Cognitive Neuroscience Society Annual Meeting Program 2007

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ANT -Advanced Neuro Technology

Avotec, Inc.

BIOPAC Systems, Inc.

Blackwell Publishing

Cambridge University Press

Cedrus Corporation

Compumedics NeuroScan

Cortech Solutions, LLC

Electrical Geodesics, Inc.

Elsevier

NIRx Medical Technologies

NordicNeuroLab

Oxford University Press

Psychology Press

Psychology Software Tools, Inc.

SensoMotoric Instruments

Sinauer Associates, Inc.

Source Signal Imaging, Inc.

The MIT Press

Worth Publishers

Schedule of Events

Saturday, May 5

12:00-5:00 pm	Exhibitor Check-In, *Empire Ballroom*
3:00-8:45 pm	On-site Registration & Pre-Reg Check In, *Met. Ballroom Foyer*
5:00-9:00 pm	Exhibits on Display, *Empire Ballroom*
5:30-6:30 pm	Opening Session: 13th Annual George A. Miller Prize in Cognitive Neuroscience and Announcement of the Young Investigator Awards, *Metropolitan Ballroom*
6:30-7:30 pm	Welcome Reception, *Empire Ballroom*
6:30-8:30 pm	Poster Session A, *Empire Ballroom*

Sunday, May 6

7:30 am-7:45 pm	On-site Registration & Pre-Reg Check In, *Met. Ballroom Foyer*
8:00-8:30 am	Coffee Service, *Empire Ballroom*
8:00-10:00 am	Poster Session B, *Empire Ballroom*
8:00 am-4:30 pm	Exhibits on Display, *Empire Ballroom*
10:00 am-12:00 pm	Symposium Session 1, *Metropolitan Ballroom West*
	Symposium Session 2, *Metropolitan Ballroom East*
12:00-1:00 pm	Lunch Break
1:00-3:00 pm	Poster Session C, *Empire Ballroom*
2:30-3:00 pm	Coffee Service, *Empire Ballroom*
3:00-5:00 pm	Symposium Session 3, *Metropolitan Ballroom West*
	Symposium Session 4, *Metropolitan Ballroom East*
5:30-7:30 pm	Poster Session D, *Empire Ballroom*

Monday, May 7

8:00 am-7:45 pm	On-site Registration & Pre-Reg Check-In, *Met. Ballroom Foyer*
8:00-8:30 am	Coffee Service, *Empire Ballroom*
8:00-10:00 am	Poster Session E, *Empire Ballroom*
8:00 am-4:30 pm	Exhibits on Display, *Empire Ballroom*
10:00 am-12:00 pm	Symposium Session 5, *Metropolitan Ballroom West*
	Symposium Session 6, *Metropolitan Ballroom East*

Monday, May 7 (*cont.*)

12:00-1:00 pm	Lunch Break
1:00-3:00 pm	Poster Session F, *Empire Ballroom*
2:30-3:00 pm	Coffee Service, *Empire Ballroom*
3:00-5:00 pm	Graduate Students Present Session, *Metropolitan Ballroom West*
	Symposium Session 7, *Metropolitan Ballroom East*
5:30-7:30 pm	Poster Session G, *Empire Ballroom*

Tuesday, May 8

8:00 am-12:00 pm	On-site Registration & Pre-Reg Check-In, *Met. Ballroom Foyer*
8:00-8:30 am	Coffee Service, *Empire Ballroom*
8:00-10:00 am	Poster Session H, *Empire Ballroom*
8:00-11:30 am	Exhibits on Display, *Empire Ballroom*
10:00 am-12:00 pm	Symposium Session 8, *Metropolitan Ballroom West*
	Symposium Session 9, *Metropolitan Ballroom East*

Mark your calendars now...
the 15th Annual Cognitive Neuroscience
Society Meeting will be held at the
Hyatt Regency San Francisco
April 12-15, 2008

George A. Miller Prize in Cognitive Neuroscience

Saturday, May 5, 2007
5:30-6:30 pm, Metropolitan Ballroom

Award Winner:
Joaquin M. Fuster, *University of California, Los Angeles*

Introduction:
Mark D'Esposito, *University of California, Berkeley*

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 2007

2007 Winners of the Young Investigator Award:
Silvia A. Bunge, *University of California*
Steven Laureys, *University of Liège*

The Young Investigator Awards in Cognitive Neuroscience recognizes 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.

Welcome Reception to Follow,6:30-7:30 pm

CNS Symposia

session one

Social Cognition and Body Motion

Sunday, May 6, 2007
10:00 am - 12:00 pm
Metropolitan Ballroom West

Chair

Marina Pavlova, PhD, *University of Tübingen*

Speakers

Marina Pavlova, *University of Tübingen*
Kevin Pelphrey, *Duke University*
Julie Grèzes, *LPPA CNRS, College de France*
Philip Servos, *Wilfrid Laurier University*

Summary: Perception of intentions and dispositions of others is an essential ingredient of adaptive daily-life behaviors. Visual information revealed in dynamic events allows for veridical estimation of social properties of agents involved in these events. The tremendous advance in brain imaging offers new research perspectives in social perception and cognition. Brain imaging data and neuropsychological studies point to the existence of distributed networks that reveal social attributes through body dynamics. The symposium will provide a forum for discussion of new concepts and interrelations between visual perception of human body motions, social cognition, and underlying them brain mechanisms. We will present recent brain imaging and developmental findings obtained in normal population and in individuals impaired in social perception (e.g., with autistic spectrum disorders). This symposium is intended to give new impulses for research in the emerging areas of social and developmental neuroscience.

ABSTRACTS

SOCIAL PERCEPTION, BIOLOGICAL MOTION AND BRAIN CONNECTIVITY: BRAIN IMAGING AND DEVELOPMENT *Marina Pavlova, University of Tübingen* – Bodily movements help to improve our social communication by means of non-verbal information about social properties (intentions, emotions and dispositions). Observers can discriminate between deceptive and true intentions conveyed by body dynamics, and true information is precisely detected despite deceptive endeavours. However, the perceived dynamics of static images also enables emotional attribution (Pavlova et al, 2005 Perception). Brain imaging data in humans, single-cell recording in the macaque monkey, and neuropsychological studies point to the existence of distributed networks that subserve revealing of social attributes through body dynamics. The right superior temporal sulcus, a "social brain" region, is repeatedly reported to be a substantial part of this network. Our recent MEG findings (Pavlova et al., 2004, 2006, Cereb Cortex) also support this view shedding light on the temporal brain dynamics. By using clinical models of abnormal development, namely, patients with early periventricular lesions (Pavlova et al, 2006 Ann Neurol, Pavlova et al., 2006 Neuropsychologia) and autistic spectrum disorders, I will argue that the structural and functional brain connectivity is of immense importance for proper functioning of the networks underlying visual social perception and cognition.

BRAIN MECHANISMS FOR PERCEIVING THE ACTIONS AND INTENTIONS OF OTHERS: LESSONS FROM AUTISM AND TYPICAL DEVELOPMENT *Kevin Pelphrey, Duke University* – Social perception, the ability to evaluate the actions and intentions of others on the basis of biological motion cues (e.g., eye gaze, body posture, and facial expressions), constitutes an advanced perceptual skill set necessary for social success. Specialized brain systems may have evolved that are critical for different aspects of social perception. Several candidate regions thought to comprise the social brain have been identified, including the fusiform face area for face perception, the posterior superior temporal sulcus for the perception of biological motion and the visual analysis of others' actions and intentions, and the amygdala and ventral frontal regions for the perception of emotional expressions. My laboratory has been investigating the properties of these brain regions using functional magnetic resonance imaging (fMRI) in typically developing children and adults as well as in children and adults with autism. I will describe our recent studies in three parts. (1) I will focus first upon functional neuroimaging studies of social perception in typically developing adults. (2) I will discuss a recent study that investigated the neural basis of eye gaze processing deficits in people with autism. (3) I will describe functional neuroimaging studies of the neurobiological basis of social perception development in children.

SOCIAL PERCEPTION: UNDERSTANDING OTHER PEOPLE'S INTENTIONS AND EMOTIONS THROUGH THEIR ACTIONS *Julie Grèzes, LPPA CNRS, College de France* – Our ability to generate and recognize the actions performed by others is the core of our social life. Each individual builds up from the observation of other's behaviour his/her own theory of the thoughts/intentions of others. Ie will review neuroimaging studies that explore the neural basis of everyday human competence to perceive emotion, beliefs and deceit through the observation of the other people's non-verbal behaviour. An automatic motor simulation process of perceived nonverbal behaviours may constitute the basis of a primitive and implicit form of understanding of other people's mental states, and therefore is one of the main components of mind-reading abilities. However, first, there are inter-individual differences in the efficiency of this process; and second, the literature suggests that mind-reading abilities cannot be reduced to motor simulation. Rather, it entails a broader network of processes that may involve studying the coupling between the representations of other people's actions, intentions and affective states, on which individual differences and contextual effects have impact.

VISUAL PROCESSING OF SPEECH BIOLOGICAL MOTION *Philip Servos, Wilfrid Laurier University* – Speech perception can involve visual as well as auditory information processing. Much of this visually intelligible phonetic information is dynamic in nature. Visual displays consisting of speech biological motion stimuli enable subjects to identify more words when the auditory speech is embedded in noise relative to their performance in an auditory-only condition. In contrast, such subjects report fewer words relative to the auditory-only condition when incongruent point-light displays are paired with the auditory signal. In this experiment we used fMRI to investigate whether congruent and incongruent audiovisual speech would modulate cortical responses when subjects performed audiovisual speech integration tasks in which the visual stream consisted only of biological motion stimuli. As in previous work, we observed activity within the left superior temporal gyrus (STG) during silent speech biological motion perception. However, sound also modulated STG activation during speech biological motion. Intriguingly, congruent speech and biological motion led to smaller signal gains in STG relative to when these stimuli were incongruent. Sound also strongly modulated speech biological motion responses in the inferior frontal gyrus. In this region, an opposite pattern was observed - congruent speech and biological motion led to greater signal gains relative to when these stimuli were incongruent.

session two

Numerical Understanding in the Brain: Comparative, Developmental, and Neural Perspectives

Sunday, May 6, 2007

10:00 am - 12:00 pm

Metropolitan Ballroom East

Chairs

Vincent Walsh and Roi Cohen Kadosh, University College London

Speakers

Andreas Nieder, University of Tuebingen

Elizabeth M. Brannon, Duke University

Roi Cohen Kadosh, Ben-Gurion University

Manuela Piazza, INSERM Cognitive Neuroscience Unit, Orsay, France and Center for Mind Brain Sciences, Rovereto, Italy

Summary: The last decade has seen rapid and impressive growth in the cognitive neuroscience of numerical abilities and their precursors in the infant and non-human primate brain. This understanding is based on findings from several different fields that form the core of cognitive neuroscience, such as neuropsychology, neuroimaging, single-cell neurophysiology, child development and comparative studies. The Numerical Understanding Symposium will reflect the depth and breadth of this progress and highlight recent research that has shed light on the neuronal substrates of numerical understanding in infant, adult and non-human primate brains. Nieder will describe findings from single-cell neurophysiology on quantity-coding neurons for spatial and temporal enumeration processes. Brannon will provide behavioral evidence from infants and neurobiological data from rhesus monkeys demonstrating that adult humans share with non-human animals a system for representing number in a language-independent format which emerges early in development. Cohen Kadosh will present imaging data that examines specialized and shared mechanisms for magnitude processing, and the possible necessity of the right parietal lobe in magnitude processing and developmental dyscalculia. Finally, Dehaene will present behavioral experiments and neuroimaging results that examine how our ability to represent numbers is changed by the acquisition of number symbols.

