence and directed Granger matrix in theta, alpha, beta and gamma bands were analyzed for graph theoretic measures including clustering index and mean path length. These matrices were further analyzed to identify the critical network nodes for each frequency, time window and working memory conditions. Differences between memory loads (2back vs. 0 back, 1 back vs. 0 back) were found to be more robust in the beta frequency band centered around the response time window. A distributed set of interconnected network nodes were observed in prefrontal and parietal regions. Many nodes in these regions exert a variety of top-down and bottom-up causal influences in different frequency and time windows. Working memory was seen to engage a distributed network of prefrontal, parietal and ACC regions.

H121

AGE-MEDIATED ASSOCIATIONS BETWEEN REGIONAL BRAIN ACTIVITY AND REACTION TIME COMMON TO WORKING MEMORY ENCODING, REHEARSAL, AND RECOGNITION *Brian Rakitin[1], Joseph Flynn[1], Christian Habeck[1], Jason Steffener[1], Yunglin Gazes[1], Yaakov Stern[1]; [1]Division of Cognitive Neuroscience, Taub Institute, Columbia University* – How do age and cognitive demands affect the brain regions that determine working memory performance? Healthy young (n = 40; mean age = 25.1 years) and elderly (n = 18; mean age = 74.4 years) subjects performed a delayed item recognition task for visually presented letters with three set sizes (1, 3, or 6 letters) while being scanned with BOLD fMRI. Voxel-wise analysss within encoding (3 s), retention (7s), and retrieval (3 s) task phases examined the age-mediated differences in slope between change in BOLD signal and change in reaction time (RT), both with respect to set size. Conjunction analysis identified voxels where the difference-of-slopes test was significant during all three tasks phases. This analysis identified a large set of brain regions including the insula, DLPFC, and SMA, where higher set size-related BOLD signal predicted higher set sized-related RT changes in the aging, but not the young participants. These results suggest the presence in all three phases of either an inefficient representational scheme, or a counter-productive operation -beyond the standard encoding, rehearsal and recognition processes - in the aging participants only. In addition, a conjunction analysis of the mean set size-related BOLD signal change without the RT covariate indicated significant results one-tenth the extent of the difference-of-slopes analysis. These results suggest that the difference-of-slopes results are not an artifact of the high correlation between the GLM predictors associated with the time-locked task phases.

H122

EVIDENCE FOR VISUO-SPATIAL AND VERBAL WORKING MEMORY IMPAIRMENT IN INDIVIDUALS WITH WILLIAMS SYNDROME. *Sinead Rhodes[1], Emma Fraser[1], Deborah Riby[1]; [1]University of Stirling, Stirling* – Williams syndrome (WS) is a genetic neuro-developmental disorder caused by the microdeletion of numerous genes at site 7q11.23. Characterised by a distinct cognitive profile of peaks and valleys, it is widely accepted that more severe impairments reside within the visuo-spatial domain than the verbal domain. Accumulating evidence suggests that individuals with WS show impairments in visuo-spatial working memory (WM). The current aim was to characterise WM functioning in WS using tasks that tap both visuo-spatial and verbal components. A secondary aim was to compare functioning on tasks with and without a central executive requirement. Twelve individuals with WS (ranging: 12-26; mean age:21) and 12 chronologically age-matched controls participated in the study. All participants were assessed on verbal (BPVS II) and non-verbal (Raven's Progressive Matrices) ability tasks and verbal and spatial WM tasks. Individuals with WS were impaired on both executive and non-executive memory tasks. Surprisingly, individuals with WS showed similar levels of impairment on verbal and spatial WM tasks in comparison to matched controls. Verbal working memory abilities have not previously been assessed in WS. Our finding of impairment on executive and non-executive verbal working memory tasks adds to growing evidence suggesting that individuals with WS show deficits across a range of verbal tasks. Although early research suggested 'intact' or even 'superior' verbal skills in the profile of cognitive abilities associated with WS, the current evidence suggests working memory deficits within the verbal and visuo-spatial domain.

H123

THE TOP-DOWN INFLUENCE OF MEMORY REPRESENTATIONS ON FACE PROCESSING *Kartik K. Sreenivasan[1], Deepak Sambhara[1], Zev B. Rosen[1], Amishi P. Jha[1]; [1]University of Pennsylvania, Center for Cognitive Neuroscience* – The present study investigated the top-down influence of actively maintaining a face in memory on the perceptual processing of faces. Previous reports have demonstrated enhanced neural activity in perceptual brain regions to memory probes that matched items being actively maintained in memory (e.g. Druzgal & D'Esposito, 2001). Yet, the neural mechanisms by which match enhancement occurs are not well understood. Here we investigated the hypothesis that match enhancement results from biased competition in favor of memory-relevant perceptual information. To test this hypothesis, we manipulated the perceptual similarity between the probe item and the concurrently held memory representation and observed the influence of the memory representation on the neural response to probes. Participants (n = 15) viewed a series of faces, and responded to the presentation of a pre-learned target face during event-related potential (ERP) recording. Non-target probe faces varied in their similarity to the target face. The impact of memory representations on perceptual processing was assessed by the amplitude of the occipito-temporal N250 ERP component, a neural correlate of the perceptual recognition of individual faces (Schweinberger et al., 1995). N250 elicited by probe face presentation was strongly modulated by the degree of similarity between the probe face and the target face; N250 amplitude was maximal to the target face and decreased as probe faces decreased in similarity to the target face. These results suggest that perceptual features comprising memory items may bias activity in perceptual regions, and that this competition may give rise to the phenomenon of match enhancement.

H124

PERSISTENT ACTIVITY IN THE HUMAN FRONTAL EYE FIELD WHEN MAINTAINING SPACE THAT IS 'OFF THE MAP' *Kyeong-Jin Tark[1], Clayton Curtis[1,2]; [1]New York University, [2]New York University, Center for Neural Science* – During the maintenance of visuospatial information in working memory, neural activity in the frontal eye field (FEF) persists. Such signals are spatially selective, where activity is greatest in neurons whose response fields match the retinal location of the visual cue. Here, we used fMRI to test if human FEF activity persists when maintaining auditory space, and further test if the activity is selective for retinal space. We recorded binaural sounds emitted from 36 positions around the subject from microphones placed within each subject's ear canals. Subjects could localize the replay of these sounds because the recordings preserved the interaural time and level differences. Then, we scanned subjects while they performed an audiospatial working memory task. They maintained the location of a sample sound (S1) over a long delay period and then indicated if it matched the location of a test sound (S2). Half of the sounds were emitted from locations that if visible would fall on the retina and half were from behind the subject. Independent staircases equated the difficulty for front and back cued trials by adjusting the distance of the S1/S2 discrimination. Putative FEF activity persisted when maintaining auditory-cued space, even when locations were behind the subject. We found this activity was greater in the hemisphere contralateral to the side of the cue when representing retinal space as well as extra-retinal space. Therefore, human FEF activity represents a map of space that includes locations in which it is impossible to make a saccade.

H125

COMPUTERIZED TRAINING OF WORKING MEMORY - A METHOD FOR COGNITIVE ENHANCEMENT IN HEALTHY ADULTS *Helena Westerberg[1], David Söderman[1], Yvonne Brehmer[1], Nicolas Dhondt[1], Håkan Fischer[1], Stuart MacDonald[1], Lars Bäckman[1]; [1]Aging Research Center, Karolinska Institute, Stockholm* – Goal: To examine the effects of computerized training of Working Memory (WM) in normal adults (N100). Background: WM is essential for cognitive functioning. Age-related decline is typically observed in WM tasks but cognitive enhancement by training of WM has not been investigated earlier. Methods: 45 participants in ages 60-70 were randomized to a treatment or a comparison condition. To compare age differences in baseline performance and in training effects, a younger group, 20-30 years (N55) were included and randomized cross conditions. The treatment consisted of intense and adaptive computerized training (Cogmed QM) on WM tasks for five weeks. The comparison condition involved training using the same software, but the difficulty level remained constant. A cognitive test battery including non-trained tasks assessing WM, attentional functions, perceptual robustness, episodic memory, and reasoning were administered before and after the training period. The Cognitive Failure Questionnaire (CFQ) was used to measure memory and attention in daily living. Results: In both age groups there was a significant difference between pre- and post training assessment in the training group, compared to the comparison group on the non-trained tests for WM, attention and perceptual robustness (reaction time). There were also a significantly lower number of cognitive symptoms reported. At follow-up three months after the intervention, most training effects were still significant between conditions. Conclusions: WM training can improve cognitive performance in healthy adults, -on neuropsychological tests and in cognitive functioning in daily life. At follow-up three months after the training period most training effects remained.

H126

FACE PROCESSING STRENGTH IN WILLIAMS SYNDROME EXTENDS TO MEMORY FOR FACES *Anna Yam[1], Yvonne M. Searcy[1], Kiley J. Hill[1], Mark Grichanik[1], Ursula Bellugi[1]; [1]The Salk Institute for Biological Studies* – Williams syndrome (WS), a neurodevelopmental disorder caused by a hemizygous microdeletion on chromosome 7q11.23, is characterized by profound impairments in visuo-spatial abilities, but relatively spared face recognition skills. Further, individuals with WS tend to display "hyper-social' behavior, the hallmark of which is a preference for, and increased attention to, human faces relative to other visual stimuli. While previous studies have assessed short- and long- term auditory and visuo-spatial memory in WS, memory for faces has not been explored. Participants completed the immediate and delayed (30 minutes) conditions of three subtests of the Wechsler Memory Scale - 3rd Edition, including one auditory memory (Logical Memory) and two visual memory (Faces & Family Pictures) subtests. Performance of the WS group was compared to that of age-, gender-, and IQ- matched individuals with developmental disorders of unspecified etiologies (DD). While in the visual domain, results revealed no significant differences between WS and DD groups on immediate or delayed memory for Family Pictures, the WS group performed significantly better than the DD group on immediate and delayed memory for Faces. These results suggest that the relative strength in face processing in WS extends to memory for faces.

H127

AGE RELATED CHANGES IN TOP-DOWN MODULATION OF LOW-LEVEL VISUAL PROCESSING *Theodore Zanto[1], Brian Toy[1], Adam Gazzaley[1]; [1]University of California San Francisco* – Top-down modulation refers to our ability to focus attention on task-relevant stimuli while ignoring irrelevant distractions and it shares an intimate relationship with memory, as the focus of attention will restrict content to relevant information and limit interference from irrelevant stimuli. In the current study, we assessed the influence of aging on the relationship between top-down modulation during low-level (i.e. color or motion) visual processing and working memory (WM), as it has been shown that older adults exhibit slower processing speeds and deficits in WM and attention. Subjects were between 18-35 y.o. and 60-80 y.o. Both age groups were presented sequential, random-dot circular apertures that contained stationary colored dots or gray dots that moved coherently in one direction. Each trial contained two different directions of motion and two different colors followed by a four second delay and a probe stimulus. Subjects were given four task conditions: remember the directions of motion (ignore color), remember the colors (ignore motion), remember both directions and colors, or passively view all stimuli. All subjects were pre-thresholded for discrimination and performance measures revealed a significant age-related decrease in WM for color, but an increased RT for both color and motion. Attentional (top-down) modulation was observed in posterior electrodes and did not differ in magnitude between the age groups. However, older subjects displayed longer reaction times and delayed neural responses as indexed by a shift in the selection negativity and alpha desynchronization. The relationship between delayed neural modulation and WM performance is being further explored.

H128

DIRECT EVIDENCE FOR BINDING IN VISUAL WORKING MEMORY *Weiwei Zhang[1], Steven Luck[1,2]; [1]Center for Mind & Brain, UC Davis, [2]UC Davis* – Most visual objects in the natural environment contain feature values along multiple dimensions. Luck & Vogel (Nature, 390, 1997, 279-281) argued for integrated object-based representations in visual working memory (VWM), and they showed that multi-feature objects can be held in visual working memory as well as single-feature objects. However, it is important to show that the features are actually bound together in some direct manner. In the present study, subjects made separate reports of the color and orientation of a previously presented bar. Feature binding was assessed on the basis of a contingency analysis of response accuracy. That is, when one feature is or is not remembered, is the other feature remembered? We found that memory for one feature of an object was strongly associated with memory for the other feature of the object. Furthermore, VWM precision and capacity were equivalent for single-feature and multiple-feature objects. These results therefore provided direct evidence for binding in VWM. Some constraints on VWM binding were also tested. In Experiment 2, we found that it was possible to represent one feature of an object without representing the other feature of that object when the other feature was selectively masked. In Experiment 3, we ruled out an alternative location-based encoding account by showing that spatially overlapping colors & orientations that belonged to different objects were encoded into VWM independently. Taken together, these results provided direct evidence for automatic, flexible, and object-based feature binding in VWM.

H130

A NEW MODEL AND TREATMENT FOR POST-STROKE TACTILE ALLODYNIA. *Paul McGeoch[1], Lisa Williams[1], Vilayanur Ramachandran[1]; [1]Centre for Brain and Cognition, UCSD* – Central post-stroke pain (CPSP) follows about 5% of all strokes and is characterised by severe, unrelenting pain throughout the contralateral half of the body, with sufferers also frequently complaining of an acute exacerbation of their pain to light touch; tactile allodynia. Whilst there is now significant evidence to support the thermosensory disinhibition hypothesis for the constant background pain in these patients, tactile allodynia has until now been something of an unexplained anomaly. We found using magnetoencephalography (MEG) that tactile allodynia in CPSP corresponds to activation of the primary motor cortex (M1) and subsequently the anterior cingulate cortex, which is known to be responsible for the motivational component of pain. Moreover, we also show that stimulation of the brain's vestibular system can temporarily return the pattern of brain activation after light touch to normal (predominantly primary somatosensory cortex (S1) activation), with consequent relief of the persistent tactile allodynia. We propose a model for tactile allodynia in CPSP in which the interoceptive cortex in the dorsal posterior insula modulates activation of S1 and M1 in response to light touch. The evolutionary drive behind such a mechanism may have been to induce a sub-threshold activation of M1 to facilitate rapid corrective action when a deviation from homeostatic norms occurs. This model, not least with its suggestion of a sensory of role for M1, ties in with the modern view of the brain as a series of interconnected systems that serve several functions.

Memory: Memory disorders

H131

CONFABULATION, REALITY MONITORING AND THE INFERIOR MEDIAL PFC: CONVERGING EVIDENCE FROM LESION AND FUNCTIONAL IMAGING STUDIES. *Martha Turner[1], Paul Burgess[1], Lisa Cipolotti[2], Chris Frith[3], Sam Gilbert[1], Tim Shallice[1], Jon Simons[4]; [1]Institute of Cognitive Neuroscience, UCL, London, [2]National Hospital for Neurology and Neurosurgery, London, [3]Wellcome Trust Centre for Neuroimaging, Institute of Neurology, UCL, London, [4]University of Cambridge* – Confabulation, the pathological production of false memories, occurs following a variety of etiologies involving the frontal lobes. However the critical frontal regions and specific cognitive deficits involved remain unclear. This poster reports three studies investigating the association between confabulation, reality monitoring abilities, and the inferior medial PFC. In the first, an investigation of the localization of confabulation in an unselected series of 38 patients with frontal lesions revealed an association with inferior medial lesions. In the second, an investigation of reality monitoring abilities in four spontaneously confabulating patients with damage to inferior medial PFC revealed a tendency to misidentify imagined events as real. In the third, an fMRI study revealed that a corresponding region of inferior medial PFC was recruited by healthy participants when determining whether imagined stimuli had been perceived or imagined, and that reduced activity in this region was associated with making "imagined-to-perceived" misattribution errors. These findings provide converging evidence from lesion and neuroimaging studies suggesting that reality monitoring abilities are associated with the inferior medial frontal lobe. An impairment in discriminating between real and imagined events might account for some confabulations seen in neurological patients with damage to inferior medial PFC.

H132

LONG-LASTING EFFECTS OF A VISUALLY-ENHANCED STUDY CONDITION ON THE N400 AND P600 COMPONENTS. *John Olichney[1,2], Alexander Bressler[3], James Gatherwright[4], Hillert[5], Shaiohui Chan[1,2], Vincente Iragui[5,3], Marta Kutas[5,6]; [1]UC Davis, [2]Center for Mind and Brain, Davis, CA, [3]VA San Diego Healthcare System, San Diego, CA, [4]School of Med., Case Western Reserve University, Cleaveland, OH, [5]UCSD, , [6]UCSD* – Background: The P600 and N400 (sensitive to semantic processing) have both been linked to aspects of verbal learning or memory. While much is known regarding the modulation of these components by repeating stimuli within an experiment, little is known regarding the correlates of long-term learning. Thus, we designed a visually-enhanced study condition (VESC) in which color photographs of objects (semantically congruous or incongruous) were studied for 3.5 hours over 7 days preceding the Event-related potential (ERP) session. Methods: Ten normal young adults were studied with 32 channel ERP. 50% of the stimuli were semantically congruous vs. incongruous. Both studied and unstudied stimuli had a 67% probability of repeating (10-140 seconds later). Results: Prior visual study resulted in a large decrease of P600 amplitude for the initial presentation of congruous words. The amplitude of this decrement correlated with subsequent recall and recognition (r's=.65-.68). For incongruous words, smaller N400 and P600s were elicited by studied items. For unstudied new words, but not for initial presentations of studied words, larger N400s were elicited by incongruous than congruous words. Free recall was strongly correlated with the P600 word repetition effect amplitude (r =.84). Cued recall and recognition were strongly correlated with the N400 repetition effect amplitude (r's =.86-.91;p's<0.001). Conclusions: Prior study of color photographs had large effects on ERPs obtained >12 hours later. Both the N400 and P600 showed sensitivity to the VESC. These data suggest that the VESC fostered memory "binding" and long-lasting semantic associations, even for incongruous material usually difficult to learn.

Poster Session I

Attentional processes: Auditory

I1

EFFECTS OF TASK PERFORMANCE ON THE AUDITORY BRAINSTEM RESPONSE TO SPEECH *Karen Banai[1], Nina Kraus[1]; [1]Northwestern University* – Auditory processing in the human brainstem is influenced by non sensory factors such as music and language expertise. Whether it is also influenced online by auditory selective attention has been subject to much controversy and the prevailing view is that while auditory selective attention influences early cortical responses, it does not influence sub-cortical auditory processing. Here we used a dichotic listening oddball procedure to determine whether the scalp recorded auditory brainstem response to a speech syllable (speech-ABR) is affected by selective attention or active task performance. Speech-ABRs were recorded from 12 young adults in two conditions: an active listening condition in which listeners were asked to attend speech syllables presented to one ear and detect occasional targets differing in fundamental frequency while ignoring the same syllables presented to the other ear, and a passive listening condition in which the same stimuli were presented but listeners were not required to perform any task and could watch a silent movie. Active task performance resulted in a small but significant reduction in the amplitude of the brainstem response to both actively-attended and actively-ignored standard sounds relative to passive listening, but not in a specific effect of attention. These data suggest that actively engaging in an auditory discrimination task can modulate sub-cortical processing of speech sounds in a task relevant manner; however, this modulation can not be attributed to selective attention because the effects of task performance are similar across the attended and ignored auditory channels.

I2

GENETIC INFLUENCES ON SELECTIVE AUDITORY ATTENTION AS INDEXED BY ERPS *Theodore Bell[1], Laura Batterink[1], Jeff Currin[1], Eric Pakulak[1], Courtney Stevens[1,2], Helen Neville[1]; [1]University of Oregon, [2]Sarah Lawrence College* – Recent electrophysiological work on selective attention has demonstrated that young children (3-5 years old) can selectively attend to one auditory stream while ignoring another (Sanders, Stevens, Coch, & Neville, 2005). The current work examines how selective attention indexed by event-related potentials (ERPs) may be influenced by genotype for a small set of genes implicated in cognition and attention. In a dichotic listening task designed for children, two stories were played simultaneously from speakers to the left and right of the listener. Children were cued to attend only one of the two stories and ERPs were recorded and compared for probe stimuli embedded in the attended versus unattended stories. We examined whether the ERP attentional modulation varied as a function of genotype. DNA was collected using buccal swabs and genotyped for the following genes: COMT, DAT1, DBH, DRD2, MAOA, and CHRNA4. The magnitude of the ERP attention effect varied significantly as a function of allelic variation in CHRNA4 and DAT1.

I3

SPECTRAL ANALYSES OF THE TOP-DOWN CONTROL OF ATTENTION TO LINGUISTIC AND MUSICAL INFORMATION USING MEG *Corby Dale[1], Gregory Simpson[1], Tracy Luks[1], Anthony Kaveh[1,2], Darren Weber[1,3], Robert Zatorre[4]; [1]University of California San Francisco, [2]University of California, Berkeley, [3]Smith-Kettlewell Eye Research Institute, [4]Montreal Neurological Institute, McGill University* – Functional imaging studies demonstrate involvement of frontal, parietal and auditory association cortices in processing linguistic and musical pattern information. Some studies also find hemispheric asymmetries whereby language is predominately processed in the left hemisphere and tonal patterns in the right. Less is known about the dynamics and patterns of activity between cortical regions, and how selective attention modulates this activity. We recorded magnetoencephalographic (MEG) signals from 12 right-handed volunteers performing a discrimination task requiring processing of linguistic information, simultaneous suppression of tonal pattern information, and vice versa. The two conditions used identical physical stimuli, differing only in instruction for which information to attend (tonal or linguistic). Subjects were visually instructed to task condition at the start of each block, after which they heard a series of compound stimuli containing one of two types of tonal pattern and either a word or non-word. Images of cortical currents were derived using cortically-constrained minimum-norm methods (BrainStorm) specific to the anatomy of each subject (Freesurfer) for an epoch of -500 to +600 ms. Dynamic maps of Event-related activity, spectral power and synchrony between brain areas were obtained for regions of interest (ROIs) in frontal, parietal and temporal cortex, defined by Talairach coordinates derived from task-relevant imaging (fMRI/PET) studies. Results reveal synchrony between frontal and temporal ROIs that reflects the interaction between top-down control of attention and auditory processing. Spectral analysis of attention to linguistic versus tonal pattern information indicates left-right hemisphere differences in dynamic interactions between cortical regions in different frequency bands.

I4

EARLY GATING OF AUDITORY NOVELTY PROCESSING BY EMOTIONAL CONTEXT IN SUPERIOR TEMPORAL GYRUS *Judith Domínguez-Borràs[1], Manuel Garcia-Garcia[1], Sina Alexa Trautmann[2,3], Peter Erhard[3,4], Thorsten Fehr[2,3], Manfred Herrmann[2,3], Carles Escera[1,5]; [1]Cognitive Neuroscience Research Group, University of Barcelona, Spain, [2]Institute for Cognitive Neuroscience, Bremen University, Germany, [3]Center for Advanced Imaging, Bremen University, Germany, [4]Bremen University, Germany, [5]Hanse-Wissenschaftskolleg, Delmenhorst, Germany* – We conducted two experiments, using functional magnetic resonance imaging (fMRI) and event-related brain potentials (ERPs), respectively, to asses the neural correlates, timing and modulatory effects of a negative emotional context on the processing of task-irrelevant novel sounds. In Study I, seventeen healthy volunteers responded to a visual color discrimination task, with images of emotional facial expressions (angry, fearful or neutral), while recorded in a 3Tesla scanner. In Study II, fourteen healthy volunteers responded to a visual discrimination task, with either neutral or threatening sceneries, while a 64-channel electroencephalogram (EEG) was recorded. In both studies, single auditory stimuli, consisting of either standard tones (700Hz, $p=0.8$) or unique environmental novel sounds ($p=0.2$), preceded the images in 300 ms and had to be ignored by the subjects. Novel sounds elicited a distractor effect on subjects' performance, reflected by longer response times (Study I: $F(1,16)=35.93$, $p<0.001$; Study II: $F(1,13)=11.61$, $p<0.01$). This effect was enhanced when preceding and following images were negative (Study I: $F(1,16)=5.3$, $p=0.035$; Study II: $F(1,13)=6.4$, $p=0.025$). In study I, bilateral superior temporal gyri, areas known to be involved in auditory novelty processing, were more activated in negative context ($p<0.001$, k=20). Accordingly, in study II, early novelty-P3 responses to novel sounds were enhanced in negative context ($F(1,13)=9.52$, $p=0.009$). Our data show that the emotional context enhances excitability of auditory novelty cerebral regions at early stages of the orientation response, making irrelevant sounds become more available in the attentional set under threatening conditions.

I5

REORIENTING NEGATIVITY: AN ERP CORRELATE OF OBJECT-FILE UPDATING? *János Horváth[1], Urte Roeber[1], Alexandra Bendixen[1], Erich Schröger[1]; [1]Institute of Psychology I, University of Leipzig, Leipzig* — Distraction triggered by unexpected stimuli is often investigated in oddball paradigms. Distraction-related processes initiated by infrequent, unexpected stimuli (deviants) presented amongst regular stimuli (standards) are reflected by a number of event-related potential (ERP) components. Deviants usually elicit an N1-increment, a modality-specific mismatch negativity (MMN), and a P3a. If participants have to perform a task based on a feature unrelated to the deviant feature on every trial (including deviant trials), deviants elicit an additional late frontal negativity termed Reorienting Negativity (RON), which is thought to reflect recovery from distraction. In the present study we investigated the necessary conditions for the elicitation of RON, using a pitch discrimination task. In Condition 1, standards were high or low tones (45-45%), and deviants were extremely high or extremely low tones(5-5%). In Condition 2, both standards and deviants were extremely high- or extremely low-pitched tones, but deviants differed from standards in their spectral width. In Condition 3, standards were high or low tones; deviants were extremely high or low and their spectral width differed from that of standards. Whereas deviants elicited an N1-increment/MMN and P3a in all conditions, RON was only elicited in Condition 2, suggesting that RON is elicited only if the task-relevant feature-level in the deviants is the same as in standards. A new hypothesis on the functional significance of RON is suggested: RON might reflect the update of an object-file, and not the restoration of the task-optimal attention set.

I6

SELECTIVE ATTENTION TO ONE OF TWO COMPETING AUDITORY RHYTHMS MODULATES PHASE OF BRAIN RESPONSES TO THE ATTENDED RHYTHM *John Iversen[1], Aniruddh Patel[1], Yanqing Chen[1], Joseph Gally[1], Gerald Edelman[1]; [1]The Neurosciences Institute* — When listening to multiple competing sounds, what brain mechanisms might enable us to attend to one sound while resisting the influence of other sounds? We addressed this question by measuring brain responses while participants tapped along with one of two simultaneously presented metronomes. An underlying question is whether selective attention is mediated by the amount of stimulus-related brain activity or by the temporal pattern of this activity. Participants (n=14) were presented with two stimuli, dichotically. Stimuli were a sinusoidal carrier (800 or 400Hz) with an isochronous rhythm impressed by transiently increasing the amplitude, with an inter-onset interval of 801 or 751 ms, respectively. During twenty 60 second trials, participants were instructed to tap in synchrony with one of the stimuli (target) while ignoring the other (distractor). To enable the independent measurement of brain responses to the two stimuli, each was sinusoidally amplitude modulated at a different frequency (typically 38 and 42Hz). Auditory cortex steady state responses (aSSRs) were measured using magnetoencephalography (MEG), and compared between target and distractor trials for each stimulus. Tap timing data were simultaneously collected. The phase of the aSSR was consistently slightly delayed by attention (mean delay across participants ~5 degrees, $p<0.023$). In contrast, neither power nor partial coherence were affected by attention, suggesting that only the timing of brain responses is modulated by attention in this task. Results from a new diotic version of this task will be compared to the current findings. Supported by Neurosciences Research Foundation.

I7

HEART RATE VARIABILITY AND THE AUDITORY EVENT RELATED BRAIN POTENTIAL *Gregory Kellett[1], Erin Ramage[1], Mark Geisler[1]; [1]San Francisco State University* — The autonomic nervous system (ANS) often responds to cognitive events via physiological activity. Likewise, acute ANS activity has been shown to affect cognitive functioning both hormonally and neurally. This study investigates the possible co-variation of chronic ANS activity, or tone, with the cognitive indicator of neuronal resource allocation and processing speed as indexed by auditory event-related potentials (ERPs). Participants included 30 healthy men and women equally represented and between the ages of 18 and 35. Heart Rate Variability (HRV), measured by the standard deviation of inter-beat intervals and correlated with sympathetic and parasympathetic ANS activity, was established via ten minute heart rate readings taken from wrist electrodes. High HRV is associated with healthy cardiovascular activity while low HRV is associated with poor cardiovascular activity. ERPs were then recorded from multiple electrode sites using a 16 channel electrode cap representing a full distribution of the scalp in response to an auditory oddball paradigm. Possible correlations between the ERP's and the standard deviation of HRV within each participant was investigated. Preliminary results show a lack of significant correlations between the heart rate variability and the amplitude and latency of the P3 component of the ERPs. These results are consistent with previous research which has also shown a lack of co-variation between similar indicators of ANS tone and ERPs.

I8

MEANINGFUL AUDITORY CONTEXT AFFECTS PRE-ATTENTIVE AUDITORY DEVIANCE DETECTION *Ursula Kirmse[1], Erich Schröger[1], Thomas Jacobsen[1]; [1]Institute for Psychology I, University of Leipzig* — Auditory deviance detection is reflected by the pre-attentively elicited Mismatch Negativity (MMN), a negative ERP component observed for a deviant in a sequence of standard sounds. Recent studies found an enhanced MMN in a sequence of familiar in contrast to unfamiliar standard sounds, and concluded an enhanced MMN in a familiar context, which might lead to more elaborate processing of the auditory input. However, the effect here might originate from a generally different quality of sound representation for familiar sounds as documented in other studies. A genuine effect of context familiarity, in contrast, could be stated when auditory context familiarity is varied outside the standard-deviant sequence. In the present study, a frequency oddball protocol (standard 550 Hz, deviant 500 Hz) was presented simultaneously with continuous speech that was either presented forwards (= familiar, meaningful context) or backwards (= unfamiliar, non-meaningful context). Participants either ignored both streams or detected target words in either text. Results showed that the additional secondary text stream generally diminished the MMN to the frequency deviants compared to a no-context control condition. However, larger MMN responses to the frequency deviants were observed in the familiar context, reflecting a genuine effect of context familiarity on the MMN. The data did not support the notion that this effect might have been due to increased attention to the familiar text stream. Additionally, behavioral and ERP data indicated that even active target word detection was easier in the familiar context.

I9

A QUESTION OF RELEVANCE: IS SUCCESSFUL COGNITIVE AGING ASSOCIATED WITH PRESERVED INHIBITORY CAPACITY AND ORIENTING ABILITY? *Scott M. McGinnis[1,2], Jenna L. Riis[1,2], David A. Wolk[3], Hyemi Chong[4], Dorene M. Rentz[1,2], Phillip R. Holcomb[5], Kirk R. Daffner[1,2]; [1]Harvard Medical School, [2]Brigham and Women's Hospital, [3]University of Pittsburgh School of Medicine, [4]University of Texas Southwestern Medical School, [5]Tufts University* — Research has suggested an age-related decrease in the capacity to inhibit the processing of task-irrelevant stimuli, which some investigators have argued plays a major role in cognitive aging. Work in our lab has indicated that cognitively high-performing old adults pay more attention to novel aspects of their visual environment than cognitively average-performing old adults. Here, we examined the impact of age and cognitive functioning (defined by performance on neuropsychological measures) on the amplitude of the N1 to repetitive auditory standard stimuli and the P3a to highly unusual novel auditory stimuli presented in a task-irrelevant sensory channel. Young adults, cognitively high-performing old adults, and cognitively average-performing old adults carried out a visual n-back task, during which they were exposed to frequent standard tones, rare tones, and infrequent novel sounds. The N1 amplitude to standard tones was larger in old than young adults. There was no difference in N1 amplitude between high and average-performing old adults. In contrast, high-performing old adults generated a P3a to novel sounds that was larger than average-performing old adults, and comparable to young adults. These results suggest that: (1) old adults are less able than young adults to suppress the processing of task-irrelevant auditory standards, 2) this reduction in inhibitory capacity does not appear to be a major factor that distinguishes cognitively high from cognitively average-performing old adults, and (3) compared to average-performing old adults, high-performing old adults may have more resources available to process potentially significant novel stimuli presented in a task-irrelevant channel.

110

THE EFFECTS OF A VIDEO SOUNDTRACK ON THE PROCESSING OF IRRELEVANT ACOUSTIC CHANGES: A MISMATCH NEGATIVITY STUDY *Patricia Moreau[1,2], Isabelle Peretz[1,2], Pierre Jolicoeur[1,2], Nathalie Gosselin[1,2]; [1]BRAMS (Brain, Music, and Sound), Montreal, [2]CERNEC (Centre de recherche en neuropsychologie et cognition), Université de Montréal, Montreal* – The mismatch negativity (MMN) is typically elicited by measuring the difference in the event-related potential (ERP) to frequently repeated auditory stimuli from the ERP to rare deviant auditory stimuli. Often these stimuli are presented in non-attentive conditions while subjects are being distracted by a variety of tasks and are instructed to ignore the auditory stimulation. MMN has been argued to be attention independent; however it is not yet clear if the type of task used to distract the subject from the auditory stimulation can influence MMN recording. In this study, we examined the effects of presenting a movie with the audio soundtrack on the mismatch negativity (MMN). In three experiments we measured the MMN to tones that differed in pitch from a repeated standard tone presented in silence, with a concurrent soundtrack played either forward or backward, or with soundtracks set at different intensities (producing different signal-to-noise ratios of the MMN-critical tones relative to the soundtrack). In each experiment we measured a reliable MMN despite the concurrent soundtrack; however the amplitude of the MMN was reduced when the soundtrack was presented compared to silence. Generally, MMN amplitude increased proportionally to the increments in the signal-to-noise intensity ratio. These results likely reflect an acoustical interference effect of the audio soundtrack with MMN-critical tones rather than to an auditory attentionnal effect.

111

TEMPORALLY SELECTIVE ATTENTION DIRECTED BY EXPLICIT INSTRUCTION AND PRECEDING RHYTHMS *Nicolas Planet[1], Lisa D. Sanders[1]; [1]University of Massachusetts, Amherst* – Previous studies have shown that directing attention to specific time points modulates early auditory evoked potentials. However, temporal judgments are much more precise when participants are provided a rhythmic structure rather than a single marker of interval onset. The current study was designed to compare the effectiveness of rhythmic and single onset cues at directing temporally selective attention and to assess any interactions between cues. In instruction blocks, participants were asked to attend to a time 500 or 800 ms after the onset of a visual cue and to press a button if the deviant sound (20%) was heard at the attended time only. In rhythm blocks, listeners were instructed to attend to the next beat in a structure provided by flashing the visual cue five times with onset asynchronies of 500 or 800 ms. In interaction blocks, participants were instructed to attend to a time 500 or 800 ms after the last visual flash regardless of rhythmic structure. Visual onsets were consistent with the attended time, consistent with the unattended time, or had no rhythmic structure. Standard sounds presented 500 ms after fixation onset elicited a larger negativity in the N1 and P2 time range when temporally selective attention was directed to that time by instruction or rhythm, indicating that both are effective cues. Further, listeners were able to ignore the preceding visual rhythms when instructed to attend to a specific time as evidenced by similar auditory attention effects across the interaction blocks.

112

ATTENTION ENHANCES MEG RECORDED GAMMA-BAND AUDITORY STEADY-STATE RESPONSE *Bernhard Ross[1,2], Steven Hillyard[3], Terence Picton[1,2]; [1]Rotman Research Institute, Baycrest Centre, Toronto, [2]University of Toronto, ON, [3]University of California, San Diego* – Gamma-band oscillations (>30Hz) have been associated with perceptual binding of stimulus features into an object. Selective attention is strongly connected to binding when focusing on target features while ignoring irrelevant information. We investigated the effect of attention on 40-Hz auditory steady-state responses (ASSR) as a model of gamma-band oscillations. Human magnetoencephalography was recorded while young adults listened to monaural sequences of 500-Hz tones with 40-Hz amplitude modulation (AM). In attended condition subjects responded with right-hand button press to 10% of the stimuli with 30-Hz modulation. In non-attended condition, only the 40-Hz AM tones were presented for 5 min while the subjects watched a series of photographs (one per 3 s) and counted four categories of visual objects. Eight blocks of each attended and non-attended conditions were recorded using left and right monaural stimulation respectively. The ASSR assessed by sources in bilateral auditory cortices were significantly larger in attended condition compared to non-attended condition, while the effect was more expressed in the contra-lateral hemisphere and to left ear stimulation. As even stronger effect of attention the sustained response were strongly enhanced. However, attentional enhancement of transient gamma-band response were small (40-80 Hz) or even not detectable (24-28 Hz). The results confirm that steady-state gamma-band oscillation is functionally dissociated from transient components. Modulation of sustained rather than transient responses was interpreted as indicating involvement of top-down attentional control.

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SUBJECTIVE RHYTHMISATION AS A PARADIGM FOR AN EEG-DRIVEN BCI *Rebecca Schaefer[1], Rutger Vlek[1], Peter Desain[1]; [1]Radboud University Nijmegen, Nijmegen Institute for Cognition and Information* – In the so-called clock illusion, isochronous stimulus trains are subjectively grouped into a binary percept (tick-tick-tick-tick becomes tick-tock-tick-tock). This subjective accenting, comparable to serial selective attention, has previously been shown to be visible in the EEG-signal [cf. Psychological Science, 14 (2003), 362; Cognitive Brain Research, 24 (2005), 117]. To use this manifestation to drive a Brain-Computer Interface (BCI), we measured EEG after instructing participants to imagine different groupings superimposed on an isochronous train of stimuli, thus producing accented and non-accented beats in identical metronome ticks. Binary, ternary and quaternary metric patterns were investigated, including both a perception part with real accents and an imagery part with subjective accents. Testing contrasting hypotheses, namely structural isomorphism on one end and gestalt perception on the other would reveal unseen patterns that are useful in single trial classification of separate events. Analyses in both the ERP and time-frequency domain reveal substantial differences over participants that indicate a high level of individuality in the brain response to this serial selective attention task, but significant within-subject patterns. As realization of a BCI system only requires robust within-subject consistency, the results appear promising. Next steps will focus on detecting periodicity and single-trial classification of single beats.

114

NEURAL UNDERPINNINGS OF AUDITORY ATTENTIONAL BLINK *Dawei Shen[1], Claude Alain[1,2]; [1]Rotman Research Institute, Bacrest Centre, [2]University of Toronto, Ontario* – The attentional blink (AB) is a phenomenon where the correct identification of the first target (target) causes a processing deficit of the second target (probe) when the two targets are to be presented among a rapid speed visual presentation. The AB can last several hundred milliseconds and provides important information about the deployment of attention overtime. Recently, behavioral studies (e.g., Shen & Mondor, 2006) have revealed the magnitude of the auditory AB is affected by the stimulus onset asynchrony (SOA) between two successive items within a sequence. In the present study we investigated the processing stage at which the auditory AB occurs by measuring scalp recorded auditory evoked potentials. On each trial, participants were required to detect predefined target and probe sounds presented in a rapid series of distractor sounds with short (90 ms), intermediate (120 ms), and long SOA (150 ms). The results showed a large AB when the SOA was short (i.e., 90 ms), and it decreased with increasing the SOA. This SOA-related decrease in the auditory AB was paralleled by an increase in P3b amplitude at electrode Pz. The latency of the P3b elicited by the probe following the target was delayed relative to the P3b elicited by probe alone. Regardless of the SOA, the probe elicited N1 and P2 waves at electrode C3, indicating that the probe was perceived in auditory cortex during the AB. These results suggest that the auditory AB reflects a limitation of short-term consolidation.

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MODULATION OF LATERALIZATION OF AUDITORY CORTICAL RESPONSES BY SPATIAL ATTENTION *Nathan Weisz[1], Bertrand Olivier[1]; [1]INSERM U821, Lyon, France* – Several studies show a stronger left-hemispheric modulation of neuronal activity by selective attention. However these works have not looked at spatial attention. Here we monaurally presented a cue sound before onset of a compound sound. The second sound included a target modulation frequency (42 Hz) on one ear and a distractor (19 Hz) on the opposite side. Participants indicated on which ear they perceived the target. The cue was informative (75%) of target location in one condition and uninformative (50%) in the other. During the task we measured neuronal activity from 275 gradiometers projected onto a source montage. Our analysis focussed on alpha band changes, as well as target evoked steady-state responses (SSR). Behavioral responses were more accurate and faster when cue and target side were congruent or less accurate when incongruent only in the informative condition. Target related alpha desynchronization showed a lateralization only when the preceding cue was informative, which was largely driven by right-hemispheric modulations. For the SSR a conditions differences were only observed when the cue was presented to the left ear. This stems mainly from a predominant right-lateralized SSR when the preceding cue was uninformative. Our study is the first to show that auditory SSRs and alpha desynchronization can be modulated in a top-down manner. We hypothesize that our data reflect a "default" (bottom-up) processing advantage for stimuli presented to the left, that has to be actively suppressed for stimuli presented to the right.

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STIMULUS AND ATTENTION EFFECTS ON SOUND ACTIVATIONS IN HUMAN AUDITORY CORTEX *David L. Woods[1,2,3], G. Christopher Stecker[4], Teemu Rinne[5], Anthony Cate[1], Isaac Liao[3], Timothy Herron[1], Xiaojian Kang[1], E. William Yund[1]; [1]Hcnlab, Vanchcs, Martinez, CA, [2]UC Davis, [3]Center for Mind and Brain, UC Davis, [4]University of Washington, Seattle, [5]University of Helsinki, Helsinki , Finland* – Previous fMRI studies have shown that activations of auditory cortex vary with the frequency, intensity, and location of sounds and with attention. We present a group analysis of auditory cortical activations in nine subjects who participated in a factorial experiment that varied these factors conjointly. Each subject was scanned on six separate sessions, three with sparse (TR=11.6s) and three with continuous (TR=2.9s) sampling. Activations were analyzed using cortical-surface mapping tools. Subjects attended to visual or auditory stimuli in separate blocks and performed a difficult one-back matching task in the attended modality. Unimodal stimulus sequences were included to isolate auditory stimulus-dependent activations (SDAs) by subtracting activations in visual-attention blocks without auditory stimuli from those in visual-attention blocks with concurrent sounds. Auditory SDAs were restricted to Heschl's gyrus (HG) and the adjacent superior temporal gyrus (STG) and were larger during sparse than continuous sampling. Low-frequency tones (~225 Hz) produced more extensive SDAs than loudness-matched high-frequency tones (~3600 Hz), particularly in mid-HG. Contralateral presentations enhanced SDAs throughout HG/STG, whereas increasing intensity (70 to 90 dB SPL) enhanced SDAs in medial HG. Attention-related modulations (ARMs) were isolated by subtracting activations in bimodal attend-visual blocks from those in bimodal attend-auditory blocks. ARMs were largest in lateral STG with little enhancement seen in medial HG. Additional analyses revealed further dissociations between ARMs and SDAs. For example, ARMs to monaural tones were enhanced in auditory cortex ipsilateral to stimulation. Auditory attention does not simply amplify auditory sensory responses but dynamically modulates processing in higher-order auditory cortical fields.

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THE TEMPORAL DYNAMICS OF LISTENING TO VERSUS HEARING WORDS: ATTENTION MODULATES BOTH EARLY STIMULUS ENCODING AND PREPARATORY ACTIVITY *Yuliya Yoncheva[1], Urs Maurer[1,2], Zeeba Daruwalla[1], Jason Zevin[1], Bruce McCandliss[1]; [1]Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University, New York, [2]University of Zurich, Switzerland* – Top-down attention to linguistic information modulates BOLD responses in a network including inferior frontal, temporal, and fusiform regions. The current study employs electroencephalography to investigate the temporal dynamics when attending to language, specifically to disentangle early influences on stimulus encoding from later decision-making processes and to assess differential preparatory activity. To isolate the impact of top-down attention we present pairs of chimeric stimuli – tone triplets embedded in auditory words – and contrast ERP responses during two tasks: linguistic (rhyme judgment) versus other auditory (tone-triplet matching) performed on the same stimuli. As revealed by a Topographic Analysis of Variance, linguistic focus drove divergence in the response to the first auditory stimulus, evident as early as ~100 msec after stimulus onset and spanning the whole 550-msec stimulus duration. Similar modulation of early stimulus encoding, encompassing the typical N1/P2/N2 auditory responses, was also present for the second stimulus. The anticipation period between the first and second stimuli was dominated, in both tasks, by strong contingent negative variation (CNV) that showed a significant shift in topography by task focus. This robust attentional effect manifested along the anterior-posterior axis suggesting differential contributions of frontal and posterior sources based on the need for maintenance of linguistic versus non-linguistic attentional set. The present findings suggest that attention to the linguistic aspects of complex auditory signals influences both on-line stimulus encoding operations as well as functions involved in maintaining relevant information for future comparisons. This work may inform the contributions and interactions of attentional mechanisms active during language processing.

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ATTENTION EFFECTS OF THE AUDITORY STEADY-STATE RESPONSE IN THE EEG EVOKED BY ARTIFICIAL AND NATURAL SOUNDS *Katja Saupe[1], Andreas Widmann[1], Alexandra Bendixen[1], Matthias Müller[1], Erich Schröger[1]; [1]Institute of Psychology I, University of Leipzig, Germany* – Isochronous modulations in a sound elicit the Auditory steady-state response (ASSR) in the EEG and MEG, with an optimal modulation frequency of 40-Hz. Examinations of the effect of attention on the Auditory steady-state responses have proven inconsistent. The present study investigates whether the ASSR is enhanced with attention (as is the case for steady-state visual evoked potentials), but in contrast to further studies, not only when evoked by artificial but also by more natural sounds. 500-Hz tones and natural noise sounds with a 40-Hz amplitude modulation served as stimuli. In the attend condition, a modulation discrimination task was performed (infrequent targets were 30-Hz modulated sounds). In the un-attend condition, the subjects performed a visual discrimination task (detect occasional tiny changes in a fixation cross).

We found a 40-Hz ASSR not only for artificial but also for complex noise sounds. An attentional modulation of the ASSR was however only obtained for artificial sounds. These results illustrate, once more, the inconsistency in finding attention effects on the auditory ASSR, yet at the same time show, that such modulations are possible. Thus, ASSR may provide a useful tool for the investigation of auditory attention in the future.

Attentional processes: Other

I19

ATTENTION TO HIERARCHICAL LEVELS AFFECTS CORTICAL PROCESSING ACROSS MODALITY AND DIMENSION *Lori B. Astheimer[1], Ahren Fitzroy[1], Lisa D. Sanders[1], Matthew C. Davidson[1]; [1]University of Massachusetts, Amherst* – Several lines of evidence indicate there is cortical specialization for processing hierarchical stimuli such that local information is preferentially processed in the left hemisphere and global information in the right hemisphere. However, it is not clear if lateralization of local and global processing is limited to visual spatial information or is a general organizational principle of the brain. Previous behavioral and ERP studies suggest attention can be directed to distinct hierarchical levels (defined by frequency or time) of auditory stimuli, but have not definitively shown if doing so leads to lateralization of processing. To index lateralization of local and global processing across stimulus modality (visual/auditory) and hierarchical dimension (space/time), fMRI data were collected while participants observed three types of hierarchical displays: 1) static visual images of ten small arrows combined to form a large arrow, 2) 40 ms frequency modulated sounds combined into 500 ms series that increased or decreased in pitch, and 3) a light that moved on the vertical midline such that the overall motion was made up of shorter paths. In separate blocks, participants were instructed to attend to the local or global features and to report the direction (up or down) at that level of the hierarchical display. An additional baseline condition required participants to press a button as quickly as possible in response to any stimulus. Analyses of BOLD signals revealed differential brain activation according to attention condition, stimulus modality, and hierarchical dimension in areas associated with sensory processing and attentional control.

I20

FUNCTIONAL BRAIN ACTIVATION IN YOUNG ADULTS WITH ADHD: A RESTRICTED RANGE OF DYNAMIC RESPONSE? *Marie T. Banich[1,2,3], Gregory C. Burgess[1], Brendan Depue[1], Blaine Ames[1], Luka Ruzic[1], Erik Willcutt[1]; [1]University of Colorado at Boulder, [2]Institute of Cognitive Science, University of Colorado at Boulder, [3]University of Colorado at Denver* – Relatively little is known about patterns of brain activation in adults with ADHD during performance of attentionally-demanding tasks. In this study we compared brain activation in 23 young adults with ADHD, who were carefully screened to not have co-morbid psychiatric disorders, and 23 age matched controls. All participants performed a hybrid blocked/event-related version of the Stroop task composed of neutral (e.g., "sum" in red ink), congruent (e.g., "red" in red ink) and incongruent (e.g., "blue" in red ink) blocks of trials. Within each block, half the trials were block specific (e.g. incongruent words) and half were a set of neutral trials that occurred across all blocks. In addition, blocks of fixation trials served as a low-level baseline. In the comparison of each block type with the fixation baseline, ADHD individuals exhibited less activity in prefrontal regions associated with attentional control. They appear to have difficulty tonically directing attention towards ink color identification and away from word reading. With regards to event-related comparisons of incongruent trials to neutral trials within the incongruent block, ADHD individuals exhibited less activation in caudal regions of the anterior cingulate cortex. These results suggest that brain systems involved in attentional control act atypically in adults with ADHD both with regards to tonic top-down regulation of attentional resources and with phasic aspects of attentional control. Their inability to recruit attentional areas to meet both tonic and phasic aspects of attentional control seems to occur as a result of a restricted dynamic range of response.

I21

PREPARATORY MEG ACTIVITIES DURING CUED SPATIAL ATTENTION TO AUDITORY OR VISUAL STIMULI *Olivier Bertrand[1], Nathan Weisz[1], Nelly Mainy[1], Claude Delpuech[1,2], Françoise Bauchet[2], Jean-Philippe Lachaux[1]; [1]INSERM U821, University Lyon 1, France, [2]CERMEP, Lyon, France* – Neuroimaging studies have demonstrated that sensory processing can be strongly affected by attention, acting either on preparatory endogeneous processes or directly on the processing of the actual incoming stimulus. Our goal was to characterize MEG correlates of endogenous spatial attention for audition and vision. We examined activity following attention-directing cues, symbolically instructing subjects to attend to one modality (auditory or visual) and to one hemifield, and to perform a simple reaction time task after stimulus presentation. A 1s-duration central visual cue indicated whether the subsequent stimulus would be auditory or visual, and left or right sided. The cue diminished reaction times to both visual and auditory stimuli in the valid trials (80% of the trials). Those facilitation effects were observed for modality and lateralization, indicating an effective attentional manipulation. Transient, sustained and oscillatory MEG activities (275-channel VSM-CTF) were analyzed during cue presentation and delay period prior to the imperative stimulus. The transient responses to cue onset showed a predominance controlateral to the cued side. During cue processing and the delay period, an alpha desynchronisation over parieto-occipital cortices was observed controlaterally to the cued side. At the end of the delay period, the sustain responses over the temporal cortices were increased when attention is cued to the auditory modality. This study allowed to disentangle the timing and the respective contribution of overlapping networks during the preparatory period, either involving general attention and motor preparation processes, or implicating perceptual-related areas, later involved in the processing of the attended stimulus.

I22

NORMAL AGING AND FEATURE BINDING: IMPLICATIONS FOR CHOLINERGIC CONTRIBUTIONS TO ATTENTION *Leigh C.P. Botly[1], Matthew L. Dixon[1], Eve De Rosa[1,2]; [1]University of Toronto, St. George, [2]Rotman Research Institute, Baycrest Center for Geriatric Care* – The binding problem refers to the fundamental challenge of the central nervous system to integrate sensory information to form a unified percept. It is commonly accepted that feature-conjunction (FC) stimuli require feature binding and are attention-dependent, while feature-singleton (FS) stimuli only require the processing of single features and are much less attention-dependent. We previously demonstrated a critical role for the neuromodulator acetylcholine (ACh) in feature binding in rats, and proposed that ACh facilitates this cognitive process by modulating attentional processes at encoding. Given this finding and the recognized decline in cholinergic function during normal aging, we expected that young adults only under divided attention and older adults under full attention would be impaired at acquiring an FC task relative to an FS task. Thus, we tested thirty-one young adults (X= 19.2 years, S.D. = 1.1) while performing a concurrent divided attention task and forty-one older (X= 75.2 years, S.D. = 5.4) adults under full attention during acquisition of the visual FC and FS tasks. As hypothesized, both groups were comparably impaired at acquiring the FC task relative to the FS task; additionally, this pattern of behaviour is strikingly similar to that of rats under the influence of the cholinergic muscarinic antagonist scopolamine while they acquired comparable FC and FS tasks. Collectively, these data illustrate the susceptibility of the feature binding process to attentional challenges induced pharmacologically, behaviourally, or as the result of normal aging. And therefore lend further support for ACh's role in the attentional modulation of learning.

I23

ANTICIPATING CONFLICT SPEEDS-UP EVENT-RELATED POTENTIALS LINKED TO CONFLICT DETECTION *Angel Correa[1,2], Anling Rao[2], Anna Nobre[2]; [1]University of Granada, Spain, [2]University of Oxford, United Kingdom* – Cognitive control can be triggered in reaction to previous conflict, as suggested by the finding of sequential effects in conflict tasks. Can control be also triggered proactively by presenting cues predicting conflict ('proactive control')? We exploited the high temporal resolution of event-related potentials (ERPs) and controlled for sequential effects to ask whether proactive control based on anticipating conflict modulates neural activity related to cognitive control. ERPs associated with conflict detection (N2) were measured during a cued flanker task. Symbolic cues were either informative or neutral with respect to whether the target involved conflicting or congruent responses. Sequential effects were controlled by analysing the congruency of the previous trial. The results showed that cuing conflict reduced both the behavioural conflict effect and the N2 latency. Other potentials less specifically related to conflict processing, such as the frontal N1 and the P3, were also modulated by cuing conflict. Cuing effects were most evident after congruent than after incongruent trials. This interaction between cuing and sequential effects suggests neural overlap between the control networks triggered by proactive and reactive signals. This finding then clarifies why previous (fMRI) studies, not controlling for reactive sequential effects, have rarely found that proactive control attenuates ACC conflict-related activity. Finally, the high temporal resolution of ERPs was critical to reveal a temporal modulation of conflict detection by proactive control. This novel finding suggests that anticipating conflict speeds-up conflict detection. Recent research suggests that this anticipatory mechanism may be mediated by pre-activation of the ACC during the preparatory interval.

I24

EXAMINING THE ATTENTIONAL COSTS OF SELF-FOCUSED ATTENTION *Katrina Fincher[1], Amishi Jha[1]; [1]Center for Cognitive Neuroscience, University of Pennsylvania* – We examined the hypothesis that self-focused attention competes for attentional resources necessary to attend and interact with the external environment. In Condition A, subjects (n = 25) rated the valence of adjectives using a 4 point Likert scale. In Condition B, these words were presented as task-irrelevant distractors at fixation as subjects performed a simple visual discrimination task for peripheral stimuli. There was no significant main effect of valence ratings on discrimination performance. In Condition C, subjects rated the self-relevance of adjectives. In Condition D, similar to Condition B, these words were presented as task-irrelevant distractors during a simple visual discrimination task. There was no main effect of self ratings on discrimination performance. Importantly, response times (RTs) during word rating in Condition C were slowest when the words were either rated as high in self-relevance and negative (determined by Condition A) or low in self-relevance and positive. This slowing may reflect high cognitive and affective conflict associated with these word categories which may heighten self-focused attention. We therefore predicted that these "high conflict" words would result in slower discrimination performance in Condition D as attention becomes usurped by self-focused processes initiated by the word presentation. Indeed, during Condition D, RTs were significantly slower for high vs. low conflict distractor words, and the magnitude of this effect correlated with the subject's degree of depression, anxiety, and rumination as indexed by self-report measures. Thus, self-focused distraction may have deleterious effects on attention to external tasks as well as overall mental health.