ABSTRACTS

QUANTITY-CODING NEURONS IN THE PRIMATE ASSOCIATION CORTEX *Andreas Nieder, University of Tuebingen* – Evolution has endowed our brains and those of many animal species with simple numerical abilities. Numerical quantity, however, can be derived from different stimulus configurations, and by distinct mechanisms. In multiple-item displays, the number of elements can be assessed 'at one glance' by parallel processing mechanisms operating across spatial arrangements. In contrast, items presented sequentially need to be added one by one. We explored the neuronal underpinning of these enumeration processes by recording single-cell activity in the depth of the intra-parietal sulcus of two monkeys trained to discriminate numerical quantity in visual displays. The results show that numerical quantity in an ongoing spatial or temporal enumeration process is represented by separate populations of neurons; cells responding to the number of sequential items were not tuned to numerosity in multiple-item displays, and vice versa. However, once the enumeration process was completed and the monkeys had to store information in mind, individual neurons represented the cardinality of a set, irrespective of whether it had been cued in a spatial layout or across time. Theses data suggest distinct processing stages for intermediate and final results of enumeration processes in the primate parietal cortex.

FROM LOOKING-TIME MEASURES TO SINGLE-UNIT RECORDING IN THE MONKEY BRAIN: WHAT HUMAN BABIES AND MONKEYS TELL US ABOUT THE NATURE OF MATHEMATICAL THINKING *Elizabeth M. Brannon, Duke University* – In my talk I will describe behavioral and neurobiological data that demonstrates that adult humans share with nonhuman animals a system for representing number as language-independent mental magnitudes and that this system emerges early in development. In the first series of experiments I will illustrate how human infants represent and compare numerosities using a ratio-dependent system. In the second series of experiments I will describe behavioral data that indicates that rhesus monkeys represent number independently of the sensory modality in which number is experienced and perform calculations such as ordering and addition on their numerical representations. Finally I will describe a population of single neurons in the lateral intraparietal area (LIP) of the macaque brain that respond monotonically to the number of elements, from 2-32, within their receptive fields. Half of the number selective neurons respond maximally to large values and decrease firing rate as number decreases and half do the reverse. These LIP neurons may serve as an accumulation stage in numerical processing and may provide inputs to the populations of neurons, described by Nieder and colleagues, in parietal and prefrontal cortex that are sensitive to cardinal numerical value.

SHARED AND SPECIALIZED NEURONAL SUBSTRATES FOR MAGNITUDE PROCESSING *Roi Cohen Kadosh, Ben-Gurion University* – Are human beings equipped with a special mechanism of numerical processing or a general mechanism for magnitude, independent of their content? Knowledge about the specificity of numerical processing is of importance in regard to evolution and the development of numerical understanding but it also has important clinical implications. For example, it is essential in devising adequate rehabilitation and treatment plans for individuals suffering from developmental and acquired dyscalculia. I will describe the use of conflict situations as a powerful method for exploring differential processing in general and of magnitudes in particular. I will present converging evidence, from functional magnetic resonance imaging (fMRI) and event-related potentials (ERP), suggesting that both shared and distinct magnitude mechanisms exist. Which mechanism is employed depends on the task requirements and more specifically, on the cognitive load created by the task. I will present findings from transcranial magnetic stimulation (TMS) in which TMS-induced dyscalculia demonstrates the crucial role of the right parietal lobe in dyscalculia, as well as in magnitude processing in general.

HUMAN NUMBER SENSE AND THE ACQUISITION OF NUMBER SYMBOLS *Manuela Piazza , INSERM Unit 562* – Humans possess a non-verbal system of number sense, which provides a mental representation of approximate quantities. Most but not all cultures also acquire number words and digits, which support exact representation of small and large numbers. I shall present behavioral experiments (some of which were conducted in the Munduruku, an Amazon people with a reduced number lexicon) and neuroimaging results that probe how our ability to represent numbers is changed by the acquisition of number symbols. The results bear upon how the brain solves the 'grounding problem' for numbers

session three

Context-sensitive Neural Dynamics and Cognitive Control: New Insights from Information Theory

Sunday, May 6, 2007

3:00 pm - 5:00 pm

Metropolitan Ballroom West

Chair

Francisco Barcelo, ***Institut Universitari d'Investigacio en Ciencies de la Salut (IUNICS) and Universitat de les Illes Balears (Mallorca, Spain)***

Speakers

Etienne Koechlin, ***Inserm U742, Ecole Normale Supérieure***

Angela J. Yu, ***Princeton University***

Sven Bestmann, ***University College London***

Francisco Barcelo, ***University of California at Berkeley***

Summary: Context shapes sensation, cognition and behavior but the neural bases of these modulations are not well understood yet. Cognitive neuroscientists have gradually begun to embrace new computational methods to describe, explain and predict large-scale neural interactions between exogenous and endogenous sources of contextual information throughout a multiplicity of hierarchical representations in the brain. The emerging picture leads to an increasingly general and biologically plausible framework for integrating mind-brain relationships from research fields as apparently distinct as visual perception, motor learning and decision-making. This symposium presents four complementary views of current research into the neural mechanisms of contextual processing, going from the computational modeling of neuromodulatory systems to brain imaging of normal cognition and lesion studies in humans.

ABSTRACTS

A THEORY OF COGNITIVE CONTROL IN THE LATERAL PREFRONTAL CORTEX *Etienne Koechlin, Inserm U742, Département des Etudes Cognitives, Ecole Normale Supérieure* – The lateral prefrontal cortex (LPFC) subserves cognitive control, i.e. the ability to select actions according to the context in which the agent is acting. In this talk, I will describe a theory describing the overall architecture of human lateral prefrontal functions underlying cognitive control and based on recent neuroimaging results. We develop an information-theoretic approach to cognitive control that explains how cognitive control works as a unitary function though operating through multiple, interacting functional components implemented in distinct LPFC regions. We show that the LPFC implements three major temporal dimensions of control, namely the synchronic, diachronic and polychronic dimension, from posterior to polar LPFC regions. Furthermore, we show that within the synchronic dimension, the posterior LPFC regions, i.e. Broca's area and its right homologue, form a modular control system operating according to the hierarchical structure of action plans. Thus, the theory especially suggests a basic segregation between two embedded prefrontal executive systems involved in the hierarchical and temporal organization of action and thought.

UNCERTAINTY, NEUROMODULATION, AND ATTENTION *Angela J. Yu, Center for the Study of Brain, Mind, and Behavior, Princeton University* – Uncertainty in various forms plagues our interactions with the environment. In a Bayesian statistical framework, optimal inference and prediction, based on unreliable observations in changing contexts, require the representation and manipulation of different forms of uncertainty.We propose that the neuromodulators acetylcholine and norepinephrine play a major role in the brain's implementation of these uncertainty computations. Acetylcholine signals expected uncertainty, coming from known unreliability of predictive cues within a context. Norepinephrine signals unexpected uncertainty, as when unsignaled context switches produce strongly unexpected observations. These uncertainty signals interact to enable optimal inference and learning in noisy and changeable environments. This formulation is consistent with a wealth of physiological, pharmacological, and behavioral data implicating acetylcholine and norepinephrine in specific aspects of a range of cognitive processes. Moreover, the model suggests a novel class of attentional cueing tasks that involve both neuromodulators, and shows how their interactions may be part-antagonistic, part-synergistic.

USING INFORMATION THEORY TO MODEL DECISION IMPLEMENTATION IN THE MOTOR SYSTEM BASED ON CONTEXTUAL SENSORY INFORMATION *Sven Bestmann , Functional Imaging Laboratory, Institute of Neurology, University College London* – Information theory (IT) provides an objective quantitative basis to model the predictability of uncertain events. IT measures of contextual uncertainty (or predictability) have recently been used to show parahippocampal response to the probabilistic context of sensory information during implicit learning. Here, measures of uncertainty predicted regional responses in these learning related brain regions. Moreover, recent studies have revealed regionally-specific correlates of decision-making based on uncertainty of sensory inputs. Less is known about how sensory context, and decision-making, shape activity in the motor system to optimize action, the essence of behaviour and ultimate purpose of any learning and perceptual inference. We varied stimulus-response contingencies in a motor preparation paradigm whilst measuring corticospinal excitability and cortical activity with transcranial magnetic stimulation (TMS) and magnetoencephalography (MEG), to investigate the cortical signatures of behavioural optimization, or “decision implementation” in the context of uncertainty. We show that IT measures of sensory context predict activity of motor structures, suggesting behavioural optimization according to the predictability of the forthcoming motor act. Critically, IT provides an objective quantitative model whose predictions can be compared with competing models (explanations) of neuronal responses using classical and Bayesian model comparison.

AN INFORMATION THEORETIC APPROACH TO CONTEXT CODING AND ENTROPY CONTROL IN THE HUMAN PREFRONTAL CORTEX *Francisco Barcelo, Robert T. Knight, University of California at Berkeley* – Context shapes human perception, thoughts and actions, but little is known about the neural mechanisms of these modulations. Here we addressed the role of lateral prefrontal cortex (PFC) in the updating and online maintenance of context from an information theoretic perspective, following predictions from an integrative model of PFC function (Miller & Cohen, 2001). Ten patients with lateral PFC lesions and ten controls responded to visual targets within a background of repetitive and novel distracters in two different task contexts. In a predictable context, targets were always preceded by a novel distracter, whereas this temporal contingency was removed in an unpredictable context condition. Behavioral and electrophysiological evidence revealed a complex pattern of deficits in the selection and suppression of familiar versus novel information, mostly apparent at the visual field contralateral to PFC damage. A stereotyped sequence of transient brain responses was bilaterally disrupted also during updating to novel neural representations in working memory. We conclude that damage to a common superordinate PFC representation of task-set information may cause a cascade of deficits in the control of response entropy, suggesting that both intra- and interhemispheric PFC-dependent modulations are critical for the flexible and efficient control of goal-directed behavior in humans.

session four

Projecting the Past Into the Future: The Cognitive Neuroscience of Prospective Thought

Sunday, May 6, 2007
3:00 pm - 5:00 pm
Metropolitan Ballroom East

Chair

Malia F. Mason, Martinos Center for Biomedical Imaging, MGH

Speakers

Daniel L. Schacter, *Harvard University*
Kathleen McDermott, *Washington University, St. Louis*
Randy L. Buckner, *Howard Hughes Medical Center*
Moshe Bar, *Harvard Medical School, Massachusetts General Hospital*

Summary: Humans spend a significant amount of time simulating possible future events, yet the bulk of cognitive neuroscience research has focused on how humans re-experience past happenings. Such an oversight is surprising as future-oriented thought makes it possible for humans to anticipate events, formulate strategies based on previous experiences, and override momentary needs in pursuit of longer-term goals. In this symposium we present findings that suggest the brain evolved sophisticated mechanisms for envisioning the future. Schacter's work suggests that to deal effectively with the future people utilize the psychological and neural processes involved in remembering the past. Based on her recent findings, McDermott suggests that the ability to envision future events involves the simulation of behavior and the reinstatement of visuo-spatial contexts. Bar presents a framework linking perception, memory and predictions and argues that that the mind is constantly anticipating "what's next" based on analogies with past experiences. Finally, Buckner will present data suggesting that one fundamental function of the brain is simulating alternative strategies and perspectives. As a package, these findings suggest that one core component of human cognition is anticipating possible future scenarios based on memories of past events.