I25

ELECTRICAL CORRELATES OF THE RESTING STATE NETWORK IN MEDIAL PREFRONTAL CORTEX IN HUMANS *Kristie J. Fisher[1,2], Kai J. Miller[1,3], Jeffrey G. Ojemann[1,4]; [1]University of Washington, [2]Psychology, [3]Neurobiology and Behavior, [4]Neurological Surgery* – We investigated changes in the dynamics of the resting state ("default") network in medial prefrontal cortex in humans (Gusnard, NatRevNeuro, 2001), using the fine temporal resolution of electrocorticography (ECoG). We studied 5 human subjects, with ECoG electrodes in dorsal and ventral medial pre-frontal cortex. We performed a comparison between fixation ("disengagement") and one of three "engagement" tasks. The engagement task was dependent on the placement of the other elements of the electrode array: a) Language (verb generation task with electrodes in left fronto-temporal-parietal areas), b) Memory (n-back visual working memory task with electrodes in right dorsolateral prefrontal cortex), c) Target Detection task (noise-masked faces and houses with electrodes in the subtemporal fusiform areas). We see the hallmarks of default network cortical activity during non-engagement using these metrics: 1) band specific power (Miller, 2007, NeuroImage), 2) phase-amplitude coupling (Canolty, 2006, Science), 3) cross-coherence between neighboring electrodes. Consistent with a study by Mantini (Mantini, 2007, PNAS), we found band-specific changes in discrete rhythms. More importantly, we also found changes in the high frequency amplitude-low frequency phase coupling that we believe is the hallmark of coordination between cortex and subcortical control structures (thalamic, basal ganglial). Our study demonstrates the usefulness of high temporal resolution in identifying distinct, separable properties of brain activity that show characteristic electrical activity when not engaged in a cognitive task, and activity suppression during task engagement.

I26

THE EFFECTS OF REFLECTIVE STATE ON PERCEPTUAL PROCESSING IN THE CONTEXT OF EMOTIONAL INFORMATION IN DYSPHORIA *Sharmin Ghaznavi[1], Susan Nolen-Hoeksema[1], Marcia K. Johnson[1]; [1]Yale University* – Theoretical accounts of depression (Beck, 1967; Bower, 1981; Teasdale, 1983) predict that depressed individuals will show selective attention to material congruent with depressed mood. However, findings from previous work on mood congruent attentional biases in depression are inconsistent across studies. One reason for the inconsistencies across studies may be differences in the reflective state of participants at the time of testing. The self-reflective state of rumination (e.g., focusing on symptoms of distress) worsens depression whereas distraction (e.g., focusing on non-self-relevant information) temporarily reduces depression. Whether depressed individuals are in a self-focused, ruminative state, or a distracted state may have consequences for the impact of emotional information on their cognitive processing in the context of negative emotional information. We investigated perceptual processing in dysphoric individuals (n = 30) and nondysphoric individuals (n = 30) while manipulating reflective state using an adaptation of a rumination/distraction state manipulation from Lyubomirsky & Nolen-Hoeksema (1993). When negative emotional items were present in the task, dysphoric individuals were affected by the state induction on a perceptual task requiring them to process words for meaning (identifying an exemplar of a category), but not on a perceptual task requiring participants to attend to basic perceptual features of a word (letter case). State induction had no effect on performance in nondysphoric individuals. This evidence suggests that reflective state as well as the specific types of processing required influences how emotional information is processed by depressed individuals.

I27

TACTILE REFLEXIVE ATTENTION; AN INVESTIGATION OF ITS TIME COURSE, AND ITS ROLE IN THE EXPERIENCE OF MEDICALLY UNEXPLAINED SYMPTOMS. *Eleanor Miles[1], Ellen Poliakoff[1], Richard Brown[1]; [1]University of Manchester, UK* – In the visual and auditory modalities, it has been demonstrated that peripheral cues facilitate responses to targets presented at the same location, which is thought to be due to reflexive (automatic) attention shifts. In the tactile modality, however, the only studies to demonstrate facilitation include potential methodological confounds (spatial discrimination tasks, or predictive cues) and involve processes in addition to reflexive attention. In the current study, we investigated the time course of tactile reflexive attention by using a non-spatial tactile frequency discrimination task, following a non-informative tactile cue. When the target was presented 150 ms after the cue, we observed faster discrimination responses to targets presented on the same side (compared to the opposite side) as the cue; by 1000ms, responses were significantly faster to targets on the opposite side to the cue. Thus, we demonstrate that tactile attentional facilitation can be observed in a non-spatial discrimination task, and provide the first demonstration of significant tactile facilitation and tactile inhibition of return within a single experiment. These findings are discussed in relation to medically unexplained symptoms (symptoms for which no physical cause can be found). Theories suggest that people with a propensity to unexplained symptoms have an attentional bias for the body, and a recent model (Brown, 2004) suggests the underlying deficit may be in the ability to disengage from the body. As yet there is no empirical support for this, and investigation of tactile attention shifts in these patients may provide a way forward.

I28

MADE YOU LOOK! IRRELEVANT INSTRUCTIONS HIJACK THE ATTENTIONAL NETWORK *Katherine Moore[1], Clare Porter[1], Daniel Weissman[1]; [1]University of Michigan at Ann Arbor* – The ability to voluntarily orient attention when presented with an instructional cue (e.g., "Listen to the teacher!") is a fundamental aspect of human cognition. Much evidence indicates that this ability depends on a fronto-parietal network, which biases activity in sensory regions to enhance the processing of task-relevant stimuli. In the present fMRI study, we investigated whether task-irrelevant instructions (e.g., "Look!") can hijack the fronto-parietal network, leading to greater processing of irrelevant features in the environment. In each trial, a visually-presented cue word ("Look" or "Hear") instructed participants to attend to either the visual or the auditory sensory modality for a possibly upcoming relevant letter ("X or "O"), while ignoring a simultaneously-presented irrelevant letter ("X" or "O") in the opposite modality. Critically, the visually-presented cue word (e.g., "Hear") was accompanied by an irrelevant auditory instruction word that signaled either the same sensory modality as the visual cue (e.g., "Hear"; congruent cues) or a different modality (e.g., "Look"; incongruent cues). In line with our hypothesis that incongruent cues should interfere with processes that orient attention, we observed greater activity for incongruent than for congruent cues in multiple regions of the fronto-parietal network. Also in line with our hypothesis, incongruent cues evoked greater activity than congruent cues in sensory regions corresponding to the uncued modality. These findings show for the first time that irrelevant, consciously-perceived instruction words can hijack the fronto-parietal network, resulting in greater attention to task-irrelevant features of the environment.

I29

INFLUENCE OF SPATIAL ATTENTION ON INTERHEMISPHERIC TRANSFER IN AN ACALLOSAL BRAIN *Eric Mooshagian[1], Marco Iacoboni[1], Eran Zaidel[1]; [1]University of California, Los Angeles* – In a lateralized simple reaction time (SRT) paradigm, a stimulus presented to the right visual field (RVF) elicits faster right-hand (uncrossed) responses than left-hand (crossed) responses. In the uncrossed condition, the stimulus and response are processed within the left hemisphere. In the crossed condition, one hemisphere registers the stimulus while the other makes the response. The crossed-uncrossed difference (CUD) is taken as a measure of interhemispheric transfer time via the corpus callosum. However, the CUD in normal subjects has recently been demonstrated to be sensitive to spatial attention. When subjects used an unnatural, arms crossed position and pressed the left button with the right hand, etc., the CUD was reduced, indicating an influence of spatial attention (Mooshagian et al., in press). Using the same task, it has been demonstrated that an unnatural arms position reduces the CUD in a commissurotomy patient as well (Mooshagian et al., 2001). In the present experiment, we tested an acallosal subject, MM, using the same task. Results, again, indicate a reduced CUD in the unnatural arms position. Importantly, MM's natural and unnatural CUDs fall between those obtained for normal subjects and split-brain patients. This confirms that the CUD is not a pure measure of callosal relay. The CUD reflects both interhemispheric transfer time and spatial attention mechanisms that are not mediated by the corpus callosum.

I30

THE NEURAL BASIS OF ATTENTIONAL TASK SET AND COGNITIVE CONTROL *Kyle P. Tierney[1], Preston P. Thakral[1], Scott D. Slotnick[1]; [1]Boston College* – Cognitive control involves retrieval and maintenance of task set/rules. We hypothesized that neural activity associated with cognitive control would be revealed during a standard visual spatial attention paradigm (which requires changes in task set). During fMRI, participants were presented with two squares rotated 30° in polar angle from horizontal with the nearest corners 2° of visual angle from fixation and an edge length 4° in visual angle. Within each square, 320 dots (each 0.05° in width) moved 5° of visual angle per second and had 70% coherence. Participants had been trained to shift and then sustain attention to the dots within either the left or right visual field based on an auditory cue that occurred every 14 seconds. Their behavioral task was to detect a brief change in dot speed that occurred at uncertain times within the attended square, encouraging sustained attention at that location. This design yielded four main types of cognitive events/task sets: shift attention to the left (shift-left), shift attention to the right (shift-right), sustained attention to the left (sustained-left), and sustained attention to the right (sustained-right). Our preliminary analysis suggests that attentional shift task sets (shift-left > shift-right, shift-right > shift-left) were associated with differential activity in the prefrontal cortex, the anterior cingulate, and temporal cortex. Sustained attention task sets (sustained-left > sustained-right, sustained-right > sustained-left) were associated with differential activity in the prefrontal cortex and the intraparietal sulcus. The prefrontal cortex association with attentional task set supports previous findings linking this region to cognitive control.

I31

INCREASED INTRA-INDIVIDUAL REACTION TIME VARIABILITY IN ADHD ACROSS RESPONSE INHIBITION TASKS WITH DIFFERENT COGNITIVE DEMANDS *Rebecca G. Vaurio[1,2], Daniel J. Simmonds[1], E. Mark Mahone[1,2], Martha B. Denckla[1,2], Stewart H. Mostofsky[2,3]; [1]Kennedy Krieger Institute, [2]Johns Hopkins University School of Medicine* – One of the most consistent findings in children with Attention-Deficit/Hyperactivity Disorder (ADHD) is increased moment-to-moment variability in reaction time (RT). In a recent study, the source of increased RT variability was examined using ex-Gaussian analyses of reaction time series that divide variability into normal ("sigma") and exponential ("tau") components. That study, however, reported performance on a choice RT task; it is unknown whether similar findings would be observed during tasks involving response inhibition. The objective of the present study was to examine these components of variability using both a "simple" Go/No-go task and a more "complex" Go/No-go task with increased working memory load. Participants were 108 children (ADHD, N=41; Control, N=67) ages 8-13 (mean=11.1). Two methods were used to measure variability: intra-individual coefficient of variability (ICV), calculated as (standard deviation of RT/mean RT) and ex-Gaussian functions (sigma and tau). Repeated measures ANOVA showed main effects of diagnosis and task for ICV, with ICV being greater in the ADHD group ($F=10.1$, $p=.002$) and greater for the complex task ($F=22.4$, $p<.001$), with no diagnosis-by-task interaction. Similar findings were observed using ex-Gaussian analyses, with stronger effects for tau (greater sigma ($F=3.2$, $p=.075$) and tau ($F=11.3$, $p=.001$) in ADHD; greater sigma ($F=4.6$, $p=.034$) and tau ($F=18.7$, $p<.001$) in the complex task; and no diagnosis-by-task interaction). The results reveal increased RT variability in ADHD regardless of task complexity. The stronger tau effects suggest that increased variability is principally due to occasional slow responses reflecting lapses in behavioral control.

I32

ELECTRICAL SOURCE ANALYSIS OF DENSE ARRAY (256-CHANNEL) EEG RECORDINGS OF SPIKE-WAVE SEIZURES REVEALS MECHANISMS INVOLVED IN VOLUNTARY CONTROL OF CONSCIOUS ATTENTION *Allison C. Waters[1], Don M. Tucker[1,2], Phan Luu[1,2], Mark Holmes[2]; [1]University of Oregon, [2]Electrical Geodesics, Inc.* – The current study has two objectives: 1) to elucidate the neural source of spike-wave discharges associated with a temporary loss of conscious attention; and 2) to contrast results gained through the application of high-density (256 channel) EEG recording to results gained through the use of conventional (19 channel) EEG recording. The neural substrate of conscious attention involves thalamic control of widespread cortical networks. Absence spells are characterized by a momentary loss of voluntary control of attention, during which the person is inactive and unresponsive. In this study, the neural sources of spike-wave discharges associated with absence spells are elucidated using advanced methods of electrical source analysis. This reconstruction of dynamic activity in the brain is made possible by improved sampling of electrical potentials, volume-conducted to the face and neck in the 256-channel array, as well as accurate characterization of head tissue conductivity. Source analysis indicates that absence spells are associated with pathology in a circuit comprising ventro-medial frontal cortex, rostral thalamic reticular nucleus, and limbic nuclei of the thalamus. These findings are then contrasted with those obtained through conventional EEG (19 channels of the International Ten Twenty system) recording and analysis. Advanced methods of neural source analysis provide superior ability to resolve neural mechanisms that are disrupted in absence and appear to regulate important aspects of the voluntary control of conscious attention.

I33

DOES AFFECTIVE PRIMING INFLUENCE ATTENTION PROCESSING IN SOCIALLY-ANXIOUS INDIVIDUALS? *Lauren White[1], Sarah Helfinstein[1], Yair Bar-Haim[2], Nathan Fox[1]; [1]University of Maryland, [2]Tel Aviv University* – Anxious individuals show an attention bias towards threatening information. However, under conditions of sustained environmental threat this otherwise-present attention bias disappears. It remains unclear whether this suppression of attention bias is due to increased task effort under threat, or a shift in processing priorities. Further, it is unknown whether this suppression of attention bias can be caused by a transient activation of the fear system. In the present experiment, high socially-anxious and low socially-anxious individuals (HSA group, n = 12; LSA group, n = 12) performed a modified dot-probe task in which they were shown either a neutral or socially threatening prime word prior to each trial. EEG was collected and ERP components to the prime and face displays were computed. ERP results suggested differential processing of the faces display by HSA and LSA individuals. The behavioral results indicated that HSA individuals show an attention bias to threat after a neutral prime, but no attention bias after a threatening prime, demonstrating that suppression of attention bias can occur after a transient activation of the fear system. Reaction time data indicated that suppression of attention bias is not due to an increase in task effort.

I34

MULTISENSORY CONFLICT MODULATES THE SPREAD OF VISUAL ATTENTION ACROSS A MULTISENSORY OBJECT *Ulrike Zimmer[1], Kenneth Roberts[1], Marty Woldorff[1]; [1]Center for Cognitive Neuroscience, Duke University* – Spatial attention to a visual stimulus paired with a task-irrelevant sound occurring synchronously from a different location can lead to increased activity not only in visual cortex, but also auditory cortex, apparently reflecting the object-related spreading of attention across both space and modality (Busse et al., PNAS, 2005). The processing of stimulus conflict, including multisensory stimulus conflict, is known to activate the anterior cingulate cortex (ACC), but the resultant influence on the sensory cortices remains relatively unexamined. Here, we asked whether the multisensory spread of visual attention across the sensory cortices previously observed will be modulated by whether there is conceptual or object-related conflict between the relevant visual and irrelevant auditory inputs. In an fMRI-study, we presented matching and non-matching letter-sound combinations while subjects visually attended one of two lateralized visual letter-streams and ignored the synchronously occurring task-irrelevant central sounds. Spreading of visual attention across modalities was again observed, replicating our previous study. In addition, significant enhancements for incongruent versus congruent letter-sound combinations were observed in the ACC and in the contralateral visual cortex when the visual component was attended, presumably reflecting the need for boosted attention to the visual stimulus during incongruent trials. Moreover, activity in the auditory cortices also varied as a function of whether the spatially discordant auditory stimulation was incongruent versus congruent. Thus, conflict processing modulates the spreading of visual attention across a multisensory object at both the levels of the ACC and the sensory cortices.

Attentional processes: Visual

I35

AN ELECTROPHYSIOLOGICAL ACCOUNT OF ATTENTIONAL ENHANCEMENT DUE TO ACTION AFFORDANCE *Maha Adamo[1], Nevena Simic[1], Susanne Ferber[1]; [1]University of Toronto* – When an observer must detect two targets that occur in rapid succession, identification of the second target (T2) is impaired if it appears within roughly 500 ms of the first target (T1). This phenomenon, known as the attentional blink (AB), may be attributed to a failure of conscious report rather than of perceptual processing. We have previously demonstrated that providing an action association between the two targets will enhance detection of T2 such that the blink is diminished. In this study, we recorded EEG while administering a rapid serial visual presentation task. Targets, presented in pale green, were embedded among greyscale images of common objects. T1 was always a tool, and T2 was either an object that could be acted upon by that tool (ACT trials) or an unrelated object (NON trials). We tested three lags (200, 400, and 700 ms) in order to sample behavioural and neural responses at different phases of the blink. ACT trials elicited a smaller blink relative to NON trials, with greater T2 detection at the critical 200 ms lag. Furthermore, we observed sustained posterior activity in the ERP waveforms for detected relative to missed T2s, which was affected by both lag and condition. The enhancement in sustained activity found over posterior scalp sites for ACT T2s is particularly interesting given that tools are selectively represented in posterior inferior parietal cortices. Our ERP results may explain why action associations improve the probability of conscious report under demanding attentional conditions, such as during the AB.

I36

INDIVIDUAL DIFFERENCES IN WORKING MEMORY CAPACITY MODULATE THE EFFECTS OF WORKING MEMORY LOAD ON VISUAL SELECTIVE ATTENTION. *Lubna Ahmed[1], Jan de Fockert[1]; [1]Goldsmiths, University of London* – Previous work has shown that both high working memory (WM) load (Lavie et al., 2004) and low working memory capacity (WMC; Kane & Engle, 2001) hinder the efficiency of selective attention, presumably because both represent situations in which resources needed for efficient selective attention become limited. Although the impact of these two factors on selective attention has been studied separately, it remains unknown how WM load and capacity interact to affect selective attention. The current studies investigated the interactive effects of WM load and capacity on distractor interference in Flanker and Navon tasks. Increasing load led to the predicted increase in distractor interference in high capacity individuals whereas for low capacity individuals the interference levels were equivalently high during both low and high WM load conditions. Under low load interference effects were greater for low capacity individuals compared to high, in other words distractor rejection of low capacity individuals under low load were comparable to that of high capacity individuals under high load. This enhanced efficiency of selective attention seen in high WMC individuals under low Load presumably occurs because WM resources are available for the high but not the low WMC group. High WMC individuals increased distractor effects under high WM Load also indicates a reduction in these resources consequently leads to reduced efficiency of selective attention processes. These studies, utilising individual differences in WM as well as load manipulations, provide further support for the view that WM resources are required for the efficiency of selective attention.

I37

NEURAL CORRELATES OF CATEGORY-INVARIANT ATTENTIONAL INHIBITION PRODUCED BY REJECTED VISUAL DISTRACTORS *JeeWon Ahn[1], Brian Levinthal[1], Alejandro Lleras[1], Diane Beck[1]; [1]University of Illinois at Urbana-Champaign* – In an oddball visual search task, when participants view a target-absent display in which all items share a unique visual feature, if on a subsequent trial, the target shares that "rejected" feature, reaction times are slowed down by as much as 80 ms as compared to RTs to trials in which the target does not have the recently rejected feature. This phenomenon is known as the "Distractor Previewing Effect" and is thought to reflect the inhibition of attention to the previously "rejected" feature. Here we extend this effect to a category-oddball search task and show that this attentional inhibitory effect generalizes to complex visual categories, such that attentional allocation to any-and-all members of a recently rejected category is inhibited: our results show that focusing attention on an oddball "face" target is delayed by as much as 96 ms if "faces" had been rejected as distractors on the previous trial (compared to trials on which "houses" had been the previous distractors). Similarly, RTs to oddball "house" targets were delayed by 69 ms when "houses" had been recently rejected as distractors. This attentional inhibition is observed even though specific faces and houses where never repeated in the experiment, suggesting generalized category-wide inhibition. Using fMRI, we looked at activity in the human brain while participants performed this category-oddball task. Specifically, we examined activity in FFA and PPA, as well as fronto-parietal regions typically associated with attentional allocation and control.

I38

EFFECT OF ALCOHOL ON PERFORMING A SECONDARY TASK WHILE DRIVING *Allyssa J. Allen[1], Shashwath A. Meda[1], Godfrey D. Pearlson[1,2], Robert S. Astur[1,2], Vince D. Calhoun[1,2,3], Pawel Skudlarski[1,2], Kathryn C. Ruopp[1]; [1]Olin Neuropsychiatry Research Center, Institute of Living at Hartford Hospital, Hartford, [2]Yale University School of Medicine, New Haven, [3]The MIND Research Network, The University of New Mexico, Albuquerque* – Introduction: In a recent analysis of traffic accidents, alcohol exacerbated the negative effects of performing a secondary task while driving (Brewer 1980). Previous studies of visual oddball (VO) tasks report dose-dependent increases in reaction time (RT) (but no effect in correct hits or errors) with increased alcohol dose. We expect to replicate findings and to find associated decreased performance on a simulated driving task. Methods/Subjects: Forty male (N=20) and female healthy social drinkers (24.75 years + 4.7 years) were given three different doses of alcohol tailored to their gender and weight: placebo, moderate (BAC=0.05), and high (BAC=0.1). The subjects performed a VO task as part of a simulated driving paradigm, while being scanned in a 3T fMRI scanner. Results: Behavioral analysis with repeated measures ANOVA showed a dose-dependent linear increase in RT, with no effects in either correct hits or false alarms. In all conditions, driving speed decreased significantly after VO. However, in the high dose this decrease was significantly less. Passenger-side line crossings significantly increased. Functional analysis was done in SPM2 with repeated measures ANOVA showed dose-dependent linear decrease in BOLD activation of the hippocampus, anterior cingulate, and the dorsolateral prefrontal areas, with the least activation occurring during the high dose. Conclusions: These results suggest that driving impairment during secondary task performance may be associated with impairment in the above brain regions, which are involved with attentional processes/decision-making. Drivers with high BAC's may be less able to orient or detect a novel or sudden stimulus during driving.

I39

A CONTINUOUS ATTENTION TRACKING TASK FOR THE COMPREHENSIVE ASSESSMENT OF ATTENTION PROCESSES IN ADHD AND NON-ADHD SUBJECTS *Lourdes Anllo-Vento[1], Benjamin N. Cipollini[1], Vladimir López-Hernández[1,2], David L. Woods[3]; [1]University of California, San Diego, [2]Diego Portales University, Santiago, Chile, [3]University of California at Davis* – Continuous Performance Tests (CPTs) have proven useful in the assessment of attention impairments associated with developmental disorders. However, attention is a complex concept comprising multiple cognitive operations. And yet, current computer-based CPTs have a limited capability of detecting and profiling such processes. Here we present a newly developed Continuous Attention Tracking Task (CATT) that quantifies more than 30 measures of attention in an immersive 3D video-game environment with sub-second temporal resolution. Participants were 12 ADHD and 12 non-ADHD adults. Continuous EEG was recorded from 62 scalp sites while subjects engaged in the CATT in 4 blocks of 5 min each. We recorded responses to targets and non-targets, tracking accuracy, and latency of stop-signal responses at 60 Hz, as well as event-related potentials at 500 Hz. While overall tracking accuracy was comparable for ADHD and non-ADHD subjects, inhibition of tracking during a stop-signal was greater in control than ADHD subjects. Similarly, the non-ADHD group stopped tracking faster, and responded to targets faster and more accurately than ADHD subjects. Event-related potentials evoked by the target and non-target signals showed that the brain activity of non-ADHD subjects was selectively modulated starting at about 180 ms following stimulus onset. The CATT replicates prior CPT and Stop-Signal Task results in a more ecologically valid experimental setup that could be used in a clinical setting. As we extend our analyses to utilize the numerous behavioral and physiological measures provided by CATT, we hope to further characterize the patterns of attentional impairment associated with distinct developmental disorders.

I40

SSVEP-BASED SINGLE-TRIAL CLASSIFICATION OF ATTENTION *Andre Bastos[1], Tim Mullen[1], Ryan Canolty[1], Brian Pasley[1], Ralph Freeman[1], Robert Knight[1]; [1]Helen Wills Neuroscience Institute, UC Berkeley* – A real-time, continuous measure of attention could prove useful for several applications, including attention monitoring and training. Previous studies have shown that attention modulates the amplitude of the Steady State Visual Evoked Potential (SSVEP), suggesting it could be used as a real-time measure of attention. We simultaneously presented two flickering stimuli to the left and right of central fixation. The stimuli were high-contrast circular gratings oscillating at 12.5 and 16.7 Hz. In response to a random cue, participants covertly attended to one stimulus while simultaneously ignoring the other. Stimuli were presented for 4.8 seconds, with a 5 second rest between trials. Analysis of 64-channel EEG collected throughout the task confirmed that attending to a particular hemifield produces a systematic change in the amplitude of the SSVEP. Narrow-band spectral estimation combined with Independent Component Analysis (ICA) allowed for robust single-trial classification of the attended hemifield with accuracies comparable to the highest reported in the literature. Based on these preliminary results, we suggest that the SSVEP amplitude could be used as a feedback signal for attention training.

I41

PREDICTIVE GAZE-CUES INFLUENCE FACE PERCEPTION: THE EFFECT OF EMOTIONAL EXPRESSION *Andrew Bayliss[1], Steven Tipper[1]; [1]Bangor University, UK* – When we observe someone suddenly shift their gaze, we automatically shift our own attention to the same location. This 'joint attention' behaviour is very important for successfully engaging in social interactions. In adapted Posner cueing paradigms, faces are presented in the centre of the screen, which look to the left or right. Despite these gaze-cues being uninformative about the location of the target, participants are reliably faster to respond to targets that appear where the eyes look, as compared with targets that appear elsewhere. This study used two sets of faces in a gaze-cueing paradigm. Ten faces always correctly cued the target location ('pro-predictive'), while ten faces never looked at the target location ('anti-predictive'). After the cueing procedure, a series of 2AFC tasks showed that overall, 'pro-predictive' faces were evaluated as more trustworthy than 'anti-predictive' faces. Further, 'anti-predictive' faces appeared to be better encoded in memory. Nevertheless, after full debrief, participants were unable to correctly choose the 'pro-predictive' faces from each pair, suggesting they could not explicitly recall which faces had looked at the target. However, these effects were only significant where each face had a happy expression. Faces with neutral and angry expressions did not reliably elicit these effects of gaze-cueing on face processing. This suggests that a positive facial expression is necessary for these gaze-cueing contingencies to affect the evaluation of, and memory for faces in a joint attention episode.

I42

SPATIAL ATTENTIONAL (RE)ORIENTING IN ADHD AND NON-ADHD CHILDREN: ASSOCIATION WITH DOPAMINE TRANSPORTER (DAT1) GENE VARIANTS. *Mark Bellgrove[1], Katherine Johnson[2], Edwina Barry[3], Ziarih Hawi[3], Michael Gill[3], Ian Robertson[2], Christopher Chambers[4]; [1]School of Psychology and Queensland Brain Institute, University of Queensland, Australia, [2]School of Psychology and Trinity College Institute of Neuroscience, Trinity College Dublin, Ireland, [3]School of Medicine and Health Sciences, and Trinity College Institute of Neuroscience, Trinity College Dublin, Ireland, [4]Institute of Cognitive Neuroscience, University College London, UK* – Impairments of spatial selective attention in children with ADHD remain controversial. This study examined whether individual differences in the spatial attention of 101 children with and without ADHD could be explained by allelic variation in the dopamine transporter gene (DAT1). DAT is the primary site of action of stimulants used to treat ADHD and a number of DNA variants within this gene appear to confer risk to ADHD. Importantly, anomalies of spatial attention in ADHD have been reported to be improved by stimulants, suggesting a role for DAT1 in spatially selective deficits in ADHD. All children performed a reflexive covert visual orienting paradigm in which attention was cued validly, invalidly or un-informatively with respect to the hemifield of an upcoming target. Children with ADHD had a higher frequency of "high-risk" genotypes (homozygosity for the 10-repeat DAT1 VNTR) than control children. In addition, irrespective of diagnostic status, children who were homozygous for the 10-repeat allele had higher ADHD symptomatology. ADHD children who carried the high-risk DAT1 genotype displayed a number of attentional anomalies relative to both ADHD children without the risk genotype and genotyped control children. At short stimulus-onset asynchronies (SOAs) ADHD children with the high-risk DAT1 genotype were slow to reorient attention on invalidly cued trials, particularly when targets appeared in the left hemifield. At longer SOAs children with ADHD were slower to reorient attention from invalid cues and this effect was also influenced by DAT1 genotype. Results are discussed in terms of the role of dopamine in spatial attention.

I43

EFFECTS OF PRISM ADAPTATION ON APPROACH AND WITHDRAWAL *Janet Bultitude[1], Robert Rafal[1]; [1]School of Psychology, University of Wales, Bangor* – Prism adaptation can ameliorate hemispatial neglect symptoms and induce neglect-like performance in healthy participants. Two studies examined whether adaptation to 15º leftward shifts in healthy participants can induce a non-lateralized motor-intentional bias associated with neglect: the tendency to make faster withdrawal than approach responses. In Experiment 1 participants moved a lever forwards (approach) or backwards (withdrawal) in response to arrows displayed on a computer screen. Faster withdrawal responses were observed following adaptation to leftward shifting prisms, while RTs for approach responses were unchanged. These results suggest that prism adaptation may not only improve the spatially lateralized bias of neglect, but also improve associated non-lateralized deficits. Experiment 2 sought to further illuminate the motor-intentional vs emotional-motivational nature of the induced withdrawal bias by requiring participants to perform the same actions under conditions of participant-centred vs screen-centred instructions. It was predicted that a motor-intentional withdrawal bias would result in reduced post-adaptation RTs for backwards movements regardless of the frame of reference, whereas an emotional-motivational withdrawal bias would result in reduced RTs for movement which caused the lever to be distanced from the object of reference.

I44

TEMPORALLY SELECTIVE ATTENTION MODULATES EARLY PERCEPTUAL PROCESSING OF IMAGES PRESENTED IN RAPIDLY CHANGING STREAMS *William Bush[1], Lisa D. Sanders[1]; [1]University of Massachusetts, Amherst* – Spatially selective attention allows viewers to preferentially process the most relevant information in complex scenes. Temporally selective attention has been shown to enhance processing of information presented at specific times. Temporal selection is hypothesized to be particularly crucial when stimuli change rapidly since under these conditions it is not possible to process all of the information in detail. However, most ERP studies showing effects of temporally selective attention on early perceptual processing have not included rapidly changing information. The current study examined the effects of temporal attention on visual evoked potentials (VEPs) using rapid serial visual presentation (RSVP). On each block of trials, participants were directed to attend to one of three times after a brief tone: short (500 ms), middle (1000 ms) or long (1500 ms). They were asked to press a button as quickly as possible if a deviant (digit) appeared at the attended time only in a stream of letters. VEPs were measured in response to task irrelevant probes presented at the critical times. Temporally selective attention modulated early visual components such that mean amplitude was larger in response to probes presented at attended times. The latency and distribution of these affects were compared with what has typically been reported for spatially selective attention. Additionally, a contingent negative variation (CNV) was observed around the attended time. These results demonstrate that temporally selective attention can be used to preferentially process information presented at critical times within rapidly changing visual displays.

I45

SEPARATING THE EFFECTS OF INTERMODAL SELECTIVE ATTENTION, AUDITORY DISTRACTION AND STIMULUS TYPE ON VISUAL FMRI ACTIVATIONS *Anthony D. Cate[1], Timothy J. Herron[1], Xiaojiang Kang[1,2], E. William Yund[1], David L. Woods[1,2,3]; [1]Human Cognitive Neurophysiology Lab, VA Research Service, Martinez, CA, [2]Center for Neuroscience, University of California at Davis, Sacramento, [3]UC Davis Center for Mind and Brain, Davis* – Cortical surface mapping was used to distinguish the effects of intermodal selective attention, auditory distraction, visual stimulus type and their interactions on whole-brain fMRI visual activations. Nine subjects each completed 6 hour-long sessions employing both continuous (2.9s TR) and sparse image acquisition (10.4s TR), which reduced activations due to scanner acoustic noise. Subjects performed demanding one-back tasks with either visual (faces or words) or auditory (tone triplets) stimuli in a blocked factorial design that included four key conditions. In "bimodal visual" blocks subjects performed a visual task while ignoring auditory stimuli; in "unimodal visual" blocks no auditory distracters were present. Equivalent bimodal and unimodal auditory blocks were also included. Visual and auditory stimuli had randomly staggered onsets to reduce crossmodal integration effects. Subjects' cortical hemispheres were segmented to isolate gray matter, inflated to a sphere and aligned to a common coordinate system for group analysis using FreeSurfer. A bimodal visual vs. bimodal auditory contrast showed the effects of task modality-selective attention separate from stimulus-specific effects, since both conditions contained identical stimuli. These visual attention-related modulations (ARMs) comprised a specific subset of the stimulus-dependent activations present in occipitotemporal (OT) and intraparietal sulcus (IPS) regions. Additional contrasts isolated anterior visual ARM areas that were significantly more active when auditory stimuli were present. Interactions between the attentional and stimulus type factors of the design further specified well-defined subregions involved during face and word tasks, not only in OT but also in IPS. These results clarify how attention modulates neural responses to visual stimuli.

I46

INFLUENCE OF PREFRONTAL-VISUAL ASSOCIATIVE CORTICAL NETWORKS IN A SELECTIVE-ATTENTION, WORKING-MEMORY PARADIGM *James Chadick[1], Aaron Rutman[1], Adam Gazzaley[1,2]; [1]University of California, San Francisco, [2]Helen Wills Neuroscience Institute, University of California, Berkeley* – Prefrontal cortex (PFC) has been shown to modulate activity in the visual association cortex (VAC) in a goal-directed fashion. As older adults show a deficit in attention-driven modulation of VAC, the PFC-VAC network is a prime target for studying the neural basis of age-related cognitive decline. Previous studies in our lab have focused on a selective-attention working memory paradigm where relevant and irrelevant stimuli were presented sequentially. A more real world based approach would be to study modulation associated with simultaneously presented stimuli, when a subject is required to concurrently enhance and suppress competing visual information. To explore this, we employed a selective-attention working memory task in healthy, young adults (22-35 years old) in both an fMRI and EEG experiment. Subjects were presented with simultaneously overlapping stimuli consisting of faces and scenes and were instructed to remember either faces or scenes, or to passively view the stimuli. After a brief delay, a probe stimulus was presented and the subject's responded if the probe matched either relevant stimuli. We found significant modulation of BOLD signal in posterior stimulus-selective VAC regions based on task instruction, which corresponded with early modulation (~100 msec) of posterior EEG waveforms. Preliminary multivariate analysis indicates this modulation is associated with a PFC-VAC network. Currently, we are investigating the effects of aging on these networks with the hypothesis that aging-related changes in VAC modulation may be due to loss of fidelity of PFC-VAC connectivity.

I47

NEURAL BASES OF GOAL-DIRECTED SELECTION OF INFORMATION FOR WORKING MEMORY *Anthony J.-W. Chen[1,2,3], Terry Nycum[3], Michael Britton[2,3], Mark D'Esposito[1,2,3]; [1]VA Medical Center, [2]University of California, San Francisco, [3]University of California, Berkeley* – Top-down selection of information for more in-depth processing in working memory is a crucial step for efficient and effective goal-directed behavior. On the other hand, selectivity of processing for particular features of information appears to be an intrinsic property of ascending levels of visual cortical processing. We hypothesize that modulation of this intrinsic selectivity is a mechanism for goal-directed modulation of information processing. We present an fMRI task that involves presentation of serial image stimuli (two categories, faces and scenes, pseudo-randomly inter-leaved), with demands for top-down selection of a subset for working memory processing, making the other images distractors in a category-selective n-back task. The design allows calculations of the relative category-selectivity of activity in pre-defined regions of interest. We calculate (10 subjects) intrinsic category selectivity for regions of visual association cortex during baseline tasks requiring minimal selection (either simply viewing and categorizing all images, or trying to hold in mind all images), and results are congruent with an independent task with blocked faces and scenes. We then show that selectivity in these regions is modulated by goal-directed selection demands, such that selectivity for goal-relevant stimuli is increased, while selectivity for non-relevant stimuli is decreased. Regions of the lateral prefrontal cortex show strong goal-directed stimulus-selectivity when tasks demand selection. These prefrontal regions may thus be a source of the top-down signals that bias the selectivity of the posterior regions. These fMRI measurements should be useful for examining how selection processes are affected by brain injuries and neurological interventions.

I48

ADULT AGE DIFFERENCES IN CORTICAL ACTIVATION DURING TASK-SWITCHING *Matthew Costello[1], David Madden[1], Julia Spaniol[2], Nancy Denis[3], Barbara Bucur[4], Roberto Cabeza[3], James Provenzale[1], Scott Huettel[1]; [1]Duke University Medical Center, [2]Ryerson University, [3]Duke University, [4]University of Missouri, St. Louis* – Older adults have shown increased top-down involvement in attentional tasks, suggesting a greater role of frontal activity within a frontoparietal network. To explore this possibility, we tested 18 younger (18-27 years; 9 female) and 16 older (60-85 years; 9 female) adults in a 3T fMRI experiment that assessed transient cortical activation associated with task switching. On cue-plus-target trials, a visual cue indicated which one of two category judgments was to be made on the upcoming target word: manmade/natural or large/small. On cue-only trials, the cue was presented without an accompanying target. Each trial was coded as a task switch or repeat, relative to the previous trial. Cue-related activity for both age groups was located in occipital and frontal regions bilaterally, with additional left posterior parietal activations for older adults. Target-related activity for younger adults elicited broad occipital-parietal-frontal activations that were primarily left lateralized. Younger adults' target-related activity was greater for repeats than for switches. For older adults, target processing elicited a similar network but maintained largely bilateral activity, with right parietal activation for switch trials. Functional connectivity analyses indicated that, for cue-related activity, older adults exhibited correlated activation within occipital regions, whereas younger adults exhibited greater bilateral frontal connectivity. For target related activity, older adults showed widespread connectivity within the frontoparietal network, whereas for younger adults correlated activations were primarily in occipital regions. The results suggest that, during task switching, younger adults activate an attention-dependent frontoparietal network during cue processing, whereas older adults activate this network later, during target processing.

I49

MODULATION OF P1 AS A FUNCTION OF VISUAL SELECTIVE ATTENTION IN ADULTS AND CHILDREN *Jane Couperus[1]; [1]Hampshire College* – Research suggests that children, like adults, show modulation of early brain processes as a function of selective attention (Bartgis, Lilly, & Thomas, 2003, Maatta, Paakkinen, Saavalaninen & Partanen, 2005, Perez-Edgar &Fox, 2005, Sanders, Stevens, Coch, & Neville, 2006, Taylor & Khan, 2000). However, while studies involving auditory attention have shown modulations in the amplitude of the P1 event related potential (ERP) component as a function of selective attention (e.g. Sanders et al., 2006), only changes in latency of early components have been demonstrated with visual stimuli (Taylor and Khan, 2000). The present investigation first replicates adult studies of visual selective attention (e.g. Mangun & Hillyard, 1991) showing selective attention based modulation of the P1 and then extends this research to children ages 7-10. Children and adults were presented with pictures at both fixation and in their peripheral visual field above fixation. In one task they were asked to attend to only the pictures appearing at fixation and determine whether the picture was an animal or vehicle. In a second task they were asked to maintain fixation but also report on pictures not presented at fixation. In both children and adults, P1 amplitude to pictures presented above fixation were significantly increased when the target stimulus was attended (task at both fixation and above fixation) as compared to unattended (task only at fixation) (adults: $F(1,5)=15.23$, $p=.011$, children: $F(1,6)=9.50$, $p=.022$). These results show that stimulus processing in children, like adults, is modulated by selective attention early in visual processing.

I50

MOTOR PLANS INFLUENCE THE VISUAL PROCESSING OF OBSERVED ACTIONS *Ross Cunnington[1], Cassandra Biddick[1], Jason B Mattingley[1]; [1]Queensland Brain Institute and School of Psychology, University of Queensland, Brisbane, Australia* – The perception and the execution of action appear to be linked by common neural mechanisms. Observed actions lead to increased activity in motor and premotor cortical areas and can interfere with the execution of opposite or incongruent actions. The "mirror" system has been suggested to mediate this link, directly matching observed actions onto equivalent motor representations in the motor system. While many studies have focussed on the influence of observed actions on the motor system, it is not known whether motor plans can similarly influence earlier visual processing associated with the perception of actions in a top-down manner. We tested this hypothesis specifically by examining visual evoked potentials (64-channel EEG) to images of hand gesture actions that were either congruent or incongruent with hand actions concurrently planned by participants in a Go-NoGo paradigm. The visual processing of observed actions was found to be significantly influenced by concurrent motor plans. Specifically, the N170 component of visual evoked potentials, known to be associated with the processing of biological stimuli, was significantly enhanced when observed actions were incongruent with concurrently planned actiona. Crucially, this effect was specific to the congruency of motor plans, and was not observed in a control condition involving similar stimulus incongruency but without motor planning. Our results provide further evidence for the association between the perception and execution of action, perhaps mediated by a mirror neuron system. Specifically, we have shown that motor plans or representations in the motor system can influence the visual processing of observed actions.

Emotion

I51

EMOTION-COGNITION INTERACTION: WORKING MEMORY AND TRANSIENT EMOTIONAL INTERFERENCE *Alan Anticevic[1], Grega Repovs[1], Jennifer Staplins[1], Tara Benesch[1], Todd Braver[1], Deanna Barch[1]; [1]Washington University in St. Louis* – Humans possess a unique ability to sustain goal-directed attention for extended periods of time regardless of incoming distractions. One example is maintenance and manipulation of information in working memory (WM), which involves a constellation of brain areas including the dorsal-parietal network. However, there are times when it is critical for humans to rapidly disengage internally focused attention and attend to relevant environmental stimuli, including those that might be task-irrelevant but survival relevant. Previous work has shown that a functional region at or near the temporo-parietal junction (TPJ) is a part of a system involved in detecting task-relevant information. Furthermore, it has been hypothesized that TPJ acts as a possible 'circuit-breaker' of the sustained, goal-directed system when reallocation of attention is warranted. However, previous investigations have not addressed the question if TPJ plays a part in helping reorient attention when emotionally salient, but task irrelevant information is presented. We used event-related functional neuroimaging at 3T to examine whether TPJ is responsive to task-irrelevant emotionally salient distraction. Furthermore, we investigated whether TPJ responsiveness across different distracter types (i.e. emotional and task-relevant) was moderated as a function of WM load. The results suggest that TPJ's role in integrating attentional and cognitive processes might also extend to emotional processing, and that the role of TPJ as a "circuit-breaker" varies as a function of memory load. Furthermore, these studies will shed light on the mechanisms that govern the interaction between goal-focused processes and allocation of attention to emotionally salient events in the environment.

I52

ROLE OF ALPHA-1 NOREPINEPHRINE RECEPTORS IN MDMA (ECSTASY) EFFECTS: A CONTROLLED CLINICAL TRIAL *Matthew Baggott[1,3], Gantt Galloway[1], Margie Jang[1], Ryne Didier[2], John Mendelson[1]; [1]Cal Pac Medical Center Research Institute, San Francisco, [2]Oregon Health & Science University School of Medicine, Portland, [3]Helen Wills Neuroscience Institute, University of California, Berkeley* – BACKGROUND/AIMS: Preclinical data suggests psychostimulant effects are mediated by multiple neurotransmitter mechanisms including noradrenergic, serotonergic, and dopaminergic. MDMA (3,4-methylenedioxymethamphetamine, 'Ecstasy') is an illicitly used drug with some typical psychostimulant effects (e.g., increased heart rate, blood pressure and positive mood) and some putatively atypical social and emotional (so-called 'entactogen') effects (e.g., increased self-report sociability). To examine possible noradrenergic mechanisms of MDMA, we administered MDMA alone and in combination with the alpha-1 noradrenergic inverse agonist prazosin. We hypothesized alpha-1 receptors contribute to the typical psychostimulant but not putatively atypical effects of MDMA. METHODS: 16 healthy MDMA-experienced participants (8 males and 8 females) received placebo, 1.5 mg/kg PO MDMA, 1-2 mg PO prazosin, or both drugs in a four-session balanced controlled trial in a laboratory setting. Pharmacokinetic and pharmacodynamic (physiological, neurocognitive, and self-report) measures were made and analyzed using linear mixed-effects models in R. RESULTS: MDMA alone increased measures of both typical psychostimulant (heart rate, diastolic blood pressure, positive mood) and putatively atypical effects (sociability). Prazosin alone did not significantly affect these measures. As hypothesized, co-administration of prazosin significantly modified MDMA effects on typical psychostimulant but not putatively atypical measures. CONCLUSIONS: Alpha-1 noradrenergic mechanisms may contribute to some typical psychostimulant but not to putatively atypical effects of MDMA. Although statistically significant, the influence of prazosin on MDMA effects was modest, suggesting a role for other receptors or neurotransmitters. Supported by NIH DA 016776.

I53

MIRROR NEURON SYSTEM NOT BROKEN IN ADULTS WITH AUTISM SPECTRUM DISORDER FOR VIEWING EMOTIONS OF OTHERS *Jojanneke Bastiaansen[1,2], Marc Thioux[1], Christian Keysers[1]; [1]Social Brain Lab, BCN Neuroimaging Center, University Medical Center Groningen, [2]Lentis, Autism Team North Netherlands, Groningen* – The mirror theory of autism spectrum disorder (ASD) proposes that ASD is characterized by reduced mirroring. For emotions, Dapretto et al. (2006) found that while children with ASD view the facial expressions of other individuals, they do not activate areas involved in producing their own facial expressions or experiencing their own emotions as much as typically developing (TD) individuals. To test this whether this holds for adults with ASD, we scanned 17 high functioning ASD adults and 17 matched TDs while they passively view movies of pleased, disgusted and neutral facial expressions. To our surprise individuals with ASD activated their 'social brain' not less but more strongly than TDs. In particular while viewing disgusted facial expressions, they show stronger activations in high level visual (fusiform gyrus), somatosensory (SI/SII), motor (M1), emotional (insula, amygdala) and mentalizing (mPFC, TPJ) areas as well as BA45 and posterior parietal cortex. This finding challenges the mirror theory of autism by showing that at least for movies of certain facial emotional expressions, the adult autistic brain appears to share motions and emotions even more strongly than the TD brain. This raises the possibility that individuals with ASD may find the social world challenging not because it fails to engage them but because it overwhelms them. Alternatively, the observed hyper-activation may indicate high functioning ASD adults cope with a less efficient brain by making it work harder, utilizing both reflective mentalizing (mPFC, TPJ) and simulation (SI/SII, insula, amygdalae) to obtain the social insights TDs take for granted.

I54

PERCEPTUAL DIFFERENCES IN THE USE OF MULTIPLE EMOTION REGULATION STRATEGIES *Genna Bebko[1,2], Steven Franconeri[2], Kevin Ochsner[3], Joan Chiao[1,2]; [1]Northwestern University Interdepartmental Neuroscience Program, [2]Northwestern University, [3]Columbia University* – We constantly regulate the experience and expression of our emotions in order to maintain physical, psychological, and social well-being (Abelson, Liberzon, Young, Khan, 2005; Gross, 2002). Prior research has shown that multiple cognitive strategies are employed to regulate emotional responses to aversive events, a process which, at the neural level, reflects modulation of amygdala response by prefrontal regions (Ochsner & Gross, 2005). Given the modulation of amygdala activity not only by prefrontal regions but also by primary visual cortices (Vuilleumier & Driver, 2007), we hypothesized that attentional deployment may also vary depending on the type of emotion regulation strategy used. To test this possibility, eye movements were measured while healthy young adult participants viewed negative IAPS images and regulated emotions by using either reappraisal (N=15), an antecedent-focused emotion regulation strategy, or suppression (N=16), a response-focused emotion regulation strategy. Consistent with prior studies, participants reported lower negative valence ratings for pictures during emotion regulation compared to the attend condition. Additionally, participants in the reappraisal group showed lower negative valence ratings relative to those in the suppression group. Novel eye movement results show that all participants made fewer fixations during emotion regulation compared to the attend condition, particularly in a priori defined emotionally salient areas compared with the background. Critically, participants suppressing their emotions made fewer eye movements relative to participants reappraising their emotions. Taken together, these results demonstrate that reappraisal and suppression vary not only in behavioral outcome but also in how attention is deployed across emotionally-rich visual scenes during regulation.

I55

NEURAL SUBSTRATES OF EMOTION REGULATION AMONG YOUNG ADULTS *Cristina Benavides[1], Christopher Beevers[1], Natalie Dailey[1], David Schnyer[2] ; [1]University of Texas at Austin, [2]Imaging Research Center, University of Texas at Austin* – Cognitive studies have indicated that a human serotonin transporter (5-HTTLPR) gene polymorphism is associated with biased processing of emotional information that likely results from altered functional connectivity within a corticolimbic circuit. The current study utilized functional magnetic resonance imaging (fMRI) and an attentional cuing task utilizing emotional face stimuli to investigate the neural underpinnings of this biased emotional processing. While recording fMRI, 18 young adult females were exposed to a briefly presented picture of a face with a happy, sad or neutral expression that was lateralized to right or left screen positions. These faces were followed by a target of one or two asterisks presented either in the location of the picture (valid-cue, VC) or in the opposing screen position (Invalid-cue, IC). Participants were asked to indicate whether they saw one or two asterisks. Response times indicated a clear effect of cuing for emotional faces (happy and sad). In addition, clear neural differences were associated with VC and IC of sad facial expressions such that VC resulted in greater left amygdala activity while IC was resulted in greater left prefrontal activity. Participants were genotyped for 5-HTTLPR alleles and preliminary results from 7 subjects have indicated that allele status is predictive of responses in the amygdala and prefrontal regions such that greater prefrontal/less amygdala activity is associated with less vulnerability to biased emotional processing. Division of the larger sample will be carried out when genotyping is completed.

I56

AGGRESSION CHANGES THE PROCESSING OF EMOTIONAL FACES - AN ERP STUDY *Katja Bertsch[1], Robina Khan[1], Ewald Naumann[1], Menno Kruk[2], Michael Hermes[1], Patrick Britz[1]; [1]University of Trier, [2]Leiden University* – According to animal research on aggression, the perception and processing of social conflict stimuli might play an important role both in the elicitation and in the escalation of aggressive behavior. So far, the influence of experimentally induced aggressive behavior on information processing has barely been studied in humans. In an ERP study, we investigated the processing of emotional faces (happy, neutral, fearful and angry) in an emotional Stroop task after experimentally provoking aggressive behavior in half of our healthy participants with the Taylor Aggression Paradigm. Although participants of the experimental group showed similar reaction times than those of a non-provoked control group, significant group differences were found in the amplitude of three ERP components (P200, P300, slow wave). Only for the P200 amplitude, this group effect was also modulated by the emotion of the faces, showing largest effects for negative emotional stimuli in the experimental group. Furthermore, in the experimental group the P200 amplitude was positively correlated with aggressive behavior. These results indicate an association between aggression and a change in early, more automatic as well as in later, more controlled and conscious stages of information processing without resulting in any behavioral differences.

I57

THE INFLUENCE OF ADVICE ON REWARD BASED DECISION MAKING AND LEARNING *Guido Biele[1,2], Lea Krugel[1,2], Jörg Rieskamp[1], Hauke Heekeren[1,2]; [1]Max Planck Institute for Human Development, [2]Berlin NeuroImaging Center, Charité University Medicine Berlin* – When decision makers choose between alternatives, they can rely on their own experience with the alternatives and on advice. Here we investigate how prior advice influences learning between different alternatives by modeling the learning process and by describing the influence of advice on the neural representation of outcomes. 21 participants performed a modified version of the Iowa Gambling Task, after they received a recommendation indicating which deck they should choose. Behavioral results indicate a long-lasting influence of advice on decisions, which was reflected in participants' preference of the recommended card deck over a corresponding deck with the same payoff distribution, even when advice was bad. Participants' reliance on advice was modeled with a Reinforcement Learning model implementing the additional assumption that monetary outcomes from recommended alternatives are perceived to be more positive than the same outcome from a non-recommended alternative. The fMRI analysis showed that positive outcomes were associated with stronger bold responses in the ventral striatum and in the orbitofrontal cortex. Negative outcomes were associated with stronger activation in the anterior insula. Region of interest analyses showed that positive feedback after recommended choices led to stronger activation in the ventral striatum, compared to positive feedback after non- recommended choices. Negative feedback after recommended choices led to a weaker activation in the anterior insula. These results suggest that advice influences decision making and learning by directly changing the perception of outcomes, so that gains/losses from recommended choices are experienced as more positive/less negative than the same outcomes from non-recommended choices.

I58

10 THINGS I HATE ABOUT YOU: THE NEURAL RESPONSE TO SOCIAL PRAISE AND CRITICISM IN GENERALIZED SOCIAL PHOBIA (GSP). *Karina Blair[1], Marilla Geraci[1], Jeffrey DeVido[1], Daniel McCaffrey[1], Pamela Ng[1], Nick Hollon[1], Matthew Jones[1], James Blair[1], Daniel Pine[1]; [1]National Institute of Mental Health* – Background: Generalized social phobia (GSP) is characterized by fear/ avoidance of social situations. Previous studies have examined the neural responses of patients with GSP to one class of social stimuli, facial expressions. However, studies have not examined the neural response in GSP to another, equally important class of social stimuli, the communication of praise or criticism. Using event-related functional magnetic resonance imaging (fMRI), the authors examined the neural response to receipt of praise or criticism in GSP. Method: Seventeen unmedicated patients with GSP and seventeen age, IQ, and gender matched healthy comparison individuals read positive (e.g., You are beautiful), negative (e.g., You are ugly), and neutral (e.g. You are human) comments that could be either about the self, or about somebody else (e.g. He is beautiful). Results: Hypothesized significant group-by-valence-by-referent interactions were observed within regions of medial prefrontal cortex (MPFC) and bilateral amygdala. In these regions, the patients with GSP showed significantly increased BOLD responses, relative to comparison individuals, to negative comments (criticism) referring to themselves. However, in contrast, there were no significant group differences with respect to neutral or positive comments referring to self or others, or negative comments referring to others. Conclusions: These results implicate the MPFC, involved in the representation of the self, together with the amygdala, in the pathophysiology of GSP. Further, findings demonstrate a powerful effect of psychological context on neural-circuitry hyperactivity in GSP, findings that may help guide novel therapeutics.

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THE VALUED BRAIN: THE NEURAL REFERENCE SPACE FOR CORE AFFECT *Eliza Bliss-Moreau[1], Tor Wager[2], Kristen Lindquist[1], Hedy Kober[2], Josh Josephs[2], Matthew Davidson[2], Lisa Feldman Barrett[1,3]; [1]Boston College, [2]Columbia University, [3]Massachusetts General Hospital, Harvard Medical School* – The science of emotion has long been preoccupied with determining which states are biologically primitive—states thought to be neurologically hardwired, present at birth, and homologous across mammals. For decades, researchers have sought the distinct neural, physiological and behavioral patterns for discrete emotions such as “anger”, “sadness” and “fear”. While there is some evidence for this “basic emotion perspective” (for reviews see Izard, 2007; Panksepp, 2007), the majority of the evidence is consistent with the existence of a broader system of distributed neural networks supporting more general core affective states which are themselves necessary (but not sufficient) for any emotional event (for review, Barrett, Lindquist, Bliss-Moreau et al., 2007). Core affect is a biologically primitive affective state that results from translating sensory information into an internal, neurophysiological code which is experienced as pleasant or unpleasant (Barrett, 2006; Russell, 2003). In the present meta-analytic review, we used new meta-analytic techniques to identify the regions consistently activated across all neuroimaging studies of emotion published from 1995 to 2005 (N = 163). First, we identified a neural reference space for core affective processing (i.e., the processing of value) that relies on a distributed network of both cortical (e.g., oribtofrontal, medial prefrontal) and subcortical (e.g., amygdala, hypothalamus) structures. Second, we demonstrated that the neural instantiation of each discrete emotion category is highly overlapping within this neural reference space. Implications for the neural investigation of emotion and affect are discussed.

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REINFORCEMENT LEARNING BY PUNISHMENT AND REWARD OMISSION: EVIDENCE FROM ERROR-RELATED EVENT RELATED POTENTIAL COMPONENTS. *Maarten Boksem[1], Mattie Tops[2], Evelien Kostermans[1], David De Cremer[1]; [1]Tilburg University, Tilburg, The Netherlands, [2]Leiden University, Leiden, The Netherlands* – In a recent experiment (Boksem et al., 2006), we showed that error related Event Related Potential (ERP) components, such as the Error Related Negativity (ERN) and Error Positivity (Pe), were related to punishment and reward sensitivity. The present study was conducted to further evaluate the relationship between punishment/reward sensitivity and error related ERP components. Therefore, we scored our subjects on the Behavioral Inhibition – Behavioral Activation (BIS/BAS) measures of punishment and reward sensitivity. Then, subjects performed one of two versions of a Flanker task: in one, they were financially punished for committing errors; in the other, they were financially rewarded for correct performance. Analyses of ERN amplitudes indicated significant interactions between personality measures of punishment (BIS) and reward (BAS) and actual punishment and reward, while analyses of Pe amplitudes showed a significant interactions between personality measures of reward and actual reward. We suggest that ERN/Ne amplitude is related to concerns over mistakes and depends on the level of aversion experienced by individual subjects when making these mistakes. Subjects that are highly sensitive to punishment are strongly motivated or engaged in avoiding punishment, while subjects sensitive to rewards are motivated to obtain rewards and therefore show high task engagement when rewards may be earned. The error related ERP components appears to track this level of engagement in task performance.