ABSTRACTS

REMEMBERING THE PAST AND IMAGINING THE FUTURE: THE CONSTRUCTIVE EPISODIC SIMULATION HYPOTHESIS

Daniel L. Schacter, Donna Rose Addis; Harvard University – Although studies of episodic memory have focused on remembering the past, an important function of episodic memory is to allow individuals to simulate or imagine future scenarios. We present fMRI evidence concerning the neural regions that mediate the construction and elaboration of past and future events. Participants were cued to construct a past or future event; once participants had the event in mind, they elaborated on it. Though there were some neural differences related to the construction of past and future events, elaboration of these events was characterized by striking overlap in regions comprising the autobiographical memory retrieval network. We link these and related data to observations indicating that episodic memory is a constructive process that is prone to distortion. According to our constructive episodic simulation hypothesis, simulation of future episodes requires a system that can draw on the past in a manner that flexibly extracts and re-combines elements of previous experiences, sometimes producing memory distortions that reflect the operation of adaptive processes.

ENVISIONING THE FUTURE THROUGH SIMULATION AND REINSTATEMENT OF CONTEXT *Kathleen McDermott, Karl Szpunar, Washington University, St. Louis* – The ability to envision specific future episodes is a ubiquitous mental phenomenon that has seldom been discussed in the neuroscientific literature. We consider design issues arising when trying to investigate this capacity and present data on the topic. While undergoing functional magnetic resonance imaging (fMRI), subjects were instructed to use event cues (e.g., birthday) as a starting point for envisioning personal future event, for recollecting a past event, or for imagining an event involving a familiar individual. Two sets of consistent activity patterns emerged. We conclude that previous research on simulation of behavior and reinstatement of visuo-spatial context may help to tentatively inform our findings, although definitive statements regarding this under-explored area await future research.

A SHARED BASIS FOR ENVISIONING THE FUTURE, REMEMBERING THE PAST, AND CONCEIVING THE VIEWPOINT OF OTHERS *Randy L. Buckner, Howard Hughes Medical Center* – When thinking about the future or the upcoming actions of another person, we mentally project ourself into that alternative situation. Accumulating data suggest that envisioning the future (prospection), remembering the past, conceiving the viewpoint of others (theory of mind), and possibly navigation reflect the workings of the same core brain network. These abilities emerge in development at a similar age and share a common functional anatomy that includes frontal and medial temporal systems traditionally associated with planning and episodic memory. All require us to use past experiences to simulate an alternative perspective. Recent imaging data further suggest that activity increases during passive states and lapses in attention (the default mode) are likely associated with the same core anatomy, raising the possibility that we spend much of our time considering the future and conceiving alternative perspectives. This bias toward a processing mode that shifts our perception from the present to simulated perspectives has far-reaching cognitive and physiological consequences.

PREDICTIVE BRAINS, INTUITIVE MINDS *Moshe Bar, Harvard Medical School, Massachusetts General Hospital* – Rather than passively "waiting" to be activated by sensations, I propose that the human brain is an active organ constantly busy generating predictions that approximate the immediate, directly relevant, future. Building on previous work, this proposal posits that rudimentary information is first extracted rapidly from a perceptual input, and then used to derive analogies, linking the input with the most similar representations in memory. The linked stored representations in turn selectively activate the associations that are relevant in the specific context, which provides focused, testable predictions. These predictions facilitate perception and cognition by pre-sensitizing representations all the way downstream to primary cortices. Predictions that involve more complex information, such as those required in social interactions, are a product of additional simulations that operate in parallel on segments of the input. We perceive the predictions as "intuitions" with varying levels of awareness and specificity. I will propose candidate neural underpinnings, potential computational constraints and links to known behavioral manifestations. Such an associations-based predictive framework can explain a wide range of phenomena, ranging from recognition to first impressions to creativity, and from the brain's "default mode" to a host of mental disorders.

session five

The Neuroeconomics of Simple Choice

Monday, May 7, 2007

10:00 am - 12:00 pm

Metropolitan Ballroom West

Chair

Antonio Rangel, *California Institute of Technology*

Speakers

Joseph W. Kable, *NYU*

Read Montague, *Baylor College of Medicine*

John O'Doherty, *California Institute of Technology*

Antonio Rangel, *California Institute of Technology*

Summary: Central to most theories of decision-making is the notion that choosers behave as if different outcomes have different subjective desirabilities. In economics, this notion is formalized in revealed preference theory, where choices are used to infer the 'utilities' of different outcomes. In a roughly similar way, most alternatives to revealed preference theory (from prospect theory to actor-critic models) posit a stage at which all the characteristics of an outcome (such as magnitude, probability, delay, etc) are combined into a single measure of the desirability of that outcome. This symposium summarizes the recent evidence from the nascent field of neuroeconomics suggesting that the neural mechanisms for making simple choices include representations of the subjective desirability of outcomes in a way that

closely parallels economic notions of utility or preference. Support for this hypothesis, in a variety of different paradigms, is the finding that neural activity in different parts of the nervous system is monotonically related to the subjective utility of different outcomes—in other words, neural activity matches the behavioral as well as the subjective preferences of the animal.

ABSTRACTS

NEURAL MECHANISMS OF INTERTEMPORAL CHOICE *Joseph W. Kable, Paul W. Glimcher; NYU* – Many everyday decisions involve a choice between outcomes occurring at different times. This intertemporal aspect of choices is important because the subjective value of a potential reward generally declines as the delay to that reward lengthens—a phenomenon known as temporal discounting. We have used detailed behavioral methods in conjunction with measurements of neural activity from functional brain imaging to characterize the mechanisms involved in simple economic choices between monetary gains occurring at different times. Behaviorally, we have found large individual differences in how sharply the subjective value of monetary gains declines with delay. Neurally, we have found that activity in a number of brain regions—including the ventral striatum, medial prefrontal and posterior cingulate cortex—tracks the subjective value of the available gains during choice, in a manner that matches the idiosyncratic preferences for delay of each subject. We have found that this match is precise at all measured delays, not just at either short or long delays. These findings suggest that the ventral striatum and other reward-related regions may represent the subjective desirability of different rewards during choice in a common neural currency that takes into account the time a reward will occur.

EXPERIENTIAL AND FICTIVE LEARNING SIGNALS DURING SIMPLE DECISION TASKS *Read Montague, Baylor College of Medicine* – Neuroimaging experiments have recently exploited reinforcement learning models to track the natural experiential error signals incurred during simple instrumental conditioning tasks. From a computational perspective, these error signals are ideally suited to guide reward-maximizing choices; however, this expectation should be true only for simple reward-harvesting tasks. In more complex environments, many other factors intrude on this simple interpretation. Two particularly vexing cases include environments where rewards are non-stationary as a function of time or choice history and environments where simple 'model-free' reinforcement learning models are inadequate to capture the complexities apparently required by the underlying representations. Here, we present a series of decision-making experiments where reward structures are non-stationary as a function of subjects' choices. These experiments illustrate how both experiential and fictive error signals appear during more naturalistic reward-harvesting experiments in human subjects. The results show that both experience and counterfactual experience engage similar, but distinguishable neural responses, yet they open up several unsolved problems related to habit-learning and goal-directed learning.

REINFORCEMENT LEARNING MECHANISMS IN THE HUMAN BRAIN: INSIGHTS FROM MODEL-BASED FMRI *John O'Doherty, Caltech* – It is axiomatic that most animals including humans have a propensity to seek out rewards and avoid punishments. Central to the organization of such behavior is the ability to represent the value of rewarding and punishing stimuli, establish predictions of when and where such rewards and punishments will occur and use those predictions to form the basis of decisions that guide behavior. Interest in the computational and neural underpinnings of such learning processes has surged in recent years. This interest can be attributed in large part to the observation that the phasic activity of dopamine neurons bears a remarkable similarity to prediction error learning signals derived from a family of abstract computational models collectively known as reinforcement learning (RL). In RL, prediction error signals are used to update predictions of future reward for different actions. These values are then compared in order to implement action selection. In this presentation I will outline evidence from functional neuroimaging studies in humans for the existence of RL related signals in the human brain during both reward and punishment learning. Although standard RL models can account for a wide range of human and animal choice behavior, these models do have important limitations. One such limitation is a failure to account for higher order structure in a decision problem. In the latter part of the talk I will present behavioral and neural evidence for the existence of an additional computational mechanism in the brain that guides action selection under circumstances where higher order structure exists such as an interdependency between actions. This system appears to use knowledge of the abstract structure of the decision task in order to make choices and may exist co-operatively or competitively alongside standard RL. This latter system may underlie the human capacity for abstract strategizing and complex social exchange.

NEURAL MECHANISMS OF SIMPLE CHOICE *Antonio Rangel, Caltech* – Almost all models of decision-making assume that choices are made in two stages: first a decision value (DV) is computed for each alternative, then the DVs are compared to generate a choice. We study the neural mechanisms underlying the first set of computations in simple choice situations. These types of choices are defined by the following characteristics: individuals choose between two highly familiar items, the chosen object is consumed immediately, there is no uncertainty about the costs and benefits generated by the items, and the individual faces no self-control problem regarding their consumption. In this talk we will present results from a series of fMRI experiments that combine tools from experimental economics and cognitive neuroscience to identify brain areas whose activity tracks measured DV. One of the main difficulties in finding neural correlates of DVs is that one needs a trial-by-trial measure of DVs. A key innovation of these experiments is the use of incentive compatible Becker-DeGroot auctions to reliably measure DVs on each trial.

session six

The Role of Parietal Cortex in Memory Retrieval

Monday, May 7, 2007

10:00 am - 12:00 pm

Metropolitan Ballroom East

Chair

Alumit Ishai, *University of Zurich, Switzerland*

Speakers

Randy L Buckner, Harvard *University, Howard Hughes Medical Institute*
Alumit Ishai, *University of Zurich, Switzerland*
Roberto Cabeza, *Duke University*
Michael Rugg, *UC Irvine*

Summary: Early functional brain imaging studies of episodic memory focused predominantly on medial temporal lobe and prefrontal structures, whereas posterior parietal cortex was implicated in many tasks that required space-based attention, mental imagery, and motor intention. The precuneus, posterior cingulate, intraparietal sulcus and inferior parietal lobule were therefore considered part of the parieto-frontal 'attentional' network. Recent studies of episodic retrieval, however, have shown that parietal regions are activated in various memory-related processes, such as the old/new and remember/know effects. In this symposium, we will present converging empirical evidence from fMRI and ERP studies for the role of parietal cortex in remembering. Specifically, we are going to examine whether recent data support the attention to internal representations, mnemonic accumulator, and output buffer hypotheses, which have been recently proposed to account for the contribution of parietal cortex in memory retrieval. Finally, we will suggest new models of functional dissociation within multiple parietal regions, which mediate distinct memory-related processes.

A B S T R A C T S

EVIDENCE FOR A MEDIAL TEMPORAL ¬ PARIETAL MEMORY NETWORK *Randy L Buckner, Harvard University, Howard Hughes Medical Institute* – Posterior parietal cortex has been traditionally associated with sensory-motor integration and spatial attention. Recent evidence suggests that specific parietal areas participate in memory function. These parietal areas are functionally correlated with the hippocampal formation, dissociable from nearby parietal areas linked to visual-perceptual pathways, and sensitive to manipulations that augment recollective experience. These findings raise the intriguing possibility that there exists a previously underappreciated medial temporal ¬ parietal memory network. I will discuss the implications of this possibility including its importance to understanding Alzheimer¹s disease and how such a network may be similar and different from previously studied parietal networks.

RECOGNITION MEMORY IS MODULATED BY VISUAL SIMILARITY *Alumit Ishai, University of Zurich, Switzerland* – Recognition memory of newly learned pictures is mediated by activation within a distributed cortical network that includes visual, parietal and prefrontal regions. In a series of event-related fMRI studies, naïve, European subjects memorized unfamiliar art paintings or unfamiliar Asian faces, and four days later performed recognition memory tasks in the MR scanner. Old pictures were recognized faster and more accurately than new items, and elicited stronger activation in visual, parietal and prefrontal regions. Modulation by visual similarity was observed in several parietal regions: in the intraparietal sulcus and superior parietal lobule, activation evoked by new pictures decreased with decreased visual similarity to old pictures, whereas in the precuneus new pictures that were visually different from the old ones evoked stronger activation than new items that visually resembled the old pictures. These results suggest that the classification of new pictures as a 'match' or a 'mismatch', based on their visual similarity to old pictures, is processed in parietal cortex, and support the 'mnemonic accumulator' hypothesis, according to which recognition memory decisions are based on the integration of sensory signals.

ROLE OF LATERAL PARIETAL AND POSTERIOR MIDLINE REGIONS IN EPISODIC MEMORY RETRIEVAL *Roberto Cabeza, Center for Cognitive Neuroscience Duke University* – Lateral parietal and posterior midline (posterior cingulate and precuneus) regions are among the most frequently activated regions in functional neuroimaging studies of episodic memory retrieval. Yet, the contribution of these regions to episodic retrieval is still unclear. In this talk three findings that shed light on this issue will be presented. First, episodic retrieval is specifically associated with posterior parietal cortex (pPc) and the posterior cingulate cortex (pCc), whereas other parietal and midline regions are shared with working memory and attention tasks. Second, rostral pPc and ventral pCc are associated with recollection, whereas caudal pPc and dorsal pCc are associated with familiarity. Finally, recollection-related pPc and pCc regions show greater activity for hits than for misses during retrieval but they show greater activity for subsequent misses than for subsequent hits during encoding. This last finding links directly the role in these default mode regions to episodic retrieval. These results suggest that the contributions of pPc and pCc to episodic retrieval are related to attention to internal representations, with this attention enhancing retrieval success and recollection.

LATERAL PARIETAL CORTEX: A ROLE IN THE REPRESENTATION OF RECOLLECTED INFORMATION? *Michael Rugg, UC Irvine* – From the earliest neuroimaging studies of memory onwards lateral parietal cortex, especially on the left, has been found to be active during successful memory retrieval. More recently, event-related fMRI, together with behavioral procedures that permit recognized test items to be segregated according to whether recognition was accompanied by retrieval of episodic information (recollection), have allowed retrieval-related parietal activity to be investigated in detail. It is now clear that the lateral parietal region contains at least two functionally dissociable regions. One, in the vicinity of the intra-parietal sulcus, demonstrates enhanced activity for recognized items regardless of the basis for the recognition decision. Other, more inferior regions respond selectively to items recognized on the basis of recollection. Evidence will be presented from fMRI and a complementary ERP study that the activity of these recollection-sensitive regions varies in magnitude with the amount of episodic information that is recollected. It will be argued that these findings are consistent with the proposal that inferior lateral parietal cortex plays a role in representing recollected information, and may act as an 'episodic buffer'.

session seven

Cognitive Regulation of Pain and Affect in the Human Brain

Monday, May 7, 2007

3:00 pm - 5:00 pm

Metropolitan Ballroom East

Chair

Tor D. Wager, ***Columbia University***

Speakers

Luiz Pessoa, ***Indiana University***
Sonia Bishop, ***Cambridge University***
Christian Buechel, ***University of Hamburg***
Tor Wager, ***Columbia University***

Summary: How we think about a situation is perhaps the single most critical factor in determining our emotional response. Though appraisal theorists have long recognized this fact, researchers have only recently begun exploring the neural mechanisms underlying the cognitive generation and regulation of

affect. Recent conceptual and methodological advances now permit the development of mechanistic, brain-based models of how attention, memory retrieval, and working memory can be deployed to both enhance and diminish affect. The speakers in this symposium present data on how pain and affect are represented in the brain and elaborate models of how cognitive processes, including expectancies and attention, modulate these representations. The speakers employ a variety of neuroscience techniques—including fMRI, ERP, and opioid-binding PET—and advanced analysis tools to develop and test mechanistic models, including classifier systems, multivariate connectivity analyses, and structural equation models. A common thread that emerges from the application of these methods is that specific regions in the prefrontal cortex and rostral anterior cingulate are critical for maintaining expectations about affective experience and other contextual information. Attention- and expectancy-related activity in these regions is associated with reduced brain responses in the amygdala and in pain pathways.

ABSTRACTS

DYNAMIC EMOTION PERCEPTION: NEUROIMAGING STUDIES OF VISUAL ATTENTION, AWARENESS, AND PERCEPTUAL DECISION MAKING *Luiz Pessoa, Indiana University* – The processing of emotion-laden information is often described as "automatic", namely, independent of attention and even visual awareness. In a series of studies we have sought to carefully test this idea with both behavioral and fMRI methods. Our findings do not favor the "automaticity" assumption and, instead, reveal that both attention and task relevance (whether a stimulus was a target or a distractor) strongly modulate responses evoked by emotional faces. In more recent studies we have investigated the neural correlates of near-threshold emotional perception. Unlike previous studies, we did not find evidence for differential responses to masked fearful faces. In addition, responses were reliably driven by the subject's percept, and less so by the physical stimulus per se - even in the amygdala. Finally, I will present recent results on the neural correlates of perceptual decision making while subjects performed difficult detection and discrimination tasks. Collectively, these studies show that while emotional stimuli may comprise a privileged stimulus category, their processing is highly dynamic and depends on the interplay of a host of factors that sculpt the associated neural responses, including task context, attention, awareness, and perceptual interpretation.

MODULATION BY ANXIETY OF THE BOTTOM-UP AND TOP-DOWN MECHANISMS IMPLICATED IN ATTENTIONAL CONTROL OVER THREAT DISTRACTORS *Sonia Bishop, Cambridge University* – Recent neuroimaging studies addressing the attentional moduation of the amygdala response to threat have produced discrepant results. In addition to reflecting differences in the paradigms used, variability in findings may be accounted for by differences in participant characteristics such as anxiety. A biased competition model suggests that attentional capture by threat distractors may be determined by the strength of a 'bottom-up' amygdala-centered threat detection signal relative to recruitment of 'top-down' prefrontal control mechanisms to support the processing of task-related stimuli. In a series of studies we explored the modulatory effects of anxiety upon the amygdala and prefrontal response to threat distractors. Our results indicate that state anxiety modulates the amygdala response to task-irrelevant threat stimuli, with high state anxious participants showing an elevated amygdala response to fearful face distractors. Furthermore, this is only observed under low perceptual load, suggesting that state anxiety may act upon an amygdala-driven threat detection system, but that entry to such a system is subject to perceptual capacity limitations. In addition, trait anxiety levels modulate recruitment of prefrontal and anterior cingulate control-related regions, with low trait anxious participants showing greater activation of these regions in response to threat-distractors, particularly under conditions of low perceptual load where these distractors are able to compete for post-perceptual processing resources.

HOW PAIN MODULATES COGNITION *Christian Buechel, University of Hamburg* – This presentation will focus on the interplay between cognition and pain processing. Initial studies have concentrated on how attention-demanding tasks are able to change pain perception. We were interested in the reverse process, namely how pain processing, and processing of negative emotional stimuli, can affect visual processing. The behavioral effects of decreased visual processing were paralleled by BOLD signal changes in the lateral occipital complex, irrespective of the nature of the distracting task (e.g. pain, negative emotions, working memory). However, using analyses of connectivity we could show that the source of modulation for each effect is distinct. We identified the rostral anterior cingulate as a potential modulator in the context of pain, the amygdala in the context of negative emotional stimuli and the inferior parietal cortex in case of working memory. These studies show that affective (pain and emotion) and cognitive (working memory) load seem to act on similar cortical regions, but that the origin of the modulatory signal is domain specific.

EXPECTANCY MODULATION OF PAIN AFFECT: ELECTROPHYSIOLOGICAL EVIDENCE AND OPIOID MECHANISMS *Tor Wager, Columbia University* – Pain is an ideal model system for studying affect because the intensity of noxious input can be quantified, because pain pathways are well-characterized, and because pain is highly modifiable by attention and expectancy. Previously, we found that placebo expectancies engage a frontal cortex-periaquaductal gray (PAG) network and reduce pain-related brain activity in peri-limbic regions. (PAG is centrally involved in opioid production and brain regulation of pain.) In this presentation, I discuss two studies that examine the temporal and neurochemical bases of expectancy-induced pain control. First, I explore the relative contribution of fast, automatic processes to placebo analgesia using laser-evoked ERPs. The results suggest that there may be both fast anti-nociceptive and slower affect-based mechanisms for cognitive regulation of pain. A second study examines the role of opioid systems in expectancy-mediated analgesia using [11-C] carfentinil PET. Opioid activity in PAG, cingulate, and a network of interconnected frontal and limbic regions increased with placebo and was correlated with changes in reported pain. Multivariate analyses revealed that placebo expectancy increased functional integration of prefrontal and limbic opioid systems in general and connectivity between rostral cingulate and PAG specifically. These findings are related to an emerging model of brain systems involved in the cognitive regulation of affect.

session eight

Between Life and Death: Implications of Cognitive Neuroscience for the Mental, Moral and Legal Status of Severely Brain-damaged Patients

Tuesday, May 8, 2007

10:00 am - 12:00 pm

Metropolitan Ballroom West

Chair

Martha J. Farah, ***University of Pennsylvania***

Speakers

Martha J. Farah, ***University of Pennsylvania***

Jon B. Eisenberg, ***J.D., Horvitz & Levy LLP***

Lionel Naccache, ***INSERM Unit 562, France***

Steven Laureys, ***Liege University, Belgium***

Summary: We think of life and death as categorical concepts, but half a century of formal attempts to define death (in terms of respiration, heartbeat, whole-brain function and neocortical function) have forced us to confront the fundamentally graded nature of personhood and personal (as opposed to biological) life and death. In the same period, improvements in medicine have increased the number of people who persist in a state that is neither obviously alive nor obviously dead, the so-called "persistent vegetative state." The premise of this symposium is that some of the important moral and legal questions about such patients are, at root, empirical questions for cognitive neuroscience. Understanding the neural bases of cognition and awareness in normal and severely damaged brains has direct implications for assessing the mental life of such patients. Recent imaging work has suggested that severely brain-damaged patients who show little or no behavioral evidence of cognition may nevertheless manifest evidence of substantial perceptual and mnemonic processing of stimuli in their patterns of brain activation. The symposium will review current work in this area, in the broader context of the philosophical and legal issues.