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FAILURE TO REVISE DECISION-MAKING STRATEGIES IN THE FACE OF CONTINGENCY SHIFTS: THE MODIFIED IOWA GAMBLING TASK AND SCHIZOTYPY *Caroline Bowman[1], Oliver Turnbull[1]; [1]School of Psychology, Bangor University, Gwynedd, Wales, UK* – The need to adapt to a changing environment in which once rewarding strategies have become punishing is an essential ability quite often disrupted in people with schizophrenia. This study investigated whether individuals highly rated in schizotypy, although neurologically normal, had similar problems in modifying behaviour when faced with affective contingency shifts. Following the three-factor model of schizotypy, candidates scoring either above the 75th percentile or below the 50th percentile on each factor were selected from a database of 404 undergraduate participants who had previously completed the Schizotypal Personality Questionnaire (SPQ; overall mean 26.78). Sixteen participants formed the High Schizotypy group, while 20 participants comprised the Low Schizotypy group (overall mean 40.94 & 16.25, respectively). All participants completed the modified Iowa Gambling Task, which in addition to the original task included shifting phases in which deck contingencies reversed. Measures of subjective awareness, assessing whether participants had explicit knowledge about deck properties, were also collected. Additionally, skin conductance responses (SCR) were assessed to establish any differences in psychophysiological arousal. The results showed that the High Schizotypy group learned the advantageous decision-making strategy during the original task, but made significantly more disadvantageous choices during the shifting periods than did the Low Schizotypy group. Moreover, this occurred in spite of apparently normal SCRs and awareness ratings, indicating knowledge of the new contingencies. The finding that those rated highly in schizotypy are seemingly ‘ignoring’ crucial information from subjective awareness and physiological sources to the detriment of behavioural performance has important clinical and theoretical implications.

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THE NEURAL MECHANISMS OF SPECIFIC PAVLOVIAN-TO-INSTRUMENTAL TRANSFER EFFECTS IN HUMANS *Signe Bray[1], Bernard Balleine[2], Shinsuke Shimojo[3], Antonio Rangel[4], John O'Doherty[4]; [1]California Institute of Technology, Computation and Neural Systems, [2]University of California Los Angeles, [3]California Institute of Technology, Division of Biology, [4]California Institute of Technology, Division of Humanities and Social Sciences* – There is considerable evidence that a cue established as predictive of a specific outcome will bias choice towards actions associated with that outcome. Formally referred to as specific Pavlovian to instrumental transfer (PIT), this effect has been argued to model the influence of reward-related cues in advertising and drug addiction. To assess the neural bases of this influence we scanned 23 healthy subjects with functional magnetic resonance imaging (fMRI) as they underwent Pavlovian and instrumental training, followed by a transfer test. During the training phase, subjects learned to associate simple visual shape stimuli with one of four outcomes: orange juice, chocolate milk, cola and an affectively neutral tasteless control solution. The training session also included instrumental training trials in which the subjects chose from a pair of four possible button push actions that earned distinct outcomes: two of the button push actions led to reward outcomes and two led to the neutral outcome. Next, specific transfer was assessed, in extinction, by presenting the Pavlovian cues and assessing the choice between pairs of actions. We found a significant specific transfer effect: when subjects chose between actions, they favored the action corresponding to the outcome predicted by the concurrently presented Pavlovian cue. Neuroimaging results showed a significant difference in BOLD responses in ventolateral putamen on trials when subjects chose the action compatible with the Pavlovian cue compared to the incompatible action. These results provide important insight into the neural processes that mediate the influence of stimulus-outcome associations on decision making in humans.

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BEHOLD THE VOICE OF WRATH: EMOTIONAL PROSODY MODULATES EARLY STAGES OF VISUAL PROCESSING *Tobias Brosch[1,2], Didier Grandjean[1,2], David Sander[1,2], Klaus R. Scherer[1,2]; [1]Swiss Centre for Affective Sciences, University of Geneva, Switzerland, [2]University of Geneva, Switzerland* – Emotional attention, the boosting of the neural representation of emotional stimuli, is usually investigated within a sensory modality, e.g. by using emotional pictures to modulate visual attention. In real-life environments, however, humans typically encounter simultaneous input to several different senses, such as vision and audition. As multiple signals entering different channels might originate from a common, emotionally relevant source, prioritization of emotional stimuli should be able to operate across modalities. Therefore, in this study we explored cross-modal emotional attention. Spatially localized utterances with emotional and neutral prosody served as cues for visually presented non-emotional targets in a cross-modal dot probe task. Participants were faster to respond to targets appearing at the spatial source of emotional compared to neutral prosody. Event-related brain potentials revealed emotional modulation of early visual target processing at the level of the P1 component. Neural sources in visual cortex were more active for targets appearing at the spatial location of emotional compared to neutral prosody. These effects were not found using synthesized control sounds matched for mean fundamental frequency and amplitude envelope, ruling out the possibility that these low-level acoustic parameters triggered the effect. Our results show for the first time that emotional attention can operate across sensory modalities by boosting early sensory stages of processing, thus facilitating the multimodal evaluation of emotionally relevant stimuli in the environment. Based on previous anatomical evidence, we suggest that the enhanced occipital activation for visual targets preceded by emotional voice cues is driven by connections between amygdala and sensory cortices.

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COGNITIVE REGULATION OF EMOTION: A COMPARATIVE META-ANALYTIC APPROACH *Jason Buhle[1], Jared X. Van Snellenberg[1], Edward E. Smith[1], Tor D. Wager[1]; [1]Columbia University* – We performed a meta-analysis of 13 human neuroimaging studies of volitional emotion regulation in order to identify common activity across diverse stimuli, strategies and goals. Emotion regulation consistently increased activity in several 'source' regions: left dorsal premotor area; left pre-supplementary motor area; bilateral inferior frontal gyrus; left dorsal anterior insula; and a dorsal medial junction (medial BA 6 and 8, dorsal BA 32) region (DMJ; commonly referred to as anterior cingulate cortex). The only 'target' region consistently modulated by regulation was the left amygdala. To interpret these findings we compared them to results of previous meta-analyses of emotion and cognition, including working memory, long term memory, inhibition, and task switching. DMJ activity has been identified in each of these cognitive meta-analyses, suggesting it performs a general role in effortful mental activity, while amygdala modulation may reflect changes in the perception of emotional material and affective salience rather than the experience of negative emotion per se. We use the present findings to assess several current neural models of volitional emotion regulation, and we offer revised models with testable hypotheses. In addition, the 'consensus' voluntary emotion regulation regions derived from the meta-analysis may be useful in formulating anatomically specific hypotheses in future studies. To facilitate such efforts, we have made the maps used here available for download on our website (http://www.columbia.edu/cu/psychology/tor/).

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SPATIAL ATTENTION RELATED AMYGDALA ACTIVITY TO MASKED FEARFUL FACES *Joshua Carlson[1], Karen Reinke[1,2]; [1]Southern Illinois University Carbondale, [2]University of Illinois at Springfield* – Neuroimaging studies indicate that nonconscious fearful faces activate the amygdala, superior colliculus, and pulvinar. It has been suggested that these structures form a subcortical fear network involved in automatic alerting. While behavioral studies indicate that nonconscious fearful faces modulate spatial attention the amygdala's role in this behavior has yet to be assessed. Twelve participants performed a modified dot probe task while fMRI activity was recorded. Each trial consisted of two faces (from Gur et al, 2002) simultaneously presented (33 ms) to the left and right of fixation and immediately masked by neutral faces (100 ms), followed by a target dot. Participants then indicated which side of the screen the target dot appeared. Directed attention trials consist of one fearful and one neutral 33 ms face while undirected attention trials consist of either both fearful or both neutral 33 ms faces. Behavioral results revealed faster reaction times for fear congruent relative to incongruent trials in the LVF. Amygdala ROIs were created using MARINA to assess its role in the processing of masked fearful faces and spatial attention. Consistent with previous research, we found increased bilateral amygdala activity for nonconscious fearful relative to neutral faces independent of spatial attention. However, of greater interest is the novel finding that directed spatial attention elicited by LVF masked fearful faces is associated with increased left amygdala activity compared to undirected attention. Therefore, both behavioral and fMRI data reveal LVF spatial attention effects for nonconscious fearful faces.

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WORKING MEMORY LOAD MODULATES PROCESSING OF IGNORED EMOTIONAL STIMULI *David Carmel[1,2,3,4], Emma Jane Bradford[1], Geraint Rees[2,3], Nilli Lavie[1,2]; [1]University College London, London, UK, [2]Institute of Cognitive Neuroscience, University College London, UK, [3]Wellcome Department of Imaging Neuroscience, Institute of Neurology, University College London, UK, [4]New York University, New York* – Executive control processes such as working memory may be critical for reducing interference from irrelevant distractors, by maintaining current processing priorities. Previous evidence regarding whether the processing of emotional stimuli is subject to attentional control has been mixed. Here we investigate the role of working memory in the processing of task-irrelevant emotional stimuli. Participants categorized the affective valence of words (positive or negative). On each trial, the target word was superimposed on an affective face, which participants were instructed to ignore, and which was either congruent or incongruent with the word's valence. This task was performed while retaining one (low load) or six (high load) digits in working memory. Two experiments using different negative distractor faces (sad and angry) showed that under high (compared to low) working memory load, reaction times in the word categorization task were longer for incongruent faces than for congruent faces, and this difference was greater under high working memory load. Loading working memory therefore increased interference from the concurrently presented affective faces. We also found that negative faces were more distracting than positive faces, and angry faces were more distracting than sad faces. These results suggest that Lavie's load theory of attention (e.g. Lavie, 2005) can be extended to emotional stimuli, and support the view that emotional stimuli are amenable to cognitive control. Lavie, N. (2005). Distracted and confused?: selective attention under load. Trends in Cognitive Sciences, 9, 75-82.

I67

FEAR AND DISGUST HAVE DIFFERENT EFFECTS ON ATTENTION AND MEMORY *Hanah Chapman[1], Kristen Johannes[1], Adam Anderson[1,2]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest Centre for Geriatric Health* – Introduction: Basic emotions models claim that the affective domain is comprised of discrete emotions, such as anger, fear, joy etc. By contrast, dimensional models maintain that all emotions are just combinations of simpler dimensions, such as valence and arousal. Most previous research on the mnemonic effects of emotion has adopted a dimensional framework, focusing on the memory-enhancing effects of arousal. However, the effects of different basic emotions on memory remain largely unexplored. We therefore investigated the impact of two negative, highly arousing emotions—disgust and fear—on memory, while simultaneously examining their role in modulating attention. Because disgust and fear have similar dimensionality, a dimensional model predicts that they should have similar cognitive effects, while a basic emotions model predicts that their effects may differ. Method: To test these predictions, participants viewed neutral as well as disgusting and fearful photographs of equivalent valence and arousal, with a horizontal line above or below each photograph. The task was to indicate the location of the line as quickly as possible. Reaction times were significantly slower for disgusting vs. fearful images, suggesting greater attentional capture by disgust than fear. Memory was tested with a recall test 10 min after encoding. Recall of disgusting and fearful photographs was enhanced equivalently, compared to neutral images. Conclusion: Disgust and fear had similar effects on memory, but different effects on attention. Thus, a dimensional model may best capture the mnemonic effects of different emotions, while a basic emotions model may best account for their attentional effects.

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INFANTS' ATTENTION TO EMOTIONAL EXPRESSIONS: EVIDENCE FOR UNIVERSAL BIASES AND INDIVIDUAL DIFFERENCES *Frances Chen[1], Susan Johnson[1]; [1]Stanford University* – Research has shown that facial expressions of emotion influence attentional processes in adults. Generally, spatial attention is more strongly captured and held by negative than neutral expressions (cf., Dolan, 2002). Depressed individuals are biased toward sad faces (Gotlib et al., 2004); anxious individuals toward angry faces (Fox el al., 2002). Our study investigated whether (1) emotional expressions exert similar influences in infancy, (2) such effects are lateralized, and (3) individual differences could be predicted by disorganized behavior in the Ainsworth's (1972) Strange Situation—a risk factor for later psychopathology. We tested 32 thirteen-month-olds, showing randomized, centrally-presented pictures of a single woman producing neutral, fearful, angry, sad, and happy expressions. 1000 ms after the infant fixated the face, it was replaced by a small target to the far left or right. Latency to shift attention away from the central fixation was measured. A repeated-measures ANOVA was run with expression and target side as within-subject variables. Infants disengaged more slowly from some expressions than others ($F=6.54$, $p<.001$). Both fear and anger took significantly longer to disengage from than neutral ($p <.001$ and $p<.05$ by simple contrast tests.) Infants were also slower to disengage from the faces when the target appeared in the left visual field ($F=6.43$, $p<.02$), suggesting a right hemisphere emotion processing bias. The interaction between expression and disorganization (a between-subject variable) was also significant ($F=2.82$, $p<.03$). To our knowledge, these results provide the first direct evidence that universal biases and individual differences exist in infants' attention to emotional expressions.

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SUBLIMINALLY-ACTIVATED EMOTION IS NOT SUFFICIENT TO BIAS DECISION MAKING *Kuan-Hua Chen[1], Nai-Shing Yen[1,2], Hui-Kuan Chung[1]; [1]National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan* – The Somatic Marker Hypothesis (SMH) proposed Somatic Marker (SM) can operate to bias decision making without coming into consciousness (Bechara et al., 1997). However, other studies suggested that the role of consciousness might be underestimated in SMH (e.g., Maia & McClelland, 2004). For the reason, the aim of this study was to re-examine the role of consciousness in SMH via a revised Iowa Gambling Task. In the revised Iowa Gambling Task, we controlled the expected values of the four decks to rule out the confounding of conscious operation. On the other hand, 10 positive and 10 negative pictures from IAPS were subliminally presented when subjects made card selection. Specifically, two decks were always associated with positive pictures (i.e., P-decks) whereas the other two decks were always associated with negative pictures (i.e., N-decks). It was hypothesized that the subliminally-presented pictures could make different emotions being generated and being attached to different decks. Then, as SMs, these emotions would reappear before card selection to make subjects approach to P-decks or withdraw from N-decks. Results from 24 Taiwanese undergraduates showed that SCRs were higher after P-decks selection than after N-decks selection (marginally significant). More importantly, SCRs were significantly higher before P-decks selection than before N-decks selection. However, regarding to the number of card selection from decks, no difference was revealed. The findings in this study altogether suggested that the emotions which were activated by subliminally-presented can reappear before decision making. However, these subliminally-activated emotions were not sufficient to bias decision making.

I70

PICTURE CONTENT VARIATION IN EMOTION RELATED P3 AND LPP *Hui-Kuan Chung[1], Kuan-Hua Chen[1], Nai-Shing Yen[1,2]; [1]National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan* – The emotion related P3 and late positive potential (LPP) are suggested to be related to increased attentive processing to emotional visual stimulus (Cuthbert et al., 2000). Accordingly, it is argued that, among positive or negative pictures, content variance might be expected because it is no doubt that some kinds of pictures (e.g., erotic couples) are easier to catch one's attention than some other kinds of pictures (e.g., food). Anokhin et al. (2006) demonstrated that viewing erotic pictures were related to larger positivity from 200 to 600 ms post-stimulus. However, it is notable that, in their study, (a) content variance among negative pictures was not reported; and (b) given that the LPP can sustain to 6000 ms post-stimulus, they only analyze the data from 0 to 3000 ms. For these reasons, the study of Cuthbert et al. (2000) was replicated and the 18 positive and the 18 negative pictures were categorized into erotic and non-erotic, attack/mutilation and non-attack/mutilation respectively. In addition, the epoch of -120 to 6000 ms was used. Sixteen Taiwanese graduate and undergraduate students were recruited. Results indicated that both P3 and LPP were higher for erotic than for non-erotic pictures, and were higher for attack/mutilation than for non-attack/mutilation pictures. Furthermore, the content effects were announced even to 5000-6000 ms post-stimulus. As the results, the findings in this study extend the findings by Anokhin et al., and confirm the suggestion that the emotion related P3 and LPP might relate to attentive processes.

I71

PREDICTING INDIVIDUAL DIFFERENCES IN DOPAMINE-INDUCED REWARD AND PUNISHMENT BIASES. A PSYCHOPHARMACOLOGICAL PET STUDY. *Roshan Cools[1,2], Sasha Gibbs[2], Asako Miyakawa[2], William Jagust[2], Mark D'Esposito[2]; [1]FC Donders Centre, Radboud University Nijmegen, [2]University of California, Berkeley* – Adequate adaptation to our constantly changing environment requires the anticipation of biologically relevant events by learning signals of their occurrence, i.e. reward and punishment prediction. This learning critically depends on our ability to respond to unexpected rewards and unexpected punishments. Here we investigated the role of dopamine in responsiveness to unexpected outcomes during an observational reversal learning task by assessing the effects of oral administration of bromocriptine (a dopamine D2 receptor agonist; 1.25mg) to eleven young healthy volunteers. Previous research has revealed that there is large variability in the direction and extent of dopaminergic drug effects. We aimed to elucidate the neurobiological basis of this large variability by combining neurochemical (fluorometatyrosine) PET imaging and behavioural psychopharmacology. The results indicate that the effects of bromocriptine on responsiveness to unexpected outcomes can be predicted from dopamine synthesis capacity in the striatum (r = 0.9). Furthermore, we found contrasting effects of bromocriptine on reward and punishment responsiveness, so that the drug induced either a bias away from reward towards punishment or vice versa. Specifically, bromocriptine increased reward responsiveness but reduced punishment responsiveness in subjects with low dopamine synthesis capacity. Conversely, the drug reduced reward responsiveness but increased punishment responsiveness in subjects with high dopamine synthesis capacity. These data demonstrate that baseline levels of dopamine synthesis predict dopamine-induced biases in reinforcement-based learning and adaptation.

Supported by NIH grant DA20600

I72

NEURAL ASPECTS OF RUMINATIVE SELF-FOCUS IN DEPRESSION *Rebecca Cooney[1], Jutta Joormann[2], Fanny Eugène[3,1], Lauren Atlas[4], Hannah Kang[5], Ian Gotlib[5]; [1]Child and Adolescent Psychiatry, Columbia University, [2]University of Miami, [3]Concordia University, [4]Columbia University, [5]Stanford University* – Rumination, or recursive thinking about one's symptoms and the consequences of those symptoms, has important implications for understanding the development and maintenance of depressed moods. Rumination may also enhance cognitive biases by increasing affective responses to negative material, increasing access to negative memories, and diminishing successful regulation of affect. It is important, therefore, to understand the basis of rumination, including its neural substrates. The present study was designed to use fMRI to examine rumination in depressed and healthy control individuals. Depressed (MDD) and control (CTL) participants underwent functional imaging while focusing on blocks of statements: Rumination, Abstract Distraction, Concrete Distraction, and a Fixation (Baseline) condition. Compared with CTLs, MDD participants exhibited increased activation in emotion processing centers (i.e., amygdala, rostral anterior cingulate, subgenual cingulate, and orbitofrontal cortex) and in areas associated with autobiographical memory (i.e., parahippocampus) during ruminative self-focus conditions contrasted with distraction conditions. Further, percent signal change in the amygdala was found to be significantly correlated with self-reported rumination. Interestingly, MDD participants also exhibited increased activation in dorsolateral prefrontal cortex across all of the contrasts, suggesting that during ruminative self-focus depressed individuals may attempt to engage in more effortful regulation than do controls. These findings represent the first examination of the network of neural regions involved in ruminative self-focus in depressed individuals and add to our growing understanding of the ways in which the brain is dysregulated in major depression.

I73

THE TIME COURSE OF PROCESSING EMOTIONAL PROSODY: BEHAVIORAL AND ELECTROPHYSIOLOGICAL INVESTIGATIONS *Lauren Cornew[1], Leslie Carver[1], Tracy Love[1,2]; [1]University of California, San Diego, [2]San Diego State University* – Research focusing on emotion processing in the visual modality suggests an advantage for emotionally salient stimuli; however, it remains unclear whether a similar bias exists in the auditory modality. The experiments presented here were designed to test for enhanced processing of emotional stimuli in the domain of speech prosody. We first utilized a gating paradigm and presented participants with successive 250ms segments of Jabberwocky 'sentences.' One group of participants heard sentences spoken with happy, angry, or neutral intonation and indicated the emotion conveyed following each segment. In a second group of participants, half distinguished between happy and neutral prosody, and the other half distinguished between angry and neutral prosody. Results indicated that both groups identified neutral prosody more rapidly and accurately than happy or angry prosody, arguing against a processing advantage for emotional compared to neutral prosody. To further investigate the time course of emotional prosody processing, and to examine whether our results reflect a bias in perception or attention, we are currently collecting data in a complementary event-related potential (ERP) study. The same happy, angry, and neutral Jabberwocky stimuli are presented, but in their entirety rather than in the spliced and successively building format utilized previously. These stimuli alternate with sequences of tones ascending, descending, or remaining constant in pitch, and a target detection task allows for manipulation of the task-relevance of emotion. The effects of emotion and task-relevance on components previously linked to attention (including the P300) will be discussed in the context of the aforementioned behavioral findings.

I74

GAZE DIRECTION AND FACIAL EXPRESSION RECOGNITION IN AMYGDALA-DAMAGED PATIENTS. *Chiara Cristinzio[1,3,5], Karim N'Diaye[1,2,3], Margitta Seeck[5], Patrik Vuilleumier[1,2,5], David Sander[3,4]; [1]Laboratory for Behavioral Neurology and Imaging of Cognition, Geneva, [2]University Medical Center, Geneva, [3]Swiss Center for Affective Sciences, University of Geneva, [4]University of Geneva, [5]University Hospital, Geneva* – Past studies have shown a critical role for the amygdala in emotion processing. Bilateral amygdala damage may impair recognition of facial expressions, particularly fear. However effects of unilateral amygdala damage are more controversial: some findings show that unilateral damage is not sufficient to impair emotion recognition, whereas others show selective deficits after right amygdala damage. Various stimulus or task parameters might account for such differences in results, including gaze direction or presence of static vs dynamic cues. These variables have been demonstrated to influence emotion perception. Here we investigate facial emotion recognition and its interaction with gaze in unilateral amygdala-damaged patients (n= 19), compared to healthy control subjects (n= 10), using computer-generated dynamic face stimuli. These faces could express variable intensities of fear, anger, or joy, with different gaze directions. According to appraisal theory, emotion perception depends by self-relevance of the expression. Therefore a fearful face should be more relevant if gaze is averted than direct, because it signals danger near to the observer; whereas anger with direct gaze should be more relevant than with averted gaze, because it directly threatens the observer. Our results confirm a critical role for the amygdala in emotion and appraisal, showing an interaction between gaze and emotion in controls, but not in patients. Moreover, patients showed a general impairment in emotion recognition, especially for fear, but with different profiles depending on the side of lesion (greater deficit for right vs left damage) and age of pathology onset (broader deficits before vs after 7 year-old).

I75

AFFECTIVE PRIMING OF PAIN: EFFECTS OF CUE VALENCE AND AROUSAL ON PAIN PERCEPTION *Katharine P. Dahl[1], Matthew J. Greene[1], Tor D. Wager[1]; [1]Columbia University* – In this study, we investigate the influence of emotional primes and sympathetic arousal on participants' perception of painful stimuli. There are two frequently cited "routes" to how emotional states can affect the experience of pain. The emotional priming hypothesis suggests that exposure to unpleasant images should amplify pain ratings, whereas pleasant images should decrease them. The arousal hypothesis suggests that sympathetic arousal acts to inhibit pain; by this hypothesis, high-arousal images should decrease pain ratings while low arousal images should increase them. To explore these questions, we presented participants with cues that varied systematically in valence and arousal, followed by painful thermal stimuli. Cues included pairs of relatively high-arousal (High) and lower-arousal (Low) negative, neutral, and positive stimuli. Negative cues were pain-specific (High) and nonspecific (Low) aversive images. Neutral cues were the Valsalva maneuver (blowing against a closed glottis, which elicits sympathetic arousal; High) and neutral images (Low). Positive cues were images indicating wins of $5 cash (High) and positive images (Low). In addition to behavioral measures, skin conductance response (SCR) and heart rate were recorded throughout the study. Preliminary results show that, contrary to the arousal hypothesis, pain ratings were higher when preceded by negative, high-arousal cues. Path models relating the experimental manipulations to anticipatory SCR, pain ratings, and pain SCR are presented.

I76

NEURAL CORRELATES OF ENVISIONING EMOTIONAL EVENTS IN THE NEAR AND FAR FUTURE *Arnaud D'Argembeau[1,5], Gui Xue[2,3], Zhong-Lin Lu[2,3], Martial Van der Linden[1,4], Antoine Bechara[2,3]; [1]University of Liège, Belgium, [2]Dana and David Dornsife Cognitive Neuroscience Imaging Center, University of Southern California, Los Angeles, [3]Brain and Creativity Institute, University of Southern California, Los Angeles, [4]University of Geneva, Switzerland, [5]Belgian National Fund for Scientific Research, Belgium* — Adaptive decision making depends crucially on the ability to mentally simulate emotional situations that might happen in the future. Using functional magnetic resonance imaging (fMRI), we addressed the functional neuroanatomy of this process and investigated, in particular, whether distinct brain regions are engaged depending on the perceived temporal distance of the future episodes. Participants imagined positive and negative events that might happen to them in the near future (i.e., in the next few days or weeks) or in the far future (i.e., in at least one year); they were also asked to think of some routine activities (e.g., showering), which served as a control condition. The results showed that envisioning near and far future events recruited the medial prefrontal cortex and medial posterior regions (posterior cingulate/retrosplenial cortex) to a greater extent than imagining routine activities. More importantly, part of the neural circuit engaged when envisioning the future was modulated by the temporal distance of the events. Specifically, activation of the ventromedial prefrontal cortex (vmPFC; BA 11) was greater when envisioning emotional events in the far future, whereas the left caudate nucleus responded more to emotional (and especially positive) events in the near future. We argue that the vmPFC might assign emotional values to mental representations of future events that pertain to long-term goals. On the other hand, the caudate might support more concrete simulations of action plans to achieve rewarding situations in the near future.

I77

HUMAN AMYGDALA RESPONSES ARE MODULATED BY UNPREDICTABLE PRESENTATIONS OF AMBIGUOUSLY VALENCED FACIAL EXPRESSIONS. *Caroline Davis[1], Emily Mazzulla[2], Jonathan Oler[2], Paul Whalen[1]; [1]Dartmouth College, [2]University of Wisconsin, Madison* — The human amygdala is highly responsive to facial expressions of emotion, particularly expressions with ambiguous predictive value. We have previously shown that habituation rates of amygdala response to facial expressions differ as a function of predictive value. Specifically, amygdala reactivity to clearly negative expressions (e.g., fear) habituates rapidly with repeated presentations, while a sustained response is observed to ambiguously valenced expressions (e.g., surprise). Importantly, the ambiguous predictive value of surprised facial expressions can be resolved with contextual information, and amygdala responsivity is sensitive to such context manipulations. Recent research suggests that the amygdala is also sensitive to subtle contextual manipulations, such as temporal unpredictability, and that such unpredictability primes anxiety-like behaviors. These results suggest that otherwise ambiguous stimuli (such as innocuous tones or surprised faces) may be perceived as negative in an unpredictable context. Based upon our previous data, we hypothesized that an unpredictable context would disambiguate the valence of surprised faces, resulting in habituation of amygdala response to these faces. In the present experiment, we used fMRI to examine amygdala responsivity to surprised faces presented in temporally predictable (i.e., constant) and unpredictable (i.e., jittered) sequences. We found that predictable presentations of surprised faces produced moderate but sustained activation of the amygdala over time. Amygdala responses to unpredictable surprised faces were initially greater than those observed to predictable faces. Consistent with our prediction, these responses habituated over time. Future studies will be aimed at determining whether surprised faces presented in an unpredictable fashion are indeed interpreted more negatively.