ABSTRACTS

SCIENTIFIC, EPISTEMOLOGICAL AND ETHICAL ISSUES IN THE STUDY OF MENTAL LIFE AFTER SEVERE BRAIN DAMAGE *Martha J. Farah, University of Pennsylvania* – I will provide an overview, emphasizing the distinction between empirical and conceptual issues and the ways in which basic cognitive neuroscience studies of normal subjects and patient studies are mutually informative. Scientific questions to be addressed include: What neural systems must remain functioning for consciousness? How does cognition, in the sense of information-processing, differ from conscious cognition? Epistemological questions include: How can we know whether someone is conscious? Ethical questions include: What implications does evidence of information processing and of consciousness have for the treatment of such patients?

LEGAL AND BIOETHICAL FRAMEWORKS PERTAINING TO LIFE, DEATH, AND PLACES IN BETWEEN *Jon B. Eisenberg, J.D.,Horvitz & Levy LLP* – The history of bioethical and legal treatment of issues regarding life, death and personhood will be reviewed, along with the cultural and political context of current law. The actual and potential role of brain studies in deciding the many difficult ethical questions in this area will be discussed. The speaker will draw on his own first-hand experiences as one of the attorneys in the Terri Schiavo case and as the surrogate decision-maker for one of his close relatives. (In addition to his work for Michael Schiavo, this speaker has participated in other right-to-die litigation as counsel for a nation-wide group of bioethicists and has argued frequently in a large variety of cases before the California Supreme Court, the California Court of Appeal, and the United States Ninth Circuit Court of Appeals.)

IN SEARCH OF THE NEURAL CORRELATES OF CONSCIOUSNESS *Lionel Naccache, INSERM Unit 562, France* – Starting in the 1970s with the study of blindsight, cognitive neuroscience has attempted to understand the neural bases of conscious awareness. Patient-based research has more recently been joined by functional neuroimaging, and although many questions remain unanswered, certain generalizations are emerging concerning the role of particular brain circuits and states in consciousness. Both the successful generalizations, as well as limitations on our understanding of consciousness and the brain, will be reviewed and integrated in a theoretical "global conscious workspace" model. Illustrative evidence from the speaker's own lab and others will be presented.

IMAGING THE SEVERELY DAMAGED BRAIN *Steven Laureys, Cyclotron Research Centre, Liege University, Belgium* – Brain-dead patients have a predictable lack of brain response to stimulation in the scanner. However, patients who are behaviorally nonresponsive and in what is termed a persistent vegetative state (PVS), also known as "cortical brain death" because of the presumed lack of cortical function, may show systematic brain responses to meaningful stimuli, such as the activation of the fusiform face area by faces. Imaging studies of patients in PVS and related states will be reviewed as they indicate cognition and/or consciousness, including the speaker's September 2006 Science report of a nonresponsive patient whose brain activity indicated that she was following instructions to imagine playing tennis or walking around her home, and the relation of imaging to behavioral evidence of conscious awareness will be discussed.

session nine Implications of Cognitive Neuroscience for Education

Tuesday, May 8, 2007

10:00 am - 12:00 pm

Metropolitan Ballroom East

Chair

Torkel Klingberg, ***Karolinska Institute, Stockholm, Sweden***

Speakers

Adele Diamond, ***University of British Columbia***
Usha Goswami, ***University of Cambridge***
Torkel Klingberg, ***Karolinska Institute, Stockholm, Sweden***
Bruce D. McCandliss, ***Sackler Institute for Developmental Psychobiology***

Summary: Advances in cognitive neuroscience have implications for education from preschool on up. The four presentations in this symposium will illustrate how basic research in neuroscience can be beneficially applied to helping children improve cognitive skills critical for success in school and in life. Two of the presenters (McCandliss and Goswami) will focus on evidence-based approaches to improving children's language skills which produce behavioral improvements and accompanying neural changes. The other two presenters (Diamond and Klingberg) will focus on evidence-based approaches to improving children's executive function skills again with clear behavioral outcomes and evidence on the neural system affected. These presentations will demonstrate how thoughtful design can incorporate factors that measure positive outcomes in classrooms.

ABSTRACTS

TEACHING COGNITIVE CONTROL & EMOTIONAL SELF-REGULATION TO PRESCHOOLERS AND ASSESSING ITS BENEFITS *Adele Diamond, University of British Columbia* – "Self-regulation" and "executive functions" (EF) include core skills such as self-control and cognitive flexibility that are critical for cognitive and social development, and for success in school and in life. Evidence will be presented demonstrating that these skills can be taught and improved by training children as young as 3-5 years of age. Evidence will be presented that the "Tools of the Mind" (Bodrova & Leong, 1996, 2001, 2006) preschool curriculum (a) improves inhibitory control and cognitive flexibility (e.g., task switching) on measures shown to depend, even in young children, on frontal regions (lateral prefrontal cortex, pre-SMA, anterior cingulate, and premotor cortex) as well as on interconnected posterior regions, and (b) generalizes that improvement to contexts different from any encountered previously. Evidence will also be presented that children's scores on cognitive-neuroscience-based EF measures correlated with independently obtained measures of academic achievement; the more a measure taxed EF, the more highly it correlated with academic measures. Tools of the Mind is successful where others have failed because it embeds EF training in all aspects of children's school day, rather than as a separate module, and it focuses on early development versus trying to fight established negative feedback loops or remediating later deficits.

RHYTHM, READING AND DYSLEXIA; GETTING THE BEAT *Usha Goswami, University of Cambridge* – In this talk, I will provide a brief theoretical overview at the cognitive level of reading acquisition and developmental dyslexia across languages. Children's awareness of the sound structure of spoken language ("phonological awareness") is a strong predictor of reading development, and develops at three linguistic levels. These are the levels of the syllable, the rhyme and the phoneme. I will show that syllabic representation is basic to many languages, and that children's ability to recognise syllables and rhymes precedes learning a particular spelling system. Individual differences predict reading development, and children with dyslexia do not develop age-appropriate skills. These children have characteristic and persistent problems in other tasks reliant on the phonological system, such as short-term memory and speeded naming, as well as in literacy. I will argue that dyslexic children in all languages have an underlying auditory deficit that impairs their acquisition of syllabic structures. I will show how EEG can be used to explore individual differences in auditory processing and how neural responses differ in children with and without developmental dyslexia. I will argue that neuroscience enables a prospective neural "marker" for risk for dyslexia that can be used before reading commences and that applies across languages.

COMPUTERIZED TRAINING OF WORKING MEMORY *Torkel Klingberg, Karolinska Institute, Stockholm, Sweden* – Working memory is the ability to retain and work with information during a short period of time. This ability is necessary for a wide range of cognitive functions, such as planning, controlling attention and problem solving. It is also important for academic activities such as mathematical problem solving and reading comprehension. The amount of information that can be retained in working memory – the so-called working memory capacity – increases throughout childhood and adolescence and this development is an important part of general cognitive development. Deficits in working memory can sometimes be seen after head injuries, after preterm birth, and is common in children with attention-deficit/hyperactivity disorder (ADHD). We have developed and tested a computerized method for training working memory. In two studies (Klingberg et al. 2002, Klingberg et al., 2005) children between 7-12 years with ADHD were randomly assigned to use either the treatment computer program for training working memory or a comparison program. Children using the training program improved their working memory significantly. Moreover, this effect seemed to spread to other abilities, such as problem solving and attentiveness in everyday life. School-based trials have also shown that training of working memory improves performance on mathematics and reading comprehension. In a separate study (Olsen et al, 2004) we investigated how working memory training affects brain activity. We measured brain activity with functional MRI in healthy adults while they performed a working memory task, before and after training. We found that task-related activity increased in frontal and parietal regions as an effect of training. This possibly indicates training-induced plasticity in the neural systems underlying working memory.

THE DEVELOPMENTAL STUDY OF BRAIN CIRCUITRY SUPPORTING VISUAL WORD PERCEPTION: INDIVIDUAL DIFFERENCES AND EXPERIENCE DEPENDENT PLASTICITY. *Bruce D. McCandliss, Sackler Institute for Developmental Psychobiology* – Reading is supported by a form of perceptual expertise that has been linked to response properties in left ventral temporal regions. The origins of such cognitive and neural effects and the factors that shape their emergence are informed by three lines of investigations that touch on the development of such responses over the typical course of education, structural-anatomical factors that account for the vast range of individual differences, and training experiments that isolate educational factors that influence the emergence of these physiological effects. Visual word form perceptual expertise in adults is linked to a left lateralized N170 response that is not present in pre-readers, and is slow to emerge over the course of schooling. Individual differences the degree of left lateralization of the N170 correlates with reading ability in children demonstrating typically reading ability, poor reading skills, and dyslexia. DTI studies reveal a similar set of relationships between reading ability and fractional anisotropy within a left temporal white matter tract structure, suggesting a potential pre-cursor influence on the development of reading ability. Finally, training studies contrasting the impact of two educational practices on ERP and fMRI responses in left ventral temporal regions provide evidence that the nature in which educational practices focus attention during learning can influence the development of neural and cognitive responses to visual words.

Graduate Students Present

Monday, May 7, 2007

3:00 - 5:00 pm, Metropolitan Ballroom West

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 Chris Kelland Friesen, North Dakota Sate University. Questions will be at the discretion of each individual speaker.

Speakers:

Lori Astheimer, *University of Massachusetts, Amherst*

Suzanne Dikker and **Hugh Rabagliati**, *New York University*

Mbemba Jabbi, BCN *NeuroImaging Center, Groningen*

Sharna Jamadar, *University of Newcastle, Australia*

Marieke Jepma, *Leiden University, The Netherlands*

Lorina Naci, *University of Cambridge*

Marius Peelen, *University Medical Center, Geneva and University of Geneva, Switzerland*

Melanie Stollstorff, *Georgetown University*

Dagmar Zeithamova, *University of Texas at Austin*

Graduate Students Present Abstracts

ERP INDICES OF TEMPORALLY SELECTIVE ATTENTION DURING SPEECH PERCEPTION *Lori Astheimer, Lisa Sanders; University of Massachusetts Amherst* – Temporally selective auditory attention allows listeners to attend to sounds that occur at specific instants in time, which is critical given the sequential nature of complex auditory stimuli. We examined whether people use temporally selective attention during speech processing to preferentially attend to time windows when unpredictable and therefore informative sounds occur. Based on previous behavioral and electrophysiological studies of differential processing of word-initial syllables, we hypothesized that listeners selectively attend to the times at which word onsets with low cloze probabilities occur. We recorded EEG from native English, right-handed participants as they listened to a 2.5 hour narrative embedded with attention probes (50 ms beeps) occurring at one of 8 time conditions: word onset, 50, 100, or 300 ms before and after word onset, or a random control time. EEG was segmented into 600 ms epochs according to time condition and cloze probability so that typical auditory onset components emerged. The relative amplitude of auditory onset components (P1, N1, and P2) elicited by the probes was measured to index temporally selective attention during speech perception; larger amplitude was interpreted as greater allocation of attention. Results indicate that probes played at word onsets elicit a larger negativity (N1) than probes played at other time intervals. This effect is most pronounced over left hemisphere electrodes. These findings indicate that listeners do use rapidly modulated temporally selective attention to preferentially attend to word onsets, offering a putative mechanism by which we process the rapidly changing acoustic information in speech.