I78

FMRI BOLD SIGNAL AND ENDOCRINE CHANGES IN ELITE SWIMMERS WHILE VIEWING VIDEOS OF SUCCESSFUL AND FAILED PERSONAL PERFORMANCE *Henry Davis[1], Sari M. van Anders[2], Helen S. Mayberg[3], Jared X. Van Snellenberg[4], Rachel McKay[5], Aynsley Smith[6], Neil V. Watson[5], Todd S. Woodward[5], Elton T. Ngan[5], Mario Liotti[7]; [1]Swimming Canada, [2]Indiana University, [3]Emory University, [4]Columbia University, [5]University of British Columbia, [6]Mayo Clinic, [7]Simon Fraser University* — Athletes who fail may develop negative affect (NA); those who succeed may become happy. We used mood provocation to investigate interrelationships between mood, neural and hormonal activity as internationally competitive athletes engaged in personal self-reference (PSR) by viewing video of a personal competitive performance. As negative provocation 14 athletes watched a PSR of career-threatening failure whereas 12 athletes viewed exceptional, international success as positive provocation. Post-video mood was rated. Neural activation was measured via echoplanar fMRI BOLD signals in two blocks (4-min neutral, 8-min PSR). Salivary hormone measures (testosterone; cortisol) were taken at Time 1 (T1: pre-fMRI blocks) and Time 2 (T2: post-fMRI blocks). Mood provocation produced expected results with successful athletes reporting less NA following the viewing of the PSR video than failed athletes ($p<.0001$). ANOVA on BOLD activations in regions of interest - premotor and sensorimotor cortices - showed greater activations for successful than failed athletes during viewing of the PSR video ($p<.01$). There were no group differences in BOLD activity during neutral stimulus viewing. Importantly, 2-way repeated measures ANOVA showed that the ratio of testosterone to cortisol change (T:C) between T1 and T2 increased only among success athletes ($p<.01$). Right premotor cortex BA6 BOLD activity was positively correlated with this percentage gain in T:C (TCG), computed between T1 and T2 ($p<.05$). TCG was not significantly correlated with left sensori-motor cortex activity. Overall, the data suggest that negative and positive PSR correspond to interrelated neural and endocrine change.

I79

WHO CAUSED THE PAIN? AN FMRI INVESTIGATION OF EMPATHY AND THEORY OF MIND IN CHILDREN *Jean Decety[1], Kalina Michalska[1], Yuko Akitsuki[1]; [1]Social Cognitive Neuroscience, The University of Chicago* — When we perceive other people in pain, the neural circuits underpinning the processing of first-hand experience of pain are emulated in the observer. This basic neural mechanism plays a critical role in the primitive building block of empathy that allows emotional contagion and sharing of other's distress. However the full blown capacity of human empathy is more sophisticated than the mere simulation of the target's affective state. Indeed, empathy is both about sharing and understanding the emotional state of others in relation to oneself. In this study, a group of typically developing children (7-11 yrs) was scanned while presented with short animated visual stimuli depicting painful and non-painful situations (e.g., hand stuck in a car door). Further, these situations involved either one person whose pain was caused by mistake or inflicted by another social agent. After scanning, children rated how painful these situations were. Consistent with previous functional neuroimaging studies of pain empathy with adults, the perception of other people in pain in children was associated with increased hemodynamic activity in the neural circuits involved in the processing of first-hand experience of pain, including the anterior insula, the aMCC, PAG, and SMA. Interestingly, when another person inflicted pain, regions that are consistently involved in theory of mind and emotion regulation were additionally activated, including medial prefrontal and orbitofrontal cortices. Childrens' ratings of pain were higher when pain was caused by another person as compared to pain caused by self, and these ratings were correlated with activity in the ACC.

I80

INFERRING EMOTIONAL STATES FROM INTENTIONAL ACTION *Katrin Döhnel[1], Monika Sommer[1], Beate Sodian[2], Christoph Rothmayr[1], Jörg Meinhardt[2], Göran Hajak[1]; [1]University of Regensburg, Germany, [2]Ludwig-Maximilians University Munich, Germany* – In the course of development, reasoning about emotions precedes false belief reasoning, a critical test for having a Theory of Mind (ToM). In adults, reasoning about others' emotional states and false belief reasoning activate similar brain regions, like the medial prefrontal cortex, the precuneus and temporal brain regions. By presenting cartoon stories, this fMRI study explored the attribution of a protagonist's emotion on the basis of its intention and the outcome of the intentional action (intention fulfilled or intention unfulfilled). Emotion attribution conditions were contrasted with a control condition that required reality judgments. Emotion attribution inferred from an unfulfilled intention compared to emotion attribution inferred from a fulfilled intention led to a decrease in functional activity in the rostral part of anterior paracingulate gyrus (BA 32). This finding provides evidence that the medial prefrontal cortex (MPFC) is centrally involved in Theory of Mind processing since it extends its role in false belief processing on emotion attribution processes. The result is discussed on the basis of the involvement of the default mode network in mentalizing.

I81

EMOTION RECOGNITION AND MENTALISING IN TOURETTE'S SYNDROME *Helena Drury[1], Roxanne Barrett[1], Mary-Beth Young[1], Jeremy Stern[2], Mary Robertson[2], Shelley Channon[1]; [1]University College London, UK, [2]St. George's Hospital, London, UK* – Tourette's syndrome (TS) is a neurodevelopmental disorder in which the core symptomatology consists of motor and vocal tics. It has been linked to a range of everyday problems including social difficulties and inappropriate behaviours, but these may be primarily attributable to comorbid psychiatric symptomatology. Brain regions thought to be disrupted in TS have been linked to emotion recognition, mentalising, and executive functions. The present study compared adults with uncomplicated TS with a matched healthy control group. Recognition of emotional faces was intact for the TS group. Prosody recognition was also intact for neutral, happy and sad emotional voices, but there was evidence of mild weakness in anger recognition. On the faux pas test, a social cognition task with separate scores for affective and cognitive mentalising, the TS group showed greater variability than controls. Implications of the findings for our understanding of TS are considered.

I82

HOW HUMAN BRAIN PERCEIVE EMOTIONAL ROBOTIC FACES *Stephanie Dubal[1], Aurélie Foucher[1], Maud Simon[1], Pierre Canet[1], Roland Jouvent[1], Jacqueline Nadel[1]; [1]CNRS_UPMC Emotion Center, CHU Pitié-Salpétrière* – Emotional facial expression can affect cortical processing at very short latencies: the occipital P1 component amplitude, peaking at about 100 ms post stimulus, is modulated by emotional content. Later, at about 170 ms post stimulus, the N170 component is generally modulated by facial identity. In this study, we used recordings of event-related brain potentials (ERPs) to investigate how human brain perceives robotic compared to human facial expressions of emotion. Stimuli consisted of pictures from 4 different robotic heads displaying happy or neutral expressions that were intermixed with pictures of human expression drawn from Ekman's set of prototypical facial expressions. 15 participants were asked to distinguish neutral from joy by pressing a button. Like human faces, robotic faces elicited a N170 wave, though not as large and later. Human faces were processed faster than robotic faces, with earlier P1 component, N170 component and shorter reaction times. Robotic faces elicited later brain responses than human faces, and were processed differently at the structural level, as indicated by the smaller N170 component. As early as 80 msec post stimulus, occipital responses differentiated neutral from happy faces for robotic as well as for human faces, with P1 wave larger in response to happy than to neutral faces. Taken together, these findings suggest a precedence of emotion perception over recognition of facial identity, when robotic faces are concerned.

I83

THE EFFECTS OF SLEEP QUALITY ON VISUAL EVENT-RELATED POTENTIALS IN RESPONSE TO INCREASING EMOTIONAL INTENSITY OF ANGRY FACIAL STIMULI IN HEALTHY ADULTS. *Joey K.-Y. Essoe[1], Erin M. Ramage[1], Mark W. Geisler[1]; [1]San Francisco State University* – Past research established that the amount of sleep (quantity) effects many indices of cognitive performance, including event-related brain potentials (ERP's); however, there is a paucity of research on how the characteristics of sleep (quality) may affect sensory perception and cognition. This study measured amplitude and latency in response to visual ERP's using photographs of angry faces, reaction times, and subjective ratings of anger intensity in 50 (22 male, 28 female) good sleepers (GS) and 18 (9 male, 9 female) poor sleepers (PS) as measured by the Pittsburgh Sleep Quality Index (PSQI). Greater amplitude differences were found between early stimulus detection (N1 component) and early sensory processing (P2) in PS as compare to GS, while greater amplitude of cognitive information processing (P3 component) are found in GS as compare to PS. Reaction times were significantly impaired in PS as compared to GS, while no significant difference in the subjective degree of anger ratings was found between the sleep quality groups. These results suggest that greater neuronal resources are allocated toward early cognitive processing and this may be a benefit of good sleep quality. However, there appears to be hyper-arousal in early sensory processing, and delay in reaction times as a result of poorer sleep quality. Thus, sleep quality may play an important role in enabling the brain to detect visual stimuli more quickly, and to process and interpret the stimuli more accurately.

I84

DEFAULT-NETWORK FMRI ACTIVATION AND RESPONSE-TIME VARIABILITY IN TRAIT ANXIETY. *Christina Fales[1], Todd Braver[1], Jeremy Gray[2], Deanna Barch[1]; [1]Washington University in St. Louis, [2]Yale University* – Trait-anxious individuals report difficulties concentrating but increases in attentional lapses during emotionally-neutral tasks have been difficult to document. Anxious participants do not always show response time (RT) differences during working memory (WM) tasks, and neuro-imaging studies have tended to show increased recruitment of WM areas during such tasks, rather than reduced. Recently, activation levels in default-network brain regions have been linked to the occurrence of attentional lapses, and deactivation in some of these regions has been associated with response time improvements during cognitive tasks. In the current study we conducted a mixed (blocked & event-related) fMRI neuro-imaging study of high and low-anxious participants during a working memory task. High-anxious subjects showed reduced sustained fMRI activation in working-memory brain regions and reduced sustained activation (increased deactivation) in default regions. Behaviorally, the two groups showed no differences in accuracy rates, mean response times, or RT standard deviations. We then conducted an ex-Gaussian analysis of RT variability that provides separate parameter estimates for mean-RT values (mu), mean-RT variability (sigma) and extreme-RT values (tau). Activity in working-memory regions showed no relationship with any of the ex-Gaussian measures. Similarly, default-network activity showed no such relationship in low-anxious participants. However, in the high-anxious, sustained levels of default-network activity were significantly positively correlated with mu and sigma values, while transient levels were significantly related to tau estimates. These findings support the idea that deactivation in default-mode regions may be related to maintenance of attentional focus, and that such processing may be relatively more important for anxious individuals.

I85

COGNITIVE CONTROL PROCESSES DURING ENCODING OF AFFECTIVE STIMULI– AN FMRI STUDY IN PTSD *Kristina Fast[1], Christine Amrhein[1], Franziska Meister[1], Dorothea Huber[2], Günther Klug[2], Thomas Meindl[3]; [1]University Hospital of Psychiatry, Ludwig-Maximilians-University of Munich, Munich, Germany, [2]Psychosomatic ClinicHarlaching, Munich, Germany, [3]Institute of Clinical Radiology, Ludwig-Maximilians-University of Munich, Munich, Germany* – Studies on Posttraumatic Stress Disorder (PTSD) show that these patients are characterized by impairments of memory. Different implicit and explict strategies may help to keep traumatic contents away from awareness. These processes might have be risk factors for developing and maintaining PTSD. In the present study, we aimed to examine the role of cognitive control during encoding and retrieval of emotional (trauma-related) word stimuli in patients with PTSD. We used a so-called "directed forgetting" paradigm and an emotional stroop paradigm, with additional registration of fMRI brain activity. Our results are in accordance with the hypothesis that attention and inhibition have a crucial impact in episodic memory in general, but in particular, in modulating the processing of affective stimuli. We conclude that PTSD patients draw their attention away from the traumatic content, making it difficult for them to voluntarily influence the encoding of aversive trauma-related stimuli. Notably, this effect was accompanied by an activation of the dorsolateral prefrontal, orbitofrontal cortex / anterior cingulate, brain areas linked to executive control functions and volitional inhibition and modulation of emotions, especially regarding negative emotional content.

I86

BILATERAL AMYGDALA DAMAGE DOES NOT IMPAIR RAPID DETECTION OF FEARFUL FACES *Csilla Felsen[1], Naotsugu Tsuchiya[1], Farshad Moradi[1,2], Ralph Adolphs[1,3]; [1]California Institute of Technology, [2]New York University, [3]University of Iowa* – Lesion and imaging studies have shown that the amygdala is important to fear perception, but it remains unknown at what stage of face processing it plays a critical role. One hypothesis is that the amygdala participates in early fear detection via a putative rapid subcortical pathway that bypasses the geniculo-cortical pathway. To test this hypothesis, we performed two psychophysical experiments on patient SM, who has complete amygdala lesions and is impaired on fear recognition tasks that permit free viewing without time constraints. In the first rapid categorization task, we briefly (40 msec) presented side-by-side two faces of the same identity, one with a neutral and the other with an emotional expression. Subjects pressed a button to indicate which of the two was the emotional face, and were instructed to respond as quickly and accurately as possible. In the second task, we used a more complex visual search array of a set of several morphed faces ranging from fear to neutral as target and distractors. Contrary to the initial hypothesis, SM did not show any impairment on either task. In the rapid categorization task, SM was as fast and as accurate as the controls. In the visual search task, she showed category boundary effects with search slopes (i.e. speed of detection per item) comparable to controls. Taken together, our results suggest that the amygdala is not necessary for early and rapid detection of fear, but that it comes into play in later judgment and recognition.

I87

NEURAL SYSTEMS OF VISUAL ATTENTION RESPOND TO EMOTIONAL SYMBOLIC HAND GESTURES *Tobias Flaisch[1], Harald Schupp[1]; [1]University of Konstanz* – Emotional cues guide selective attention. Specifically, erotic displays, emotional facial expressions, as well as body posture elicit enhanced activation in associative visual processing areas. Theoretically, selective processing of evolutionary relevant stimuli may reflect phylogenetic heritage and ontogenic experiences. To isolate ontogenetic processes, the present study examined hand gestures with symbolic emotional meaning. The processing of the sexually insulting middle finger jerk gesture was compared to the thumb up gesture signaling approval and a non-emotional control gesture, the forefinger point. While being scanned in a 1.5 Tesla magnetic resonance imaging machine, thirty volunteers viewed images of these hand gestures displayed by 8 models. Stimuli were grouped into 12s-blocks of a single stimulus condition, interleaved with 12s-fixation periods. The three conditions were presented in a perceptually random order and each condition was repeated 14 times. Expectations regarding reported level of emotional valence and arousal and knowledge about the semantic meaning of each gesture were confirmed. As compared to the affectively neutral forefinger point gesture, passive viewing of both the offensive middle finger jerk, as well as the approving thumb up gesture resulted in increased BOLD-activity in extrastriate visual cortex. The main loci of these effects were observed dorsally in parieto-occipital areas and also covered temporo-occipital regions. These results show that culturally transmitted symbolic gestures of threat and approval direct perceptual processing similar to evolutionary relevant emotional cues.

I88

LONG TERM INTEGRATION OF REINFORCEMENT PROBABILITY AND MAGNITUDE: NEUROCOMPUTATIONAL AND GENETIC COMPONENTS *Michael Frank[1], Bradley Doll[1]; [1]University of Arizona* – Computational modeling suggests that the basal ganglia (BG) and prefrontal cortex (PFC) contribute differentially to reward-based decision making (Frank & Claus, 2006). Whereas the BG can integrate the long term probability of reinforcement via changes in synaptic weights driven by phasic dopamine signals, the PFC is specialized to maintain the magnitudes of recent reinforcement values in a working memory-like state. A recent genetic study identified three genes controlling striatal and prefrontal dopaminergic function which independently modulated different aspects of reinforcement learning in a probabilistic selection task. The striatal genes predicted long-term positive and negative probability learning, whereas the prefrontal gene predicted trial-to-trial adaption requiring working memory for recent negative outcomes. However, it was not tested in that study whether prefrontal genes contribute differentially to learning about reinforcement magnitudes, as compared with their probability. Here we introduce two novel frequency-magnitude tasks designed to measure the degree to which participants learn about positive and negative reinforcement probabilities versus their magnitudes. Pilot studies tuned task parameters such that on average half of participants preferred higher reward probabilities, and half preferred large reinforcement magnitudes. We will report results from approximately 70 subjects to determine whether these biases can be predicted by striatal and prefrontal genetic markers. Behavioral data will also be fit with computational reinforcement learning algorithms designed to find best fitting parameters (learning rates, sensitivity to magnitude, etc) to each subject and whether these parameters are predictably modulated by genotype.

I89

EFFECT OF EMOTION REGULATION ON REWARD PROCESSING: PRELIMINAL INVESTIGATION WITH EVENT-RELATED POTENTIALS *Hirokata Fukushima[1], Kazuo Hiraki[1]; [1]The University of Tokyo* – Reward processing is considered to inherently involve emotional processing. However, neural correlates of emotional process under reward perception has rarely, at least in human electrophysiology, been nvestigated,. This study aimed to shed light on emotional characteristic in reward processing, by examining whether the volitional effort of emotion regulation would modulate the ERP components eminent in reward processing, i.e. Feedback-related negativity (FRN) and P300. Being measured ERPs, subjects performed a simple gambling task under two within-subject experimental conditions; up-regulation and down-regulation conditions. In the up-regulation condition, subjects were instructed to try to mentally behave like a highly-emotional person concerning the gambling task. In the down-regulation condition, subjects were tried to be a calm and less-emotional person. After each block, the subjects scored the degree of subjective emotional impact in the task. Those scores confirmed that the subjects could, at least in terms of subjective feelings, regulate up and down the emotional impact inherent in the gambling task. ERP results showed that the subjects' effort of emotion regulation influenced only P300, but not FRN: P300 amplitude was significantly larger in up-regulation than down-regulation condition. It has been known that the amplitude of FRN reflects motivation, stress, or affective states, but not reflects magnitude of reward. Along with these knowledge, our data will provide further insight about relationship among reward, emotion, and conscious awareness of them.

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ATTENTION AND AMYGDALA ACTIVATION IN SPIDER PHOBIA *Antje B.M. Gerdes[1], Georg W. Alpers[1,3], Bernadette Lagarie[2], Katharina Tabbert[2], Dieter Vaitl[2], Rudolf Stark[2]; [1]University of Würzburg, [2]University of Giessen, [3]University of Bielefeld* – In theory, threat detection operates on an automatic level and should therefore activate the amygdala independently from allocation of attention. However, previous studies using emotional facial expressions or phobic cues yielded contradictory results. We used fMRI to examine whether different attentional allocation influences amygdala activation. Nineteen spider-phobic women were instructed to pay attention to and identify as quickly as possible either a moving or a stationary animal in briefly presented double-exposure displays. Compared to congruent neutral displays (two birds), amygdala activation was most pronounced in response to congruent phobic displays (two spiders) and less but still significant in response to mixed displays (spider and bird) when attention was focused on the phobic component. When attention was focused on the neutral component, mixed displays did not result in significant amygdala activation. This was confirmed in a significant parametric graduation of the amygdala activation in the order of congruent phobic displays, mixed displays with attention focus on the spider, mixed displays with focus on the bird and congruent neutral displays. These results show that attention does modulate amygdala activation in response to briefly presented phobic cues.

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INFLUENCES OF TESTOSTERONE, AGGRESSION AND ANGER ON ULTIMATUM GAME BEHAVIOR *Shauna Gordon-McKeon[1], Noah Isserman[2], Cynthia Gill[1]; [1]Hampshire College, [2]Amherst College* – Research suggests that during the economic decision-making game known as the Ultimatum Game players tend to reject low offers from another player despite the fact that this leaves both players with nothing. Some researchers believe this behavior is driven by a negative emotional response such as anger (Pillutla and Murninhan, 1996), rather than an abstract sense of fairness. Anger, especially in response to a challenge, has been linked to the androgen hormone testosterone. In this study, participants were asked to accept or reject fair and unfair offers in a sham Ultimatum Game network. They were then asked to make offers to others in the network. Rates of offers and of rejection were examined in relation to saliva testosterone levels, digit ratio, and scores on the Buss-Perry Aggression Questionnaire (BPA). Significant correlations were found between rejection rates and scores on the anger subscale of the BPA (offers of two: $r = .44$, $p = .04$; three: $r = .49$, $p = .02$). Additionally, low offers were correlated with a low digit ratio ($r = .41$, $p = .02$) supporting previous research (Van den Bergh and DeWitte, 2006). However, there was no correlation between saliva testosterone and Ultimatum Game behavior. This suggests that while Ultimatum Game behavior may be determined in part by a tendency towards aggression and high prenatal testosterone (supported by correlations with digit ratio), it is not influenced by, nor does it influence, dynamic testosterone levels (reflected in saliva testosterone level).

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SNAKE PHOBICS ANTICIPATING AND RESPONDING TO SNAKES: SKIN CONDUCTANCE RESPONSES AND FMRI *Danielle Green[1], Deborah Kerr[1], Tim Flink[1], Issidoros Sarinopoulos[1,3], Jack Nitschke[1,2]; [1]University of Wisconsin, Waisman Laboratory for Brain Imaging and Behavior, [2]University of Wisconsin, [3]Michigan State University* – Anticipation and uncontrollability have been implicated as major contributors to anxiety disorders (Barlow, 2002). Previous research has found that in anticipation of threatening stimuli, various areas of the brain along with the sympathetic nervous system (autonomic markers like skin conductance response) are activated abnormally in anxiety disorders. The current research explores the link between brain areas activated in snake phobia – amygdala, insula, and anterior cingulate cortex (ACC) – and skin conductance response (SCR) in the anticipation of, and response to, aversive stimuli in both specific phobia and non-phobic controls. In the present event-related fMRI study, SCR was collected while participants viewed snake, fish and disgust videos preceded by cues that were the first letter of each stimulus type: S, F, and D. Preliminary results show greatest SCRs in phobics during the anticipation of snake cues compared to fish and disgust cues. Controllability modulates these responses, with phobics showing greater SCRs to controllable vs. uncontrollable snake cues. For the response portion of the task, phobics show significant SCRs while viewing both snake and disgust videos compared to fish. Preliminary analyses suggest associations between these SCRs and previously reported amygdala, insula, and ACC activations in anticipation of and response to snake stimuli among snake phobics. These results confirm the hypothesis that SCRs in phobics would be greatest in anticipation of and response to snakes, consistent with amygdala, insula, and ACC activations in the same subjects, and suggest that autonomic arousal is modulated by controllability for phobogenic and aversive cues.

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AMYGDALA REACTIVITY TO FACIAL EXPRESSIONS: SELECTIVITY, LATERALITY AND GENDER DIFFERENCES *Tsafrir Greenberg[1], Merav Shor[1], Lilianne Mujica-Parodi[1]; [1]Stony Brook University* – Despite growing evidence for the amygdala's role in emotional processing that extends beyond fear, studies presenting facial stimuli have reported mixed findings regarding amygdala reactivity to different emotional expressions. Furthermore, it remains unclear to what extent activation is lateralized in response to these and other emotional stimuli and whether differences in patterns of activation exist between men and women. To address these issues, we performed a functional magnetic resonance imaging (fMRI) scan in 66 healthy individuals while they passively viewed angry, neutral, happy and fearful faces. Our large sample size permitted us to investigate more closely the role of selectivity, laterality and gender differences in amygdala-activation patterns within a healthy population. Random-effects analyses revealed significant bilateral activation for each of the facial expressions relative to baseline. In order to assess laterality differences in the blood oxygen level-dependent (BOLD) response we performed an analysis of variance on parameter estimates extracted from each amygdala. There was a significant main effect for laterality with greater activation on the left side. Follow-up pairwise comparisons were significant for the angry and neutral faces only. Overall, men and women exhibited equivalent patterns of activation, for all facial expressions, except for greater activation in women in response to the angry faces. The present findings provide support for an amygdalar role in processing facial expressions beyond fear with predominant activation of the left amygdala. Similar activation patterns across gender groups suggest that other factors, besides gender, may more reliably account for variability across participants.

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INVESTIGATING THE RELATIONSHIP BETWEEN EXECUTIVE CONTROL OF ATTENTION AND EMPATHY *Xiaosi Gu[1], Jin Fan[1], Xun Liu[1], Kevin Guise[1], John Fossella[2]; [1]Mount Sinai School of Medicine, [2]Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University* – The anterior cingulate cortex (ACC) and fronto-insular cortex (FI) are involved in multiple aspects of cognition and emotion. Meta-analysis has shown that the ACC and FI are critical regions in executive control of attention. Recent brain imaging studies have shown that the ACC and FI are also involved in social cognition such as empathy, the ability to infer and generate sensory and emotional experiences of other people. Given that the executive control of attention and empathy are supported by ACC and FI as the essential structures, we predicted that the behavioral measurements of these two cognitive processes should be highly correlated. In the current behavioral study we investigated the functional relationship between executive control and empathy. Executive control of attention was tested using the Attention Network Test (ANT). Empathy was assessed by showing a set of 256 photographs we have recent developed with left/right hand/foot in either painful or context-matched non-painful situations, to effectively induce empathetic responses. Participants were asked to judge how painful the situation was. In addition we administered the Adult Temperament Questionnaire (ATQ) and the Empathy Quotient (EQ). The correlation coefficients between executive control and empathy measures were examined. Results were further discussed with regard to the role of ACC and FI in executive control of attention and empathy.

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THE HUMAN EMOTIONAL BRAIN WITHOUT SLEEP: A PREFRONTAL-AMYGDALA DISCONNECT *Ninad Gujar[1], Seung-Schik Yoo[2], Peter Hu[1], Matthew Walker[1]; [1]Sleep and Neuroimaging Laboratory, University of California, Berkeley, [2]Brigham and Women's Hospital, Harvard Medical School, Boston* – Introduction: A commonly reported consequence of sleep-deprivation is altered mood and affect. Furthermore, a hallmark feature of many affective psychiatric conditions is abnormal sleep. Here, we investigated the neural impact of sleep-deprivation on the evaluation of negative emotional stimuli using functional MRI (fMRI). Methods: Subjects (n=26) were either sleep-deprived for 35hr (deprivation group) or allowed to sleep normally (control group) before performing an emotional picture-slide assessment during fMRI scanning. Subjects viewed a series of standardized emotional pictures, ranging form neutral to increasingly negative and aversive, and made an emotional strength judgment to each. Results: Both groups demonstrated limbic brain activation to increasingly negative stimuli, specifically in bilateral amygdala regions. However, the sleep-deprived group expressed a far more profound, hyper-reactive amygdala response; levels that were +60% more intense than the control group (P=0.004). Moreover, sleep-deprived subjects expressed a three-fold increase in the extent of amygdala activated in response to the negative stimuli (P=0.009). Most interestingly, there was a significant loss of functional connectivity between the amygdale and the medial-prefrontal cortex (MPFC) following sleep-deprivation. Discussion: Together, these data demonstrate an amplified, hyper-limbic response by the human amygdala to negative stimuli under conditions of sleep-deprivation, associated with a functional disconnection with the MPFC. It therefore appears that sleep may "reset" the correct brain reactivity to next-day emotional and psychosocial challenges. Such findings provide new insights into the relationship between sleep loss and affective moods disorders, hostile and non-optimal decision-making in sleep-curtailed work personnel, and more generally, emotional irrationality in an increasingly sleep-deprived society.

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SOCIOECONOMIC STATUS AND STRESS PHYSIOLOGY: ACUTE CORTISOL RESPONSE TO A SOCIAL STRESSOR IN ADOLESCENTS. *Daniel A. Hackman[1], Laura Betancourt[2], Hallam Hurt[2], Robert J. Gallop[3], Martha J. Farah[1]; [1]University of Pennsylvania, [2]Division of Neonatology, University of Pennsylvania School of Medicine and the Children's Hospital of Philadelphia, [3]Applied Statistics Program, West Chester University* – One mechanism hypothesized to underlie the relationship between socioeconomic status (SES) and cognitive development is early life-stress and its influence on the basal functioning and reactivity of the hypothalamic-pituitary-adrenal axis. Higher baseline levels of cortisol have been found in children and adults of lower SES, while previous work in our lab demonstrated a relationship between early-life home experiences and medial-temporal memory in adolescence. No studies, however, have directly examined if SES predicts both baseline levels of cortisol and reactivity to a social stressor in adolescents. Low-SES (n=18, 13 females) and middle-SES (n=25, 16 females) African-American adolescents were administered a modified version of the Trier Social Stress Test in groups of 2 or 3, with 10 measurements of salivary cortisol taken throughout the procedure. A preliminary analysis (n=43) using a mixed model ANOVA with an unstructured covariance matrix showed no main effect of SES on overall cortisol levels and no Time x SES interaction, indicating no difference between low- and middle-SES groups in their cortisol response to the stressor. However, there was a significant Time x Gender x SES interaction: (1) males showed a larger response to the stressor than females; (2) low-SES females showed a larger response to the stressor than middle-SES females; and (3) low-SES males showed a higher but delayed peak cortisol response than middle-SES males. Results suggest that SES is an important predictor of cortisol reactivity to social stress in adolescents but this relationship is dependent on gender.