SENSITIVITY TO SYNTAX IN VISUAL CORTEX: AN MEG STUDY *Suzanne Dikker, Hugh Rabagliati, Liina Pylkkänen; New York University* – Language is among the most complex of human cognitive systems, yet its processing is extremely automated and fast. Electroencephalography (EEG) studies have demonstrated that syntactic operations can take effect as early as 130-150ms post-stimulus onset, at which point the presence of an unpredicted word category elicits an early left anterior negativity (ELAN). We employed magnetoencephalography (using a 148-channel whole-head neuromagnetometer) to investigate the neural generators of this effect in word-by-word reading. Subjects read sentences including either an expected or unexpected target word. In two conditions, the target contained overt category-marking morphology- prepositions ('Joe's ABOUT stories Africa') and participles ('The discovery was in the REPORTED'). As a test of whether overt category-marking morphology is a prerequisite for early effects of structural prediction, a third condition contained a bare stem ('the discovery was REPORT'). Surprisingly, we found that expectedness modulates activity already at ~100ms, in visual cortex (visual M100). This early effect was limited to prepositions and participles though, showing that it is not a result of just any mismatch between prediction and visual input. Rather, the visual cortex seems to identify only a limited set of closed class morphemes, which can be compared against the predicted input. In addition to the visual M100 effect, all conditions elicited later, temporally dissociated, increased activity in left anterior and temporal sources, consistent with the previous ERP literature. The finding that the visual cortex monitors syntactic properties of linguistic input may provide a crucial key for understanding how language processing can be so remarkably fast.

NEURAL CORRELATES OF IMAGINING, EXPERIENCING AND OBSERVING GUSTATORY DISGUST AND PLEASURE *Mbemba Jabbi, Jojanneke Bastiaansen, Christian Keysers; BCN NeuroImaging center Groningen* – Theory: There is a growing research interest in the neural correlates of human social behaviour. Simulation, the capacity to transform the feeling states of others onto ones own, synonymous to emotional contagion (Keysers and Gazzola 2006), is often perceived as involving a somatic route (Adolphs et al. 2000; Gallese et al. 2004; Adolphs 2006). On the other hand, theory of mind, synonymous to mentalizing, is often perceived as involving a cognitive route to social emotional perception (Saxe and Powell 2006; for reviews see Frith and Frith 1999; Saxe 2006; Amodio and Frith 2006). Methods: To examine the neural correlates of first person mentalizing, own expereince and social perception of appetitive and aversive emotional experience, we applied an induction paradigm using gustatory stimuli. Participants were exposed to the following emotional inductions during fMRI: (1) scripts that induces the imagination of strong pleasant, disgusting and neutral gustatory experiences, (2) pleasant, disgusting and neutral gustatory beverages and (3) dynamic facial expressions of pleased, disgusted and neutral gustatory experience. Results: We found a common neural substarte involved in the imagination, experience and social perception of disgust and to a lesser extent pleasure in the insula/frontal oppercular cortex. Additionally, prefrontal areas, especially the medial prefrontal cortex, were more involved in the imagination of gustatory experience while the posterior insula and caudate nucleus were biased towards the processing of ones own gustatory experience. Parts of the cingulate cortex and prefrontal areas were more recruited during the social observation of gustatory experience. Conclusion: Together, this results suggest a common neural substrate that is involved in cognitive and affective aspects of social emotional processing. This areas include those initially though to represent processes relevant for simulation. In sum, our results suggest that simulation may to some extent be complementary to mentalizing.

ERP AND FMRI CORRELATES OF ANTICIPATORY TASK SET RECONFIGURATION *Sharna Jamadar, Frini Karayanidis[1], Ross Fulham, Matthew Hughes, Rebecca Nicholson, Pat Michie; University of Newcastle, Australia, Hunter Medical Research Institute, Australia* – Task switching involves rapid alternation between simple tasks and results in larger reaction time for switch than repeat trials. In cued-tasks paradigms, this RT switch cost is reduced when the cue-stimulus interval (CSI) is sufficient to allow preparation in anticipation of a switch trial. A differential ERP positivity for switch as compared to repeat trials within the CSI has previously been associated with anticipatory task-set reconfiguration. The present study investigated fMRI correlates of this effect. Participants (n=24) switched between letter and digit classification tasks using color cues and no cue repetition at a CSI of 700ms. ERP and event-related fMRI data were collected in highly practiced participants. Anticipatory task-set reconfiguration was associated with increased differential switch positivity in cue-locked ERP waveforms, as expected. Differential switch-repeat activation was found in the precuneus, superior parietal lobule and precentral gyrus (all p<.01). Behavioral switch cost was correlated with increased activation in the superior and middle frontal gyri, inferior parietal lobule and postcentral gyrus (all p<.001). Mean amplitude of the ERP differential switch positivity was correlated with activation in the precuneus and postcentral gyrus (all p<.001). Anticipatory task-set reconfiguration was associated with increased positivity in switch relative to repeat ERP waveforms and activation of a network of parietal regions. Activation in some of these regions was correlated with the behavioural switch cost and ERP switch positivity.

THE SIZE OF NUMBER-INDUCED ATTENTION SHIFTS PREDICTS ACTIVATION IN THE POSTERIOR PARIETAL AND INFERIOR FRONTAL CORTEX *Marieke Jepma[1,2], Silke Göbel[3], [1]Leiden University, The Netherlands, [2]York Neuroimaging Center (YNiC), York, UK, [3]University of York, England,* – Endogenous and exogenous orienting of attention has been investigated extensively. Recent behavioural studies have shown that numerical cues induce shifts in spatial attention with smaller numbers cueing for the left side of space and larger numbers for the right side of space, congruently with the numbers' relative position on a putative mental number line (Fischer et al., 2003). We used functional magnetic resonance imaging (fMRI) to identify brain activation during this task, as well as during an endogenous and an exogenous spatial cueing task. In the whole-brain analysis, activation reflecting number-induced orienting (number-cued versus number-neutral blocks) was found in the left inferior parietal lobule and in both inferior frontal gyri. This activation was significant for participants (N=6) who showed the behavioural number cueing effect but not for participants who did not show the number cueing effect (N=5). Furthermore in a region of interest analysis including all participants (N =11) there was a significant correlation (r = 0.67, p < 0.03) between signal change in the left posterior parietal cortex/inferior frontal gyri and the strength of the behavioural effect. The behavioural results suggest that number-induced orienting is similar to endogenous orienting. Our findings suggest a role for the left inferior parietal lobule in orienting attention in external space as well as along an internal number line.

RECURRENT BOTTOM-UP AND TOP-DOWN INTERACTIONS DURING MULTISENSORY OBJECT PROCESSING *Lorina Naci, Emmanuel Stamatakis, Lorraine K Tyler; University of Cambridge,* – This research asks how the brain combines low-level features processed in remote sensory cortices to create meaningful multisensory object representations. Models of visual object processing typically assume a feedforward system in which increasingly complex visual features are processed in the hierarchically organized ventral object processing stream. The integration of multisensory inputs into meaningful object representations additionally involves frontal and antero-medial temporal cortex (Taylor et al., 2006). Here we test the feedforward hypothesis, contrasting it with an alternate hypothesis in which object processing is viewed as an interactive, iterative feedforward and feedback process (Bar et al., 2006). To determine how the key regions involved in the meaningful multisensory integration interact with each other over time, we carried out an EEG study. Subjects performed a one-back same/different audio-visual identity task on auditory, visual, and audio-visual stimuli. We used coherence analysis to investigate any large-scale cortical interactions during multisensory processing that would be expressed as synchronized oscillations between our regions of interests. We found a recurrent pattern of induced coherence in the θ range (4-7 Hz) between (a) frontal and antero-temporal regions and (b) antero-temporal and occipital regions at 150-500 ms, suggesting frontal facilitation of antero-temporal activity, and antero-temporal facilitation of subsequent processing in the visual regions. The theta rhythm has been associated with mnemonic processing and long-range synchronization between distant cortical regions (von Stein & Sarnthein 2000). Our results suggest that the integration of multisensory inputs into meaningful object representations involves the recurrent interaction of top-down and bottom-up processes.

EMOTIONAL MODULATION OF BODY-SELECTIVE VISUAL AREAS *Marius Peelen[1,2], Anthony Atkinson[3], Frederic Andersson[1], Patrik Vuilleumier[1,2]; [1]University Medical Center, Geneva, [2]University of Geneva, Switzerland, [3]University of Durham* – Much brain research on human emotion perception has focused on facial expressions. However, it is increasingly appreciated that body postures may also convey important cues for emotion communication. Using fMRI in 18 healthy subjects, we show that dynamic displays of bodies with various emotional expressions, versus neutral bodies, produce significant activation in two distinct regions of visual cortex with body-selective responses, including the extrastriate body area (EBA) and the recently discovered fusiform body area (FBA). Furthermore, multi-voxel pattern analysis showed that the strength of this emotional modulation was related, on a voxel-by-voxel basis, to the degree of body selectivity, while there was no relation with the degree of selectivity for faces. Across subjects, amygdala responses to emotional bodies correlated with the modulation of body-selective areas. Taken together, these results suggest that emotional cues from body expressions produce topographically selective influences on category-specific populations of neurons in extrastriate visual cortex, and these increases may implicate discrete modulatory projections from the amygdala.

EFFECT OF DOPAMINE TRANSPORTER GENOTYPE AND METHYLPHENIDATE ON WORKING MEMORY IN CHILDHOOD ADHD: A PHARMACOLOGICAL FMRI STUDY *Melanie Stollstorff[1], Jennifer Foss-Feig[1], Edwin Cook[2], Laura Kenealy[3], Mark Stein[2], Chandan Vaidya[1]; 1Georgetown University, [2]University of Illinois at Chicago, [3]Children's National Medical Center* – Children with ADHD exhibit impaired working memory due to functional abnormalities in prefrontal, parietal and striatal regions. Improvements in working memory mediated by methylphenidate (MPH) enhance synaptic dopamine by blocking reuptake by the dopamine transporter (DAT). Polymorphism of the DAT gene (DAT1) influences synaptic dopamine and susceptibility to ADHD such that homozygosity of the 10-repeat-allele (10/10) is more common in ADHD and relates to higher striatal DAT density (and therefore, less synaptic dopamine). We examined whether DAT1 modulates the neural basis of working memory and efficacy of MPH for ADHD. fMRI was performed during N-back performance (2-back vs 1-back) in ADHD (on and off MPH) and control children who were heterozygous (9/10) or homozygous (10/10) for the 10-repeat-allele. Behaviorally, accuracy was higher in the 9/10 group overall and improved more in the 10/10 than 9/10 ADHD children following administration of MPH. In 9/10 Controls, DLPFC, anterior cingulate, striatum, insula and motor cortex were activated. These areas were also activated in 10/10 Controls, but to a lesser extent. 9/10 ADHD group showed weak activation in those areas, but MPH normalized activation levels to that of Controls. In 10/10 ADHD, activation at the group level was weak due to high variability among children. Specifically, children with MPH-induced performance improvement showed activation in those regions. Regional recruitment was atypical in 10/10 ADHD children both on and off-MPH. Thus, DAT1 modulates engagement of the neural network subserving working memory as well as regional involvement mediating efficacy of MPH in ADHD.

CATEGORY LEARNING SYSTEMS: COMBINING BEHAVIOR, COMPUTATIONAL MODELING AND FMRI *Dagmar Zeithamova[1], J. Vincent Filoteo[2,3], Alan Simmons[2], W. Todd Maddox[1], Martin Paulus[2,3]; [1]University of Texas at Austin, [2]University of California, San Diego, [3]VA San Diego Healthcare system* – Traditionally, the fMRI BOLD signal recorded during a cognitive task, such as category learning, is correlated with performance in the task, such as accuracy. However, the same categorization accuracy profile can be achieved using qualitatively different learning strategies that can change over time and that are mediated by different neural circuits. Here we report results from a novel approach that combines computational modeling of each participant's category learning data with their BOLD signal recorded during the category learning task. Fifteen participants performed an information-integration category learning task in the scanner. Their behavioral data were fit individually by a trial-by-trial computational model with a hypothesis-testing subcomponent and a procedural learning subcomponent (based on the COVIS model; Ashby et al, 1998). Separately, brain regions involved in the category learning task were identified using whole brain thresholded voxel-by-voxel analysis. Individual BOLD signals in several identified regions correlated with individual model parameters. Additionally, brain activation patterns differed between participants that relied mainly on the hypothesis-testing subcomponent and individuals that relied mainly on the procedural subcomponent. These observations could not have been made without application of the trial-by-trial model. The results suggest that combining fMRI research with computational modeling of behavioral data within a single study is a promising method that can increase our understanding of the cognitive and neural meaning of parameters in existing models of cognition and may help explain individual variability in brain activation often observed despite equivalent performance.

Poster Abstracts

Poster Session	Date & Time	Set-up Begins	Session Begins	Session Ends	Take-down Complete
A	Saturday 5/5/07	5:00 pm	6:30 pm	8:30 pm	9:00 pm
B	Sunday 5/6/07	*7:30 am	8:00 am	10:00 am	11:30 am
C	Sunday 5/6/07	11:30 am	1:00 pm	3:00 pm	3:30 pm
D	Sunday 5/6/07	3:30 pm	5:30 pm	7:30 pm	7:45 pm
E	Monday 5/7/07	*7:30 am	8:00 am	10:00 am	11:30 am
F	Monday 5/7/07	11:30 am	1:00 pm	3:00 pm	3:30 pm
G	Monday 5/7/07	3:30 pm	5:30 pm	7:30 pm	7:45 pm
H	Tuesday 5/8/07	*7:30 am	8:00 am	10:00 am	11:30 am

* 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 9:00 pm. On Sunday-Monday the doors close and lock at 7:45 pm. On Tuesday, the doors close and lock at 11:30 am. No attendee or exhibitor will be allowed to enter the exhibit hall once the doors are locked.

Poster Session A

Attentional Processes: Auditory

A 1

ERP MEASURES OF AUDITORY SELECTIVE ATTENTION IN CHILDREN WITH AD/HD *Hilary Gomes[1], Martin Duff[1], Virginia Wolfson[1], Walter Ritter[2], Jeffrey Halperin[3]; [1]City College of New York, [2]Nathan S. Kline Institute for Psychiatric Research, [3]Queen College* – Recent models of attention in typically developing and attentionally challenged children have focused on speed and efficiency of attention allocation and the ability to inhibit processing of irrelevant stimuli. Our study examines the event-related potentials (ERP) elicited from children with attention deficit/ hyperactivity disorder (AD/HD) and typically developing children during an auditory selective attention task. These tasks generally require the participant to attend to one of two stimulus streams which are presented concurrently and to respond to target stimuli in the attended stream. An electrophysiological correlate of attentional selection measured in these tasks is the Nd. Nd is the electrically negative difference that results from subtracting the ERP waveform elicited by the standards when they are unattended from those elicited by the same standards when they are attended. Seven AD/HD (5 boys) and eight typically developing children (4 boys) participated. The groups did not differ in age (M = 10 y, 4 m; SD = 18 m) or IQ (M = 102; SD = 12). Channels were defined by frequency (1 KHz, 2 KHz) and ear while targets were of lower intensity in one channel and shorter duration in the other. Preliminary analyses suggest that a robust Nd was elicited from the AD/HD children in the condition with the intensity target, but not in the condition with the duration target. These findings suggest that children with AD/HD are poorer at allocating their attention when focusing on the duration of stimuli than when attending to the intensity.

A 2

BENEFITS OF OPTOKINETIC STIMULATION IN PATIENTS WITH AUDITORY AND VISUAL NEGLECT: TRANSIENT AND PERMANENT EFFECTS *Georg Kerkhoff[1,2], Christian Groh-Bordin[1], Ingo Keller[3], Vera Ritter[2], Frank Artinger[4], Wolfram Ziegler[2]; [1]Saarland University, Saarbruecken, Germany, [2]Clinical Neuropsychology Research Group, Munich-Bogenhausen, Germany, [3]Neurological Clinic Bad Aibling, Germany, [4]University of Applied Sciences, Karlsruhe, Germany* – Unilateral neglect after right cerebral stroke involves visual and auditory impairments in orientation and exploration of contralesional stimuli. Several treatments – mostly focussing on visual neglect - have been proposed: prism adaptation, pharmacological treatments and optokinetic stimulation (OKS). Recently, we showed that repetitive OKS with active tracking of the moving targets ameliorates visual neglect considerably(1). In two further studies we tested the possible benefit of OKS on auditory neglect. Study 1: Twenty patients with auditory (and visual) neglect following a single, righthemispheric stroke were randomly allocated to an experimental (n=10) and a control group (n=10). Both groups showed a comparable right-sided shift of their auditory subjective median plane (ASMP) indicative of auditory neglect. 20 minutes of leftward OKS led to a complete, but transient recovery of their ASMP to normal values. This improvement persisted up to 30 minutes after the cessation of OKS stimulation, indicating a clear after-effect. No immediate or after-effect was seen in the control group. Study 2: Two small samples of neglect patients (N=3 each) received either conventional visual scanning training or OKS training (20 sessions, respectively). Auditory neglect was significantly reduced after OKS training, but not after conventional scanning training. In conclusion, repetitive OKS with active tracking eye movements to the neglected hemispace provides an effective, easy-to-apply, and well-tolerated treatment for patients with multimodal neglect.

A 3

WHEN ABSTRACT KNOWLEDGE MEETS PERCEPTUAL GROUPS IN METRICAL STRUCTURE - BEHAVIORAL AND ERP EVIDENCE FROM MUSICIANS AND NON-MUSICIANS *Shu-Jen Kung[1], Denise H. Wu[2], Daisy L. Hung[1,2], Ovid J.L., Tzeng[1,3]; [1]Institute of Neuroscience, National Yang-Ming University, Taiwan, [2]Institute of Cognitive Neuroscience, National Central University, Taiwan, [3]Institute of Linguistics, Academia Sinica, Taiwan* – People easily extract the embedded metrical structure from a rhythmic pattern, as they tap with music at strong metrical positions effortlessly. Both perceptual grouping and abstract metrical knowledge are hypothesized to contribute to this ability. To independently demonstrate the bottom-up and top-down influence on perceiving metrical sequences, we manipulated the location of the strong metrical position in a perceptual group. Both musicians and non-musicians were examined in a click detection task to further investigate whether musical training modulates these effects. Both behavioral and ERP data showed independent influences from abstract knowledge and perceptual grouping on people's ability to detect an auditory signal. Musicians located the click more accurately and showed larger MMN amplitude when the click coincided with a metrically strong than weak tone, regardless of its location in a perceptual group. This effect in non-musicians, however, was less pronounced and only appeared at the beginning tone in a group. As for the effect of perceptual grouping, both groups of participants located the click more accurately and demonstrated larger MMN amplitude at the beginning of a perceptual group regardless of its metrical position, while only musicians located the click more accurately at the end of a perceptual group when it was on a metrically strong tone. In sum, these results suggest that both perceptual grouping and abstract knowledge are adopted by both musicians and non-musicians, while metrical representation is more salient to musicians. Furthermore, musical training not only enhances abstract metrical knowledge but also heightens the sensitivity of perceptual grouping.

A 4

LEFT-LATERALIZED MODULATIONS OF INFERIOR FRONTAL REGIONS AND VISUAL WORD FORM AREA WHEN ATTENDING TO LANGUAGE IN CHIMERIC WORD-TONE STIMULI *Yuliya Yoncheva, Jason Zevin, Urs Maurer, Bruce McCandliss; Weill Medical College of Cornell University* – To investigate the impact of attention on processing of complex auditory stimuli we created chimeric stimuli - tone triplets imbedded in auditory words - and contrasted BOLD responses to them in two tasks: rhyme judgment and tone-matching. Both tasks induced extensive activations along the superior temporal gyrus (STG), with stronger activity in the left hemisphere. Examining top-down task modulation for rhyme versus tone judgments showed no influence on STG activation, yet did reveal a left-lateralized network including left inferior frontal gyrus (opercular and orbital IFG) and the fusiform visual word form area (VWFA). This pattern of activity is consistent with findings of left opercular regions engaging in phonological processing and the involvement of left fusiform gyrus in orthographic processes, known to be influential in auditory rhyme judgments based on behavioral evidence. Region of interest analyses were conducted relative to baseline rest conditions for each active region and its right homologue. Left opercular and orbital IFG regions showed increased activation only during the rhyming task, whereas increases in right IFG were present for both tasks. The task effects in visual regions, on the other hand, were dominated by deactivations: right VWFA was deactivated in both tasks, while left VWFA was deactivated only in the tone-matching task. Results suggest that top-down selective attention toward linguistic information may operate by modulating left frontal regions. Furthermore, our results imply a role for top-down selective deactivation of visual regions, which plays out differently while focusing on linguistic versus non-linguistic information in complex auditory stimuli.

A 5

EXTRACTION OF ABSTRACT REGULARITIES FROM DYNAMIC AUDITORY STIMULUS SEQUENCES *Alexandra Bendixen, Erich Schröger; University of Leipzig* – Abstract stimulus features are encoded in sensory memory, as shown by the electrophysiological consequences of deviations from abstract regularities (Mismatch Negativity, MMN). Previous studies applied the same abstract regularity over long periods of time. In order to investigate whether abstract regularity extraction also occurs in more naturalistic situations where regularities constantly build up and vanish, we applied a new experimental protocol with dynamic auditory stimulus sequences. Continuous streams of tones were presented which comprised regularities consisting in ascending or descending frequency relations, respectively. Regularity-conforming tone sequences of different lengths (3 to 10 consecutive tones with identical frequency relations) were terminated by deviations in the direction of the frequency change. Subsequent frequency repetitions and alternations made the beginning of the new abstract regularity unpredictable. Independently of the frequency dimension, tone duration varied randomly (200 vs. 400 ms). In successive conditions, subjects performed (a) a choice reaction task to tone duration and (b) a simple reaction task to detected regularity violations. We found that during the duration discrimination task, regularity violations were non-intentionally detected (MMN), elicited an involuntary attention switch (P3a) and attentional re-orientation to the task-relevant stimulus dimension (re-orienting negativity, RON), and influenced behavioral performance in the primary task (reaction time, error rates). During the detection task, the expected sequence of event-related potentials was elicited (MMN/N2b, P3a, P3b); behavioral performance varied according to the length of the regularity-conforming sequence. Results suggest that abstract regularities are extracted from short tone sequences and are utilized for the prediction of forthcoming stimuli.