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BEHAVIORAL AND NEURAL CORRELATES OF EMPATHY IN DEPRESSION *Julie L. Hall[1], Marc G. Berman[1], Vincent A. Magnotta[2], Hanna Damasio[3], Thad A. Polk[1], Stephanie D. Preston[1]; [1]University of Michigan, [2]University of Iowa, [3]University of Southern California* – Depression has consistently been linked to deficits in affective and cognitive processing. However, little research has investigated the relationship between empathy and depression. Using an fMRI block design, the current study investigated the behavioral, psychophysiological, and neural correlates of empathy in 11 depressed and 18 nondepressed women. Participants watched thirteen videos, in which real patients were interviewed about their experience with chronic and terminal illness. After each video, participants provided self-report ratings about their emotions (e.g., personal distress, empathy, positive and negative emotion) and helping behavior (e.g., how much help the patient needed, their willingness to offer help). Data from both groups generally supported behavioral research on empathy in that personal distress and empathy were positively correlated and activated similar brain regions. In addition, empathy was more strongly associated with willingness to offer help compared to personal distress. However, depressed women showed greater emotional responses to the videos and did not demonstrate the typical decrease in empathy and helping for highly distressing situations, differences which were mirrored in the fMRI data. Our findings provide novel evidence that depression may actually increase empathy and helping, which may be because depressed individuals can better relate to others' distress. Our data support a Perception-Action Model of empathy, which emphasizes the need for common past experiences and overlapping neural representations for empathy to occur. However, they also suggest that an inability to down-regulate negative emotions and helping behavior to others' distress may be an important factor in the development and maintenance of depression.

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NEURAL CORRELATES OF MORAL SENSITIVITY IN AN ADULT INCARCERATED POPULATION *Carla L. Harenski[1], Keith A. Harenski[1], Matthew S. Shane[1], Kent A. Kiehl[1,2]; [1]The MIND Institute, [2]University of New Mexico* – The neural correlates of moral appraisals have been well studied in healthy populations, but have been less studied in individuals who may have diminished moral sensitivity (e.g. brain damaged patients, criminal populations). The purpose of the current study was to obtain converging behavioral and neural evidence of diminished moral sensitivity in an incarcerated population. The primary hypothesis was that behavioral indices of diminished moral sensitivity would be associated with reduced activity in brain regions associated with moral appraisal, including medial prefrontal cortex (mPFC), posterior superior temporal sulcus (pSTS), and posterior cingulate cortex (PCC). Functional magnetic resonance imaging (fMRI) data was collected from 40 incarcerated adult males on a mobile scanner (1.5T) while they viewed 50 unpleasant pictures, 25 of which depicted moral violations (moral) and 25 without moral violations (non-moral). Moral and non-moral pictures were matched on emotional arousal and social complexity. Participants rated each picture according to the degree of moral violation they perceived (1=none, 5=severe). Moral sensitivity (defined as the mean difference in moral severity rating between moral and non-moral pictures) was highly variable across participants, ranging from -0.15 to 3.78. This variability was substantially higher than in previous normative samples (Harenski et al., 2006; 2007). fMRI results indicated increased mPFC, pSTS, and PCC activity when viewing moral relative to non-moral pictures. Moral sensitivity was positively correlated with mPFC and PCC activity (but not pSTS). These results suggest that reduced moral sensitivity in incarcerated populations is associated with reduced activity in brain regions associated with moral appraisal.

I99

BRAIN STRUCTURE CORRELATES OF INDIVIDUAL DIFFERENCES IN THE ACQUISITION AND REGULATION OF CONDITIONED FEAR *Catherine Hartley[1], Janelle Szary[1], Bruce Fischl[2], Elizabeth Phelps[1,3]; [1]New York University, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, [3]Center for Neural Science, New York University* – Research employing classical conditioning paradigms has elucidated the neural systems involved in acquiring and diminishing fear responses. However, the factors that give rise to individual differences in fear acquisition and regulation are not presently well understood. In this study, we tested the hypothesis that the magnitude of individuals' fear-related arousal responses and their capacity to diminish these responses, might be correlated with structural differences in brain regions involved in affective processing. Two previous neuroimaging studies from our laboratory explored two methods of reducing conditioned fear, extinction and intentional cognitive regulation. We reanalyzed skin conductance response and structural MRI data from these studies to explore whether physiological measures of fear acquisition and regulation covaried with cortical thickness and volume in our regions of interest, ventromedial prefrontal cortex, insular cortex, and the amygdala. Results showed that our physiological measures of fear acquisition in both data sets correlated with cortical thickness in a region of posterior insula. This region is thought to be critically involved in the experience and anticipation of aversive visceral stimulation. Replicating previous results (Milad et al., 2005), thickness in ventromedial prefrontal cortex correlated with fear reduction via extinction. Our intentional cognitive regulation measures had no brain structure correlates. Notably, subjects' acquisition and regulation measures were uncorrelated, suggesting that while individuals may have a structural propensity towards increased fear expression, these responses can be diminished via passive extinction learning and intentional cognitive regulation strategies.

I100

THE PREDICTIVE POWER OF SOCIAL SMILES *Erin Heerey[1]; [1]Bangor University* – How do humans navigate a social world in which no two interactions are the same? How do we choose which of many possible social behaviors to make? It is likely that environmental cues, such as the social cues of others, guide behavior in the social world. This hypothesis suggests that the cues we see carry information that allows us to make predictions about forthcoming social rewards. To test this idea, participants (N=10) played a game in which they chose which of two faces, presented side-by-side on a computer screen, would be "happy to be picked." After each choice, the chosen face generated a social cue. If the face was incorrect, it frowned. If the face was correct, it smiled with either a pleasurable or a polite smile. Smile cues were predictive of the next correct answer. If the chosen face smiled pleasurably, the same face would be correct again on the next trial. If it smiled politely, the other face would be correct on the next trial. Each face was correct on 50% of trials, randomly intermixed. Participants won 2 pence for each correct answer, although they only received this non-social feedback at the end of each block. Eight of ten participants learned the reward contingency. Across all participants, smile-type predicted response to the next trial (p=.02). Additional data collection is underway. These preliminary results suggest that pleasurable and polite smiles may carry reinforcement value in social contexts, allowing receivers to predict forthcoming rewards and serving to guide social behavior.

I101

GENE ENVIRONMENT INTERACTION FOR COMT ON EMOTIONAL PROCESSING *Martin Herrmann[1], Heidi Würflein[1], Theresa Schreppel[1], Andreas Mühlberger[1], Andreas Reif[1], Klaus-Peter Lesch[1], Andreas Fallgatter[1]; [1]University of Würzburg* – The interaction between genes and environment is highly relevant for our understanding of the development of psychiatric disorders. Recently it has been shown that the catechol-O-Methyltransferase genotype (COMT) modulates the brain activity during the processing of negative stimuli, but not for positive stimuli. Here we tested whether life stress, as an environmental factor, modulates this COMT genotype effect. Therefore, we measured the event-related brain potentials in 81 healthy subjects during the processing of positive and negative emotional pictures. As expected, we found that COMT modulates the neural correlates of emotional processing (the early posterior negativity, EPN), but only for negative and not for positive stimuli. Including the factor life stress we could explain this missing COMT effect for positive stimuli. We found that high and low life stress modulates the effect of the COMT genotype on the neural correlates of positive stimuli processing in contrary manner. We found that high life stress diminishes the positive evaluation of stimuli but only in subjects with the Met/Met genotype. This might be relevant for the development of depressions, as depressed patients often describe a lost of positive reinforcement.

Linguistic processes: Other

I102

AN ERP STUDY OF NONWORD RHYMING IN 3- TO 5-YEAR OLDS: THE EFFECT OF AGE AND PROFICIENCY *Annika Andersson[1], Yoshiko Yamada[1], Jessica Fanning[1], Helen J Neville[1]; [1]University of Oregon* – Previous event-related potential (ERP) research of auditory rhyming showed the classical phonological rhyming effect (RE; N450) to be evident in children as young as 6 years of age (Coch, Grossi, Skendzel & Neville, 2005). ERPs to spoken nonword targets preceded by nonrhyming nonwords showed increased negativity (400-600ms post-stimulus-onset) in comparison to rhyming targets, and this effect was largest at posterior medial sites bilaterally. Thus the previous research suggests that the neurocognitive networks involved in processing auditory rhyme information are comparable to adults by the age of 6. The current study extends this finding to younger children aged 3, 4 and 5 years. Behaviorally, the proportion of children with proficiency in rhyming (production and recognition skills) increased as a function of age. When comparing the RE in these age groups, no differences were found in amplitude. However, the onset of the RE decreased linearly with age. An examination of 4-year-old children with different levels of rhyming proficiency revealed similar differences in the RE. Specifically, the onset of the RE was earlier in children with rhyming skills (production and recognition) as compared to children of similar age with little rhyming skills. These results will be discussed in the framework of how phonological processing and awareness impact language and literacy development.

I103

CONSONANT-SPECIFIC DIFFERENTIAL ACTIVATION IN THE SENSORIMOTOR CORTEX MAY OCCUR PREDOMINANTLY IN THE LEFT HEMISPHERE *Eishi Asano[1], Miho Fukuda[1], Masaaki Nishida[1], Robert Rothermel[1], Csaba Juhasz[1], Sandeep Sood[1]; [1]Children's Hospital of Michigan, Wayne State University* – By measuring gamma-oscillations on electrocorticography recording, we determined whether consonant-specific differential activation during speech occurred in the left, right or both primary sensorimotor lip areas in children with medically-uncontrolled focal epilepsy (age: 7-17 years), who underwent epilepsy surgery. Subdural electrodes were placed on the left hemisphere in four children and on the right hemisphere in the remaining four. Subjects were asked to vocally repeat a non-semantic sound consisting of either "Fee", "Faa", "Hee" or "Haa" 80 times (= 20 vocalizations per each sound) in a pseudorandom sequence, and the magnitudes of event-related gamma oscillations were measured. Analysis of all epochs for all sounds showed that gamma oscillations were increased in the primary sensorimotor cortex for the face around the onset of vocalization in all eight patients. Comparison between epochs for vocalizing sounds with "F" and those for vocalizing sounds with "H" revealed that the primary sensorimotor lip area was activated by vocalizing "F" significantly more than vocalizing "H" in 3/4 patients with left-sided recording and in 0/4 patients with right-sided recording. The subject who showed no such consonant-specific differential activation in the left sensorimotor cortex had many erroneous responses due to poor auditory memory. Larger cortical activation in the left sensorimotor lip area during vocalizing "F" may be partially attributed to larger movement of the lip. Lack of such consonant-specific differential activation in the right hemisphere may lead to the hypothesis that lip movement associated with vocalization is predominantly driven by the left hemisphere, if intact, in humans.

I104

THE EFFECTS OF CONTEXTUAL CONSTRAINT IN THE NEURAL SPECIALIZATION OF READING PROCESSES *Noemi Aznar-Bese[1], Arturo E. Hernandez[1], Pilar Archila[1]; [1]University of Houston* – The aim of our study was to investigate how contextual cues modulate the neural specialization of reading processes in the adult brain. Twenty-four volunteers underwent fMRI scanning at 3 Tesla while they completed a silent self-paced sentence reading task. A total of 102 sentences selected from Bloom and Fishler's "Completion norms for 329 contexts" were grouped into three experimental conditions according to the cloze probability (CP) of their target words: a high-constraint (CP>0.70), a neutral-constraint (CP 0.40-0.70) and a low-constraint condition (CP<0.40). The analysis of the functional data revealed significant differences in the BOLD response across conditions. Low-constraint sentences led to increased activation of the right MTG, STG, DLPFC, fusiform area, and MFG, bilateral IFG, and left cingulate and SFG - areas involved in language and reading processes. These results are consistent with our hypothesis of higher cognitive demands expected for low-constraint conditions. Surprisingly, the high-constraint condition led to greater activation of the left amygdala and bilateral middle cingulate – areas involved in processes of response monitoring, decision making and their inherent emotional effects. These results suggest that highly predictable contexts engage, to a greater extent, an additional continuous feedback system responsible for the self-monitoring of performance. Taken together, our results stress the need for stricter contextual control in subsequent reading studies.

I105

READING VERSUS WRITING IN DEEP DYSLEXIA: IMPLICATIONS FOR THE COMMON AND INDEPENDENT LEXICON THEORIES *Venu Balasubramanian[1], Anna Barrett[2]; [1]Seton Hall University, South Orange, New Jersey, [2]Kessler Medical Rehabilitation Research and Education Center, West Orange, NJ* – The issue of the alleged dependency of reading and writing on oral language, an issue that was hotly debated in the classical neurology by Pitres (1884) Wernicke (1903) and Dejerine (1914), is resonated in two contemporary cognitive neuropsychological theories: The 'common lexicon' theory postulates that one single lexicon subserves both reading and writing (Coltheart & Funnell, 1987., Rapcsak & Beeson, 2002), whereas the 'independent lexicon' theory claims that the input orthographic lexicon for reading is separate from the output orthographic lexicon for writing (Rapp 2002., Rapp, Benzing, & Caramazza, 1997). These theories deserve to be investigated further because they rest on a few case studies that were inconclusive. The current study undertook an analysis of reading and writing of LK, a 45-year-old right-handed male school teacher with a stroke induced lesion in the left temporo-frontal areas. A number of tests from Psycholinguistic Assessment of Language Processing in Aphasics (Kay, Lesser & Coltheart, 1992) were used to assess LK's oral reading and writing. LK's reading and writing were found to be influenced by factors such as grammatical class, imageability and word frequency, spelling regularity, non-word, and homophone. Although the near identical patterns of response in LK's reading and writing could be construed as supportive evidence for the 'common lexicon' theory, the discrepancy between the presence of semantic substitutions in reading and its absence in writing would warrant a cautious interpretation. The 'Common lexicon theory' finds itself in an incompatible position with the numerous reports on isolated agraphias (Luzzi & Piccirilli, 2003).

I106

SPORTS EXPERIENCE CHANGES THE NEURAL PROCESSING OF LANGUAGE *Sian Beilock[1], Ian Lyons[1], Andrew Mattarella-Micke[1], Howard Nusbaum[1], Steven Small[1]; [1]The University of Chicago* – Sport is unlike most human activities, inspiring those who play as well as those who merely watch. For those who aspire to achieve elite performance levels, intensive practice is necessary. However, whether athletic experience carries implications beyond the playing field (i.e., beyond action perception and production) is unknown. Here we show that sports experience changes the neural basis of language comprehension – even when there is no intention to act based on the language. People with different motor skill experience rely on different cognitive and neural operations in both overt action execution (Beilock & Carr, 2001) and the comprehension of action-related language. In an fMRI study, ice-hockey players (n=12), ice-hockey fans (n=8), and novices (n=9) passively listened to sentences depicting ice-hockey scenarios and then performed a task that gauged understanding of spoken hockey scenarios. Participants with more hockey experience (players and fans) were better hockey language comprehenders. This relation was fully explained by increased neural activity in left dorsal premotor cortex and decreased activity in both primary sensorimotor cortices that occurred while subjects initially listened to the ice-hockey scenarios. We conclude that athletic experience changes language comprehension through the recruitment of neural areas involved in the selection of well-learned action plans and procedures (Toni et al., 2002; Wise & Murray, 2000) and the inhibition of neural areas known to support the explicit step-by-step control of novel movements (Rizzolatti & Luppino, 2001) – areas not traditionally involved in language understanding. This occurs because of experience performing and watching the actions in question.

I107

EXPLORING INDIVIDUAL DIFFERENCES IN LATERALIZATION OF FUSIFORM ACTIVATION DURING READING *Gal Ben-Yehudah[1,2], Elizabeth Tricomi[4], Julie Fiez[1,2,3]; [1]University of Pittsburgh, [2]The Center for the Neural Basis of Cognition, [3]The Center for Neuroscience, University of Pittsburgh, [4]California Institute of Technology* – Reading involves a set of processing stages from visual analysis to phonological and semantic retrieval. A large body of work has identified a left fusiform region that is crucial to the perceptual analysis of word form (i.e. the visual word form area, VWFA). Readers of alphabetic scripts show strong left lateralized activation of the fusiform cortex. In contrast, readers of nonalphabetic scripts show bilateral activation of the fusiform cortex, typically associated with the perceptual demands of processing complex visuo-spatial scripts. Interestingly, variability also exists in the differential activation of left and right fusiform among readers of alphabetic scripts. To investigate the functional consequences of these individual differences, we conducted a post-hoc analysis of fMRI data collected during a visual word-pair associate learning task. For each right-handed participant, we identified the VWFA and its right homologue as reported in past studies. In these regions, we determined the amount of signal change during visual word presentation, and calculated a laterality index based on magnitude differences between activations in left and right fusiform regions. At the group level there was a significant left bias in fusiform activity, whereas individual subjects showed considerable variability in their laterality index. We used a behavioral manipulation of word inversion (rotation by 180 degrees) to probe the behavioral relevance of these individual differences in lateralization. We found a significant relationship between larger sensitivity to word inversion and smaller laterality indices suggesting that the right fusiform is functionally important for some readers of alphabetic scripts.

I108

BETWEEN LAN AND P300: MARKERS FOR DISSOCIABLE ASPECTS OF RULE PROCESSING. *Angele Brunelliere[1], Peter Ford Dominey[2]; [1]FPSE, University of Geneva, [2]EMC – EA 3082 – Université Lyon 2 / CNRS* – The LAN, a left anterior negativity component, has been found both in language comprehension tasks, after function word that predicted the subsequent syntactic structure, and in non-linguistic tasks after function symbols predicting structural transformations to be applied to preceding symbols (Hoen & Dominey 2000). Such results led to assume that the LAN is not specific to language, but rather an ability for treating structural information in rule-governed sequences. However, it is not clear whether the LAN is related to an extraction of rules indicated by function information, or application of a structural transformation triggered by the rule. To investigate this question, we examined ERP responses after function symbols which predicted order of upcoming letters, i.e. either in alphabetical order or in inverse order but involved no structural transformation. A P300 effect was observed after function symbols. Moreover, the observed sub-components P3a and P3b were modulated by the complexity of non-linguistic sequences. Hence, the P300 effect appears sensitive to extraction of rules about upcoming symbols order. The absence of the LAN component in this experiment suggests that the LAN is not related to retrieval of rules from memory, but rather to structural transformation processing triggered by the function information. Hence, in a sentence, the function information allows the mapping of previously recognized words in non-canonical syntactic structure by structural transformations. Our experiment thus offers new insights about the processes involved in language and non-linguistic rule processing.

I109

THE EFFECTS OF ANAPHOR FORM AND ANTECEDENT TYPE ON ANAPHORIC PROCESSING *Sarah Callahan[1], Janet Nicol[2], Tracy Love[1,3], Jeffrey Witzel[2], David Swinney[1]; [1]University of California, San Diego, [2]University of Arizona, Tucson, [3]San Diego State University* – Psycholinguistic and neurolinguistic models of anaphoric processing have tended to focus on the processing of phonetically overt noun phrase anaphors; however, a recent event-related potential (ERP) study (Callahan et al., 2007) demonstrated processing variation related to the form of the anaphor (i.e. phonetically null vs. overt) and the type of antecedent phrase (i.e. noun phrase (NP) vs. verb phrase (VP)). The current study used eye-tracking techniques to further investigate the effect of these factors on the processing of NP anaphors and VP anaphors. Eye-movements were recorded while participants (n = 36) read sentences involving overt NP anaphors (e.g. The rebel pursued the boat and the colonel pursued it too following for days.), overt VP anaphors (e.g. …and the colonel did it too…), or null VP anaphors (e.g. …and the colonel did too…). As a secondary manipulation, the frequency of the antecedent of the overt NP anaphor was also varied (e.g. HIGH-FREQ: boat vs. LOW-FREQ: raft). As predicted, the frequency manipulation revealed the standard effect of longer first-pass fixation times for low-frequency words. Of greater interest and consistent with the previous ERP study, both the antecedent type and the anaphor form had a significant effect on first-pass fixation times for the anaphor region (e.g. and the colonel did/did it/pursued it too). Taken together, the results of the ERP and eye-tracking studies suggest that the development of comprehensive models of anaphoric processing will benefit from further research aimed at elucidating the effects of characteristics of the antecedent and anaphor.

I110

LANGUAGE CONTENT AND CARRIER: THE FUNCTIONAL NEURAL ORGANIZATION OF SIGN AND SIGNER IDENTIFICATION FROM POINT-LIGHT DISPLAYS *Cheryl M. Capek[1], Karine Gazarian[1], Ruth Campbell[1], Bencie Woll[1], Mairéad MacSweeney[2], Anthony S. David[3], Philip K. McGuire[3], Michael J. Brammer[3]; [1]DCAL, University College London, [2]BBSU, Institute of Child Health, University College London, [3]Institute of Psychiatry, King's College London* – Language perception typically involves processing information about the carrier, in addition to lexical content. In spoken language, speaker identity is conveyed by acoustic properties in voice whereas in signed language, signer identity is expressed through hand and body movements as well as visual characteristics present in full pictorial displays. Using fMRI, we studied 12 congenitally, profoundly Deaf native signers of British Sign Language (BSL) as they viewed blocks of point-light displays (PLDs) composed of signers producing BSL signs alternating with two baseline conditions (non-biological movement and still dot arrangements). PLDs were chosen to ensure that no facial or other pictorial information could aid identification. Participants viewed the stimuli in two identification experiments: 1) sign and 2) signer. Compared to the moving dot baseline, both identification tasks elicited activation in the right inferior and middle frontal gyri and temporo-parieto-occipital cortices in both hemispheres. In addition, distinct activations were observed as a function of identity task, even when differences in task difficulty (signer > sign) were accounted for in the analysis. Signer identification elicited greater activation than sign identification in the temporo-occipital cortices of both hemispheres, including the posterior STS, which has previously been shown to be involved in recognising person identity from voice and non-linguistic PLDs. In contrast, identifying signs elicited greater activation than identifying signers in the right inferior and superior parietal lobules and superior extrastriate cortex. These findings suggest that, as for spoken language, identifying the language carrier and content in signed language relies on non-identical neural networks.

I111

IS LANGUAGE-SWITCHING A MATTER OF SUBJECTIVE FREQUENCY?: AN EVENT-RELATED POTENTIALS STUDY USING MASKED PRIMING *Krysta Chauncey[1], Jonathan Grainger[2], Phillip J. Holcomb[1]; [1]Neurocognition Laboratory, Tufts University, [2]Universite de Provence* – It is generally accepted that switching between languages incurs cognitive costs under most circumstances. Previous research has shown that this cognitive cost occurs during automatic lexical processes (Chauncey, Grainger, & Holcomb, in press)--e.g., an L1 prime followed by an L2 target causes an increase in the N250's amplitude when compared to a within-language prime-target pair, whereas an L2 prime followed by an L1 target causes an increase in the N400's amplitude when compared to a within-language prime-target pair. As this was shown in non-balanced bilinguals, these results could be due to experienced word frequency (since participants had more exposure to their L1 than their L2, all L1 items were necessarily higher frequency than any L2 items). This possibility was tested by examining "frequency-switching" effects within one language using masked priming and ERPs. Primes and targets could either be from the same frequency range (low-low, high-high) or from different frequency ranges (high-low, low-high). If the language-switching costs observed by Chauncey et al. (in press) were caused by differences in subjective frequency across L1 and L2 words, then the same pattern of effects should be observed when switching between frequency ranges as were seen when switching between languages. However, no such effects were observed. This data will be discussed in relation to earlier language-switching data to examine the root of language-switching costs.

I112

WHEN THINGS DO NOT REFER: AN FMRI STUDY *Nicole Chevalier[1], Edith Kaan[1], Guojun He[2], Yijun Liu[2]; [1]University of Florida, Program in Linguistics, [2]University of Florida* – How do we analyze quantifiers in multi-sentence discourses when they do not match? Discourse processing is generally considered a right hemisphere function; however this stance is somewhat controversial, as experiments until now have not elicited consistent results. To determine what areas of the brain speakers activate and thereby gain a better understanding of discourse and quantifier processing, we designed and conducted the following fMRI experiment. Sixteen neurologically healthy, monolingual speakers of English viewed 133 sets of two-sentence trials (constructed based on the results of 3 offline pretests). Experimental sentences either had matching quantifiers or mismatched ones: Four tires were leaking some air. All four had already been patched last week. (plausible); Four tires were leaking some air. All three had already been patched last week (implausible). The first sentence of each set was presented two words at a time, for 400ms each (200ms blank in between). The first two words of the second sentence (containing the second quantifier) were presented in the same manner; the rest of the second sentence was shown word-by-word for 300ms each (separated by 200 ms blank). Subjects were then cued to respond by pressing buttons whether the two sentences were plausible or implausible together. Preliminary data from a comparison of the differential activation of the implausible versus the plausible condition supports the idea that the right hemisphere is involved in discourse processing: the right hemisphere cingulate, precentral, and postcentral gyri, as well as the left inferior parietal lobule are activated to a significant degree.

I113

THE ROLE OF EXPERTISE IN LANGUAGE COMPREHENSION: HOW NEURAL ACTIVITY CHANGES WITH INCREASING EXPOSURE TO CATEGORICALLY RELATED SENTENCES *Matthew Cieslak[1], Ian Lyons[1], Sian Beilock[1]; [1]The University of Chicago* – We are often repeatedly exposed to information about a specific category of events. For example, in a meeting or lecture, one will hear a variety of different sentences all addressing the same topic. Does neural activity underlying the comprehension of these sentences vary with increasing exposure? Furthermore, does this pattern of activation depend on the degree of prior experience we have with the topic at hand? In an fMRI study, we examined how the neural activity of expert hockey players (n=12) and hockey novices (n=9) changed as they listened to sentences about hockey-specific events and everyday events in which all participants should be experienced. While passively listening to hockey-related sentences, hockey players showed activation increases over time (i.e., after several minutes of exposure to 20 different sentences of each type randomly intermixed) in occipital and parietal regions involved in visually simulating the meaning of linguistic stimuli. Novices also showed increasing activation in these areas, but only for everyday (non-hockey) sentences. These results suggest that visual cortical areas may be sensitive to repeated processing of event-related linguistic stimuli in a given category. We interpret this finding to reflect changes in how the sentences' meaning is understood. Moreover, these changes appear to be sensitive to one's domain of expertise. Experts (e.g., hockey players listening to hockey-sentences or even hockey novices listening to everyday sentences) may increasingly recruit these visual areas as one hears more sentences that are about domains with which they are familiar.

I114

"WHAT YOU ENCODE IS NOT NECESSARILY WHAT YOU STORE": AN ERP STUDY OF PHONOLOGICAL PROCESSING *Sonia Cornell[1], Aditi Lahiri[1,2], Carsten Eulitz[1]; [1]University of Konstanz, Germany, [2]University of Oxford, England* – Models of speech perception differ with respect to the question, how detailed phonological information of speech is represented in the mental lexicon. One option is not to store redundant information in order to ensure efficient processing. Alternatively, models can assume full specification of all phonological and phonetic details in the mental lexicon. The Mismatch negativity (MMN), an automatic change detection response in the brain, which is sensitive to language-specific information, has been used to demonstrate underspecified phonological representations for isolated vowels. The present MMN-study extends these findings by using linguistically more complex stimuli.Three German vowels [e], [o], [Ø] placed in words (e.g. M[Ø]ren-M[o]ren) and identical non-words (e.g. M[Ø]ken – M[o]ken) were presented, each serving as standard and deviant. Only models assuming underspecification of phonological features predict an asymmetry of MMNs within the reversal of vowel contrasts, presented as standard and deviant. For instance, vowels like [Ø] which are assumed to be underspecified for place of articulation, cannot build up this representation when presented as standard. Consequently, they do not conflict with other vowels, which will then be reflected in reduced MMN amplitudes. Results showed exactly this asymmetry in the MMN with the largest amplitudes when the unspecified deviant [Ø] maps onto the represented standard /o/. Finding these differential MMN asymmetries for similar acoustic/phonetic differences between pairs of vowels in isolation as well as in linguistically more complex structures suggests that the brain refers to underspecified phonological representations during speech perception.

I115

PHONEMIC DISCRIMINATION IN CHILDREN WITH CEREBRAL PALSY *Nina Davids[1,2], Danille van den Brink[2,3], Holger Mitterer[4], Hans van Balkom[1], Jan de Moor[1], Miranda van Turennout[1,2], Ludo Verhoeven[1]; [1]Behavioural Science Institute, University of Nijmegen, The Netherlands, [2]F.C. Donders Centre for Cognitive Neuroimaging, Nijmegen, The Netherlands, [3]Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands, [4]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands* – Cerebral Palsy (CP) is a non-progressive posture and motor disorder which is caused by brain damage during pregnancy, birth or first year of life. A large majority of children with CP have reading and spelling problems. If they could learn to read they would be less restricted in communicating and would have access to more learning materials. The cause of the reading and spelling problems is unclear. Precursors of learning to read may not be normally developed in children with CP. The present study investigates whether children with CP differ from age-matched controls in phonemic discrimination, a low-level precursor of learning to read. This is studied by means of an ERP study, using the mismatch negativity (MMN). The MMN reflects the brain's automatic response to any infrequent discriminable change in a stream of auditory stimuli (Näätänen, 2003). ERPs were recorded from children with CP (range: 4-6 years old) while they passively listened to series of speech stimuli and watched a silent movie. Stimuli included standard /i/ sounds which were intermixed with three deviants /u/, /y/ and high pitch /i/, resulting in a small and large phonemic contrast and a pitch contrast. The results indicated that the children with CP showed similar effects as the control children. We conclude that children with CP do not have an impairment with respect to phonemic discrimination. Therefore, future research should focus on higher levels of learning to read.

I116

CORPUS CALLOSUM AND LONGITUDINAL ASSOCIATION FIBER RADIAL DIFFUSIVITY CORRELATES WITH READING ABILITY IN DYSLEXIA AND NORMAL READING *Marc Dubin[1], Sumit Niogi[1], Aziz Ulug[2], Bruce McCandliss[1]; [1]Sackler Institute for Developmental Psychobiology, Weill Cornell Medical College, [2]Weill Cornell Medical College* – Radial diffusivity (RD) provides a measure of the degree to which white matter restricts diffusion of water, and has recently been shown to correlate with an important precursor skill to early reading, phonological awareness, specifically in regions of interest in the corpus callosum (CC) restricted to fibers that project to temporal lobes (Dougherty, et al 2007). The current study examines this effect by attempting to correlate Tract Based Spatial Statistics (TBSS) analysis of RD in all the major white matter tracts with a more direct measure of reading skill in a sample of average to reading disabled children. Replicating and extending previous findings, RD in caudal regions of the CC is correlated with reading skill. As in the previous study, this finding is anatomically specific to a caudal subregion of the CC known to project to temporal lobes. Furthermore, we find that correlation with reading skill is cognitively specific in that there is no such correlation with standardized performance on a short term working memory task. Additional regions demonstrating positive correlations between major white matter tract RD and reading skill include clusters in the superior longitudinal fasciculus (SLF) and inferior longitudinal fisciculus (ILF) in the left, but not right, hemisphere. Results support recent findings suggesting that CC morphology is implicated in developmental dyslexia in a way that might specifically impact temporal lobe function and morphology, yet also suggest a role for association pathways within the left hemisphere, including longitudinal fasciculi connecting anterior and posterior brain regions.

I117

EMOTIONAL VALENCE MODULATE THE PHONOLOGY PROCESSING DURING CHINESE CHARACTER READING: AN FMRI STUDY *Ning Fan[1], Danling Peng[1]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University* — This study used event-related fMRI to examine if the emotional valence can impact on the phonological processing of Chinese character, and the interaction with the character frequency. A 3 (Emotional valence: negative, positive, and neutral) × 2 (Frequency: high and low) design was selected. The number of stroke, concreteness and arousal level of the emotion characters were matched among the conditions. Subjects (N=14, 8 females) viewed a series of characters and were asked to perform a rhythm decision task. The behavioral data revealed that negative and positive valence accelerated the low-frequency characters' performance, but not for the high-frequency characters. However, high-frequency positive characters' reaction was slower than high-frequency negative and neutral stimulus. When contrast negative with neutral characters, there was increased activation in anterior and posterior cingulate cortex, posterior area of left middle/superior temporal gyrus, as well as bilateral amygdala. Compared positive to neutral character, only under the lower threshold, greater activation was occurred in anterior cingulate cortex, left hippocampus and bilateral superior parietal gyrus. Related to high-frequency characters, low-frequency characters activated left dorsal-lateral frontal cortex, left inferior parietal lobule, and right fusiform gyrus. ROI analysis indicated that the interaction between emotional valence and frequency was significant in left inferior frontal gyrus, anterior and posterior cingulated gyrus. The result suggested that the emotional modulation on phonology processing had more efficiency in low-frequency characters. Cingulated cortex, left temporal cortex and left inferior frontal cortex, which related to attention, phonological store and retrieve respectively, were sensitive to the modulation.

I118

PROSODY INFLUENCES THE LISTENER'S ONLINE REPRESENTATION OF THE SPEAKER'S THOUGHTS *Evelina Fedorenko[1], Lillia Cherkasskiy[2], Rebecca Saxe[1]; [1]MIT, [2]Stanford University* — An important factor that affects interpretation of a linguistic utterance is its prosody (a combination of extra-lexical acoustic cues). In two studies (one behavioral, one fMRI), we investigated the effects of prosody on meaning in the domain of social cognition. We manipulated the prosodic contour of the phrase "I think" in naturalistic dialogs, contrasting the version of "I think" where both words were unstressed and the version where "I" was stressed (a combination of an increase in pitch height, intensity and lengthening). Speakers use the latter prosodic contour to draw attention to their own opinions, in contrast to opinions of others. In the behavioral study, we found that people infer greater confidence of the speaker (but do not themselves form more confident opinions) when "I" is stressed. In the fMRI study we first identified brain regions that have been implicated in forming a representation of someone's thoughts. We then compared the activation in these regions to "I think" sentences with different prosodic contours. These regions show a higher response to the condition where "I" is stressed than to exactly the same sentence if both words are unstressed. These results have implications for both linguistic processing (by demonstrating that subtle prosodic manipulations can affect meaning), and for social cognition (by investigating the circumstances under which comprehenders represent a speaker's thoughts in an on-line, naturalistic task).

I119

THE LONG ROAD TO AUTOMATION: TIMING CHARACTERISTICS OF THE DEVELOPMENT OF LETTER/ SPEECH-SOUND INTEGRATION REVEALED WITH ERP. *Dries Froyen[1,2], Milene Bonte[1,2], Nienke van Atteveldt[1,2], Hanne Poelmans[1,2], Leo Blomert[1,2]; [1]Maastricht University, The Netherlands., [2]Maastricht brain imaging center (M-BIC), The Netherlands* — In transparent languages mastery of letter/speech-sound associations is standard within one year of reading instruction. If and how this is reflected in brain processes is currently unknown. A recent event-related potentials (ERP) study demonstrated automatic integration of letters and speech-sounds in fluently reading adults early in neural processing time (at 150 ms) [1]. Additionally, manipulating stimulus onset asynchrony (SOA) revealed a narrow temporal window of integration (at 0ms SOA, not at 100 or 200ms SOA). The present study aimed to unveil when and how letter/speech-sound integration becomes automatic by employing the same ERP-paradigm with beginning (8y) and advanced (11y) readers. In an auditory oddball paradigm, speech-sounds were presented in isolation or in the context of letters appearing either simultaneous with or 200ms before the speech-sound (0 or 200ms SOA). In beginning readers, the early effect of letters on speech-sound processing (at 150ms), as shown in adults, was not present. Instead, they showed a later effect (at 650ms), but only at SOA 200ms. Advanced readers showed an adult-like early effect (at 150ms), however despite four years of reading instruction, only at 200ms SOA. At 0ms SOA, only a late effect (at 650ms) was present. In sum, a double shift in timing characteristics of letter/speech-sound processing was found; in latency (from late to early) and temporal window of integration (from 200 to 0ms SOA). These results indicate extended neural development of letter/speech-sound processing, most likely caused by a reciprocal interaction between brain maturation and reading experience. [1] Froyen e.a., in press, NSL

I120

SUBTYPES OF DYSLEXIA *Marion Grande[1], Elisabeth Bay[1,2], Helen Schreiber[2], Julia Tschierse[1], Klaus Willmes[1], Walter Huber[1], Katrin Amunts[1,2], Stefan Heim[2]; [1]University Hospital Aachen, [2]Institute for Neurosciences and Biophysics - Medecine, Research Centre Juelich* — Different theories conceptualise dyslexia as either a phonological, attentional, auditory, magnocellular, or automatisation deficit. Such heterogeneity suggests the existence of yet unrecognised subtypes of dyslexics suffering from distinguishable deficits. The purpose of the study was to identify cognitive subtypes of dyslexia. Out of 642 children screened for reading ability 49 dyslexics and 48 controls were tested for phonological awareness, auditory discrimination, motion detection, visual attention, and rhythm imitation. A combined cluster and discriminant analysis approach revealed three clusters of dyslexics with different cognitive deficits. Compared to reading-unimpaired children cluster #1 had worse phonological awareness; cluster #2 had higher attentional costs; cluster #3 performed worse in the phonological, auditory, and magnocellular tasks. These results indicate that dyslexia may result from distinct cognitive impairments. The underlying neurofunctional mechan isms are currently being investigated and will also be presented.

I121

HOW DOES THE BRAIN DEAL WITH THE SYNTAX OF TWO NATIVE LANGUAGES? AN ERP STUDY IN EARLY BILINGUALS *Manfred F. Gugler[1], Sonja Rossi[1], Angela D. Friederici[1], Anja Hahne[1]; [1]Max Planck Institute for Human Cognitive & Brain Sciences, Leipzig, Germany* — The age of acquisition of one or more languages seems to be one important factor in determining how the learned languages are processed in the brain. In the present study the syntactic processing in German-Italian bilinguals was investigated with event related brain potentials (ERPs). For this purpose, a German and an equivalent Italian material were created. Each material contained four different experimental conditions, namely a correct sentence, a word category violation, a morphosyntactic violation, and a combination of both violation types. 12 German-Italian bilinguals who learned both languages in their families from birth on and thus had a very early age of acquisition participated in the EEG study. The results show the same ERP components when participants heard the German and the Italian sentences. In detail, word category violations compared to correct sentences elicited an early anterior negativity reflecting early phrase structure building processes, followed by an additional negativity probably reflecting referential integration processes and a P600 suggesting syntactic reanalysis. Results for the morphosyntactic versus correct condition show an anterior negativity indicating the processing of the morphosyntactic error followed by a P600. Finally, combined violations elicited the same ERP components as in the pure word category condition suggesting a primacy effect of word category information over morphosyntactic aspects. These findings indicate that at least when two languages are acquired very early the brain processing mechanisms are similar for both languages suggesting that both languages recruit the same underlying neuronal mechanisms.

I122

THE N200 AS AN INDEX OF ORTHOGRAPHIC PROCESSING IN A REICHER-WHEELER PARADIGM *Margaret M. Gullick[1], Elyse George[1], Priya Mitra[1], Donna Coch[1]; [1]Dartmouth College* – Previous research has suggested that the N200 component of the event-related potential (ERP) waveform may index early, automatic orthographic processing. To investigate the sensitivity of the N200 to orthography, we used a variant of the Reicher-Wheeler task in an ERP paradigm. We briefly presented (40 ms) four-letter strings, followed by a mask (200 ms), then a string of four hash marks with one letter below and one letter above a given hash mark; this required a button-press response indicating which of the two letters had been presented in the masked string in that position. ERPs were recorded to the masked four-letter strings, which were real words (DARK/PARK), pseudowords (DARL/PARL), or nonwords (RDKA/RPKA); here followed by forced-choice letters D and P. In participants run to date (n = 13, half the full sample), a behavioral word superiority effect (WSE) was evident: letter choices were more accurate for words than nonwords ($p < .01$). A pseudoword superiority effect (PWSE) was also evident, with greater accuracy for letters in pseudowords than nonwords ($p < .01$). Electrophysiologically, mean amplitude of the N200 (170-220 ms) was greater for nonwords than words at posterior, right hemisphere sites (condition x hemisphere x anterior/posterior, $p < .05$) and was greater for nonwords than pseudowords (condition, $p < .05$). Our findings from a classic masked priming, forced-choice letter paradigm adapted into an ERP format are consistent with the suggestion that the N200 is sensitive to early, automatic orthographic processing in terms of both a WSE and a PWSE.

I123

WHAT'S THE POINT OF GESTURES? ERPS DURING CO-SPEECH POINTING IN ABSTRACT SPACE. *Thomas Gunter[1], Henning Holle[1], Douglas Weinbrenner[1]; [1]Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – An increasing number of neuroscience studies have shown that gestures can impact language comprehension. Here, we explored the effects of abstract pointing gestures. Typically, a pointing gesture indicates a certain direction, location or object. It is, however, also possible that a pointing gesture does not have a preexisting target, but is directed towards seemingly empty space. In such abstract deixis a physically empty location is assigned a meaning by virtue of being the target of a pointing gesture. For instance, when talking about pets, a speaker could refer to 'cat' using a left pointing gesture and to 'dog' by a right one. Then, by observing a pointing either to a left or right position, all interlocutors may be able to infer which animal is referred to. While EEG was recorded, participants were presented with an interview in which a female was interviewed on 84 topics (i.e. animals: 'What kind of pets do you like more, cats or dogs?'). By answering several topic-related questions the interviewee established abstract space (cf. left: cats, right: dogs). During the response on the last question of a particular topic, either a correct or an incorrect pointing gesture was made by the interviewee. The ERPs elicited by incorrect co-speech pointing showed an N400-like negativity between 200 and 450 ms followed by a slow positivity between 600 and 800 ms. Tentatively, we interpret the negativity to reflect difficulty of semantic integration of co-speech pointing into the speech context, whereas the positivity possibly reflects a reanalysis process.

I124

ELECTROPHYSIOLOGICAL BRAIN ACTIVITY IN SPANISH SIGN LANGUAGE PROCESSING: EVIDENCE FOR SEMANTIC AND PHONOLOGICAL STRUCTURE. *Eva Gutierrez[1], Oliver Müller[1], Cristina Baus[1], Manuel Carreiras[1]; [1]University of La Laguna* – The present ERP study investigates lexical processing in Spanish Sign Language by means of formal and semantic priming. Studies of word recognition in spoken languages have used priming as a tool to explore the structure of word representations: Word pairs are presented that share a property of interest and performance is compared to word pairs without any relation. The assumption is that only the manipulation of properties encoded in word representations would lead to processing differences. Such priming effects have not only been found for behavioral measures, but also for the ERP. This study extends the ERP priming methodology to a signed language, testing whether overlap in phonological properties, as well as semantic characteristics, affects word recognition also in a different language format. According to the seminal work of Stokoe one can classify each sign regarding three phonological parameters: handshape, location, and movement. In three phonological experiments, critical prime-target pairs were equal regarding one particular parameter (handshape, movement, or location) while being different on the other two. In addition, we included an identity priming condition to differentiate phonological and visual-perceptual effects. A further experiment manipulated the semantic relatedness of prime-target pairs. Eight deaf native speakers and ten deaf non-native speakers participated in the experiment. Results indicate a difference in amplitude in the N400 window for the semantic manipulation, as well as for phonological manipulations involving location and movement, but not handshape. Furthermore, identity priming produced a difference in peak latency, with repeated signs showing an earlier peak than unrelated ones.

I125

CORTICAL ACTIVATION EVOKED BY SPOKEN WORD FORMS AND REPETITIONS IN SLI AND DYSLEXIA *Päivi Helenius[1], Tiina Parviainen[1], Ritva Paetau[2], Riitta Salmelin[1]; [1]Brain Research Unit, Helsinki University of Technology, Finland, [2]Helsinki University Central Hospital, Finland* – Young adults with a history of specific language impairment (SLI) differ from reading impaired (dyslexic) individuals in terms of limited vocabulary and poor verbal working memory capacity. We tracked cortical processing of spoken word forms in young adults with SLI (n=10), dyslexia (n=9), and normal language development (n=13) using magnetoencephalography (MEG). The stimuli were 7-8-letter spoken real words and pseudowords, presented every 2.5 seconds. Stimuli were either repeated immediately after first presentation (75 target words/ pseudowords) or presented only once (150 filler items). The participants were instructed to listen to the stimuli and respond to proper nouns by button press. The spoken words evoked a transient peak at 100 ms (N100) followed by longer-lasting activation peaking around 400 ms (N400) in the left and right temporal cortex. The effect of lexicality (words vs. pseudowords) was detected about 400 ms onwards as activation culminated for words but continued for pseudowords. This effect was more pronounced in the left than right hemisphere in control subjects. The left hemisphere lexicality effect was also present in dyslexic adults but was insignificant in subjects with SLI, possibly reflecting their limited vocabulary. The N400 activation between 200-700 ms was attenuated by the immediate repetition of words and pseudowords in both hemispheres. In SLI adults the repetition effect was abnormally weak between 200-400 ms after word and pseudoword onset, suggesting impaired short-term maintenance of recently activated lexical candidates in the bilateral temporal networks. The potential role of attenuated repetition effect in vocabulary growth and SLI is discussed.

I126

ROUTES TO ACHIEVING LITERACY IN DEAF READERS: THE CASE OF NATIVE AMERICAN SIGN LANGUAGE (ASL) USERS *Elizabeth Hirshorn[1], Matt W.G. Dye[1], Peter C. Hauser[2], Daphne Bavelier[1]; [1]Brain and Cognitive Sciences & Center for Language Sciences, University of Rochester, [2]National Technical Institute for the Deaf, Rochester Institute of Technology* – For hearing children, the sounds of a language play a key role in learning to read. They learn early on that the sound of the word 'cat' is composed of separable sound units /k/-/a/-/t/. This 'phonological awareness' is tightly coupled with reading skills in normal readers and dyslexics alike. If sounding out words is so important to young readers, how do profoundly deaf individuals, with little or no hearing in the speech range, achieve literacy? A battery of new behavioral measures was administered to deaf native signers to assess the role of phonological awareness, short-term memory, speech-reading, and ASL fluency in reading comprehension in this population. The goal was to characterize the skills that distinguish good deaf readers from poor ones. Importantly, our tests of phonological awareness were designed to detect phonological knowledge based solely on orthographic cues separately from that based on a deeper understanding of sound structure, by taking advantage of the irregularities of grapheme to phoneme correspondence in English. Tests at varying levels of analysis (e.g., phoneme, syllable, rime) also provided greater details about the profile of a good deaf reader. Finally, functional imaging during single word and sentence reading allowed us to characterize the neural networks involved in reading in the deaf, and how such networks correlate with the cognitive skills identified to support reading in the deaf. Implications for clinical populations who face difficulties learning to read through traditional instruction will be discussed.

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LEFT, RIGHT, CENTER: INTERHEMISPHERIC COMMUNICATION IN WORD NAMING *Zoe Hunter[1,3], Padraic Monaghan[2]; [1]University of Muenster, Germany, [2]University of Lancaster, United Kingdom, [3]Royal Holloway University of London, United Kingdom* – To try and define those principles that govern interhemispheric communication, we investigated how different types of supplementary stimuli can influence processing speed in a lateralized word naming task. In order to identify information that is beneficial to processing when presented contralateral to the target word we compared five conditions in a cued visual half-field design: unilateral (____>word), bilateral length (xxxx>word), bilateral congruent (word>word), bilateral CAPITAL (WORD>word) and bilateral incongruent (foil>word). For all conditions the target was also shown in the LVF. We found a significant RVF advantage for word naming responses in all five conditions. We did not find a bilateral redundancy gain for the 'bilateral congruent' condition (a phenomenon that has been demonstrated in several lexical decision studies), but rather observed that the more complex the contralateral stimulus was, the slower the response times. The 'unilateral' and 'bilateral length' conditions were most beneficial, while the 'bilateral congruent' and 'bilateral CAPITAL' conditions showed a strong advantage over the 'bilateral incongruent' condition. We reproduced this result pattern with a lexical decision version of the same task. In both cases response times depend strongly on the lexical properties of the stimulus presented contralateral to the target, which can either inhibit or aid processing. Interhemispheric interaction and input comparison is based on letter-level information and takes place after processing of basic visual features. Word naming is fastest if there is no interference on a lexical level and benefits from congruent perceptual and/or lexical properties.

I128

DISSOCIATING MEMORY REPRESENTATIONS FOR DISCOURSE FROM GENERAL MEMORY REPRESENTATIONS: EVIDENCE FROM ERPS *Clinton L. Johns[1], Peter C. Gordon[3], Tamara Y. Swaab[1,2]; [1]University of California, Davis, [2]Center For Mind and Brain, University of California, Davis, [3]University of North Carolina, Chapel Hill* – The use of repeated name anaphora to establish coreferential relationships in discourse contexts induces processing difficulty when such anaphors' antecedents are names in discourse focus (e.g., John went to the store because John…"). This repeated name penalty (Gordon et al., 1993) manifests as an N400 effect in ERP research (e.g., Swaab et al., 2004). A previous study (Johns et al., 2007) examined whether this effect of discourse prominence could be distinguished from more general memory effects by manipulating perceptual characteristics of the antecedent names (e.g., "Alexis" vs. "lAexis"). Behavioral results showed that these perceptual manipulations enhanced memory performance. ERPs timelocked to the coreferential repeated name anaphors replicated the RNP N400 effect when antecedent names did not contain a letter reversal. In addition, increased priming for repeated names with antecedents in discourse focus when the antecedent contained the perceptual manipulation was found. The present study applied this perceptual manipulation to names in unstructured word lists in order to dissociate the memorial effects of the perceptual manipulation from memorial effects of discourse focus; critical names either were repeated from an earlier instance in the list, or were not. Results reveal repetition priming effects in both conditions; these results, in concert with previous research, suggest that discourse-driven memory effects can be dissociated from the effects of general, stimulus-driven memory operations.

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AN ERP STUDY OF CEREBRAL ASYMMETRIES FOR PROCESSING LITERAL AND FIGURATIVE MEANINGS *Natalie A. Kacinik[1], Johnchristopher A. Aragon[1], Tamara Y. Swaab[1]; [1]University of California, Davis* – The right hemisphere has been proposed to be preferentially involved in comprehending subordinate figurative meanings (Anaki et al. 1998; Beeman, 1998; Brownell, 2000; Jung-Beeman, 2005). However, a series of behavioral divided visual field (DVF) and central ERP experiments (Kacinik & Chiarello, 2007; Kacinik et al., in preparation) have repeatedly failed to show hemispheric and N400 differences for the integration of literal and figurative meanings into ambiguous contexts. Since figurative senses are generally extended from the literal meaning, they may not engender the kind of semantic competition and selection processes typical of homonymous words like BALL. The current experiment was designed to further directly test this hypothesis by measuring ERPs to lateralized sentence-final words related to the literal or figurative sense of polysemous words in ambiguous contexts (e.g., The girl did not approach the slimy FROG / CLERK). No significant differences between the integration of literal and figurative meanings were found in either visual field with respect to both N400 and late positive effects. The more imageable literal endings, however, did show a bigger frontal imageability effect in the LVF/RH than the RVF/LH, supporting prior indications that brain activity differences in understanding literal and figurative meanings mainly reflect differences in imageability rather than the literal or figurativeness per se. Semantically incongruent endings in the LVF/RH also resulted in a larger N400 than for the RVF/LH, providing further evidence of RH involvement in sentence comprehension and sensitivity to message-level meaning.

1130

PREFRONTAL NONVERBAL INFORMATION PROCESSING IN TRANSLATION OF VERBAL SPEECH INTO FINGER BRAILLE: A FNIRS STUDY. *Takeo Kondo[1], Naoyuki Okochi[1], Satoshi Fukushima[1]; [1]Research Center for Advanced Science and Technology, The University of Tokyo* – Deaf-blind people can talk with other people through a special communication method called finger braille. In this method, well-trained translators listen the speech, then they real-timely types six points braille expressing the speech contents directly on the deaf-blind people's six fingers of both hands. By this method, deaf-blind people can "listen" the speech from the tactile information. Finger braille users among deaf-blind people say that they can feel nonverbal aspects (e.g., prosody) of vocal speech from the touch. To investigate whether translators are translating nonverbal aspects of speech into tactile information or not, we recorded touch-strength of translations by pressure sensors. And coincidently with the pressure recording, we recorded prefrontal neural activations through functional near-infrared imaging method (fNIRS) to investigate neural basis of the processing. Seven translators participated in three fNIRS sessions. One session for tasks of translating adjectives with rich emotional prosody, one for adjectives with less emotional prosody (flat intonation), and one for control tasks in which they simply typed their six fingers according to repeated sequences of beep sounds. Touch-strength of well-trained translators varied dynamically according to the prosody and their bilateral orbitofrontal region significantly activated in both translating tasks against the control task. Though it has been known that orbitofrontal region involved nonverbal processing (i.e., aprosodia) , these results also suggest that this region might also involved in inter-modality translation of prosody information.

1131

BRAIN RESPONSES EVOKED BY PHONOLOGICAL, SEMANTIC AND SYNTACTIC PROCESSES OF AUDITORY JAPANESE *Ayumi Koso[1,2], Shiro Ojima[3,1], Hiroko Hagiwara[1,3]; [1]Tokyo Metropolitan University, [2]Japan Society for the Promotion of Science, [3]Research Institute of Science and Technology for Society* – Modern linguistic theories assume that human language consists of components, such as phonology, semantics and syntax. The accumulated electrophysiological literature provides evidence for the distinctiveness of brain responses that reflect phonological, semantic and syntactic processes. Here, we report an event-related potential (ERP) study that investigated the brain responses evoked by sentences that were phonologically (PHO), semantically (SEM) or syntactically (SYN) anomalous. The present study exploited the properties of Japanese (head-final, agglutinative and pitch-accent) to control for factors, such as linear distance and morpheme type across conditions. The electroencephalogram was continuously recorded while participants listened to the PHO sentences that violated pitch-accent, the SEM sentences that contained non-words and the SYN sentences that violated a syntactic dependency. The PHO condition displayed a combination of anterior negativity and P600. The SEM condition elicited a broadly distributed N400 followed by a wide spread P600, whereas the SYN condition elicited only a P600. The anterior negativity was interpreted as reflecting phonological processes, in contrast to the N400 that reflected semantic integration difficulty. The P600 observed among all three conditions was considered as reflecting the costs of integration. Moreover, an analysis of the onset latencies of the negativities elicited by the PHO and SEM conditions revealed that the former onset latency was earlier than the latter. The present results suggest that phonological, semantic and syntactic processes are indexed by distinct electrophysiological indices and that phonological analysis occurs before semantic analysis.

1132

AGE-RELATED DIFFERENCES IN INTERLINGUAL PRIMING: AN ELECTROPHYSIOLOGICAL AND BEHAVIOURAL INVESTIGATION *Shanna Kousaie[1], Natalie Phillips[1,2]; [1]Center for Research in Human Development, Concordia University, Montreal, Canada, [2]Lady Davis Institute for Medical Research, Sir Mortimer B. Davis, Jewish General Hospital, Montreal, Canada* – The available literature is inconsistent regarding the representation of a bilingual individual's two languages. Some studies suggest that language access is non-selective (i.e., both languages are accessed simultaneously), while others find language access to be selective (i.e., one language is accessed preferentially). Furthermore, the aging literature suggests age-related slowing in semantic activation or processing resulting from an inhibition deficit, which limits the ability of older adults to ignore irrelevant information, causing them to rely more heavily on compensatory strategies such as context. This study examines age-related differences in bilingual language selectivity and processing using both event-related brain potentials (ERPs) and reaction time (RT) measures. Using interlingual homographs (IH, i.e., words with identical orthography in French and English but with distinct semantic features, e.g., COIN meaning 'corner' in French and 'money' in English) in a semantic priming paradigm we investigated the use of language context in biasing the reading of an IH towards one language. Young (n=19; M = 24.5 years) and older (n=13; M = 72 years) highly proficient French/English bilinguals were presented with triplets of letter strings comprised of a language context, an IH, and a target word, in a lexical decision task. RT data revealed no age-difference in language context use. ERP data show less widespread N400 priming in older relative to younger adults and differential priming effects based on language consistency between the language context and target word. Results will be discussed in terms of language selectivity and processing in the native and second language of bilinguals.

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