A 6

SEQUENTIAL TONE DISCRIMINATION WITH IMPLICIT PRESENTATION RULE: AN EVENT-RELATED POTENTIAL (ERP) AND EVENT-RELATED OPTICAL SIGNAL (EROS) STUDY *Chun-Yu Tse, Kathy Low, Jason Agran, Guadalupe Arroyo, Monica Fabiani, Gabriele Gratton; Beckman Institute, University of Illinois at Urbana-Champaign* – This experiment investigated brain responses in sequential tone discrimination by using event-related potentials (ERPs) and event-related optical signals (EROS). Participants, naïve to the implicit presentation rule, responded to high (H) or low (L) frequency tones by pressing buttons. In half of the odd-numbered trials (odd-alternate), the presented tone differed from that of the previous trial, while in the other half (odd-repeat), the tone was the same as that of the previous trial. The odd-alternate and odd-repeat conditions were presented randomly in the odd-numbered trials. In all even-numbered trials, the tone presented differed from that of the previous trial, and thus were potentially 100% predictable. Because there were no cues to indicate whether the trial was odd or even, the usefulness of the even trial predictability was contingent on some internal representation of the sequence. Effects of overall probability (repeat = 25%; alternate = 75%) and trial pair predictability were present in the behavioral data. ERP results showed increased negativity at 200ms (MMN) for the repeat compared to alternate trials, with no difference in early negativity for the odd-alternate versus even-alternate trials. These alternate trials, however, produced differential effects on later positivities (P300) that were dependent on the predictability embedded in the sequential structure. These results indicate that deviance detection and specific evaluation of trial predictability were both operational during stimulus evaluation and that these representations were temporally dissociated. EROS results will address the spatiotemporal dynamics of the neural substrates involved in these two levels of stimulus representation.

A 7

EVENT RELATED POTENTIAL EVIDENCE OF RAPIDLY MODULATED TEMPORALLY SELECTIVE ATTENTION *Lisa Sanders, Lori Astheimer; University of Massachusetts, Amherst* – Spatially selective attention allows individuals to preferentially process subsets of stimuli when more information than can be processed in detail is presented simultaneously at different locations. Temporally selective attention may play an important role in perception when too much information is presented rapidly in time. The current study was designed to determine the extent to which temporally selective attention modulates auditory perception by employing a paradigm parallel to that of many spatial attention studies. Participants were instructed to attend to sounds that occurred at one of three time intervals: short (500 ms), middle (1000 ms) or long (1500 ms), following the onset of a fixation point. Participants responded with a button press when a deviant (20%) target sound was presented at the attended time only. Analysis of ERP waveforms revealed that following the fixation point onset, a negativity distributed over anterior and medial electrode sites increased in amplitude until the attended time. Temporally selective attention modulated early auditory onset components such that the negativity peaking around 110 ms (N1) was larger in amplitude for standard sounds presented at attended compared to unattended times. The N1 attention effect was observed for sounds played at all three cue-target intervals. Furthermore, deviants presented at attended times elicited larger amplitude P3s. These results indicate that temporally selective attention can operate within time windows as small as 500 ms. Additionally, temporally selective attention modulates auditory perception at an early stage of processing similar to what has been shown for spatially selective attention.

Attentional Processes: Other

A 8

WHAT HAPPENS IN BETWEEN? MODULATIONS OF CORTICAL RHYTHMS IN THE INTER-STIMULUS-INTERVAL OF A SPATIAL CUEING TASK *Maja Trenner[1], Markus Bauer[2], Rüdiger Wenzel[1], Manfred Fahle[3], Arno Villringer[1]; [1]Charité Universitätsmedizin Berlin, Germany,[2]Max-Planck Institute for Human Development, Berlin, Germany, [3]Abt. Humanbiologie, Universität Bremen, Germany* – In crossmodal spatial cueing (Posner, M., 1980), the position of a task-irrelevant cue stimulus influences the processing of a succeeding target stimulus from a different modality presented either at the same position as the cue or at a different position. We conducted an EEG study and examined frequency-domain effects associated with spatial attention preceding the target. Subjects underwent periods both of (I.) vibro-tactile (cue) + visual (target) stimulation in a spatial cueing condition and of (II.) vibro-tactile stimulation as a control. Vibro-tactile 60 Hz stimuli were randomly delivered to the index fingers. Bright squares served as targets. Subjects had to decide whether a target appeared in the upper or lower half of the screen. Time-frequency analysis revealed modulations, which were specific to the cueing condition. First, the central beta rebound (18-25 Hz) induced by the somatosensory stimulus was more clearly lateralized (stronger contralaterally). Second, a parieto-occipital alpha suppression (7-13 Hz) occurred and was stronger contralaterally to the attended side. Third, a prefrontal gamma increase (25-35 Hz) was observed and was related to faster mean reaction times. The post stimulus beta rebound has been described (Salenius, S. et al., 1997). Alpha modulations have been demonstrated in visual spatial cueing (Worden, M. et al., 2000). An induced gamma-band activity has been related to top-down-driven cognitive processing (e.g. Tallon-Baudry, C. et al., 1998). We conclude that crossmodally induced shifts of spatial attention not only modulate the response to a stimulus but also the ongoing rhythms before stimulus onset.

A 9

DISRUPTION OF AUDITORY AND VISUAL ATTENTION IN SCHIZOPHRENIA *Susan Wood[1], Geoffrey Potts[1], Laura Martin[1], Delia Kothmann[1], Jennie Hall[2], Jocelyn Ulanday[2]; [1]Rice University, [2]Michael Debakey VAMC* – Disruption of attention is a hallmark symptom of schizophrenia, and event-related potentials have been instrumental in studying this cognitive deficit, particularly the well-described reduction of the P300 component in auditory tasks. Some studies have found sparing of the P300 in visual attention, despite reduction of an earlier attention-sensitive N2 or related component (e.g. N2b), suggesting that auditory attention may be differentially disrupted in schizophrenia and that the N2b may be a more sensitive index of attention disruption. Previous studies used a variety of stimulus presentations and experimental designs in different patient groups. The current study compared visual and auditory attention using both unimodal and bimodal stimulus presentation in the same participants to examine the impact of schizophrenia on attention at both the early N2b and later P300 stages. Twelve patients with schizophrenia and twelve control participants were compared using unimodal auditory and visual oddball tasks as well as attend auditory and attend visual audio-visual bimodal presentation tasks. Both N2b and P300 showed attention effects, being larger to targets than non-targets in all tasks. The N2b was reduced in the patient group in all tasks except the bimodal attend visual task, while the P300 was spared in the patients in all tasks. Early auditory and visual attention, as indexed by the N2b, are impaired in patients with schizophrenia, with auditory attention more susceptible to disruption, even when later attention, indexed by the P300, is intact. This P300 sparing may be due to effortful compensation by the patients for earlier attention deficits.

A 10

JUDGMENT OF TEMPORAL ORDER AND RELATIVE SIZE IN VISUAL EXTINCTION *Alessia Folegatti[1], Elaine Wencil[2], Anjan Chatterjee[2]; [1]University of Turin, Italy, [2]University of Pennsylvania* – Patients with right brain damage can show a lateralized deficit of spatial attention. Recent studies claim that temporal processing can also be disrupted in these patients raising the possibility that spatial and temporal information is integrated and coded by the same brain area. Consistent with this view, the Theory of Magnitude suggest that space, time and size could be all coded by a common magnitude estimator, presumably located in the parietal cortex. According to this theory, brain damage in this regions should impair all three dimensions. To test this hypothesis, a temporal order and a relative size judgment task were used. Two patients suffering from left neglect and extinction were asked to judge the temporal order and the relative size of two stimuli presented either in the two hemifields or within the same hemifield. The results showed that time and size judgement may be dissociated in right brain damaged patients, not supporting the aforementioned theory. Moreover, patients with left extinction judged ipsilesional stimuli as occurring before contralesional ones, showing a strong effect of space representation on time perception. More importantly the time order judgement is worse in the left hemifield and may be amelioreted by greater separation in space. These findings provide further evidence that right temporal-parietal damage produces a processing refractory period for stimuli in contralesional space that extends in both space and time. Right temporal-parietal cortex may be crucial in integrating the spatial and temporal representation of stimuli, but might not generalize to magnitudes of size.

A 11

PHONOLOGICAL RELATEDNESS INFLUENCES TOP-DOWN PICTURE PROCESSING IN VISUAL CORTEX *Mart Bles, Francesco Gentile, Bernadette Jansma; Maastricht University* – In everyday life, we face the difficult task of selecting stimuli that are important to us from a myriad of stimuli. Most attention research focuses on visual properties of objects we see, and the effects they have on stimulus selection. However, objects do not solely consist of visual properties: they also have names and meanings, which may influence the selection process. In this fMRI study, subjects viewed blocks of two simultaneously presented pictures which were either phonologically related (e.g. cat-cap) or unrelated (e.g. cat-pill). One of the pictures had to be ignored while performing one of three tasks on the other picture. Two phonological tasks required subjects to indicate whether the name of the attended picture started or ended with a certain target letter (onset and offset task, respectively). The third task was a categorization task where subjects indicated whether the attended picture belonged to a target category (e.g. fruit, furniture). In a control condition, both pictures had to be ignored while performing an attentionally demanding task at the fixation point. Phonologically related picture pairs lead to lower BOLD-signal changes in lower visual areas and LOC than unrelated picture pairs. Strongest effects were observed when subjects performed the onset judgment task. These results indicate that top-down attentional modulation of visual cortex can be driven not only by visual stimulus characteristics and task demands, but also by higher-order properties like phonology.

A 12

RESTING STATE NETWORKS IN ADHD AND CONTROLS *Lucina Q. Uddin[1], A.M. Clare Kelly[1], Bharat Biswal[2], Michael P. Milham[1], F. Xavier Castellanos[1]; [1]The Phyllis Green and Randolph Cowen Institute for Pediatric Neuroscience, NYU Child Study Center, New York, [2]University of Medicine and Dentistry of New Jersey, Newark, NJ* – Structural and functional imaging studies suggest that Attention Deficit/Hyperactivity Disorder (ADHD) may be associated with alterations in functional connectivity. Recently developed methods for analysis of resting state data have provided a new way to characterize spontaneous neural activity and its effect on behavior. Independent component analyses suggest the existence of at least 5 functionally significant networks identifiable in resting fMRI data (De Luca, 2006), only two of which have been examined in ADHD to date. Here we further examine ADHD-related differences in functional connectivity within five previously identified resting state networks (RSNs), as well as interactions between them. We obtained 237 EPI whole-brain images (TR = 2000 ms; TE = 30ms; Flip angle = 90, 39 slices) while subjects relaxed with eyes open in the scanner. Data was preprocessed using FEAT, part of FSL (www.fmrib.ox.ac.uk). Image processing consisted of slice timing correction, motion correction, spatial smoothing, and temporal bandpass filtering. We seeded each previously identified RSN (De Luca, 2006) using an ROI mask, and used each mask to extract an average timeseries for each RSN for each subject. Multiple regression analyses were then carried out using FEAT, including the 5 RSN seed timeseries regressors. Group-level analyses were carried out using FLAME. Preliminary data suggests a possible compromise between lateral prefrontal and default mode networks in ADHD compared to control subjects. Additional data collected from ADHD subjects will allow further characterization of these differences.

A 13

GOING AWOL IN THE BRAIN: MIND-WANDERING REDUCES THE CORTICAL PROCESSING OF THE TASK ENVIRONMENT. *Jonathan Smallwood[1], Jonathan Schooler[2], Emily Beech[2], Todd Handy[2]; [1]University of Aberdeen, [2]University of British Columbia* – Attention to the outside world waxes and wanes, producing reliable oscillations between periods of comparatively high and low externally-oriented attention. This latter state in particular - where attention is disengaged or decoupled from the constraints of the task - we describe as "mind wandering" (Smallwood and Schooler, 2006). Recent psychological, and, theoretical models of cognitive neuroscience converge on the assumption that when ongoing thought is unconstrained by the task environment it competes with processing of external task relevant information in working memory, although to date a complete demonstration has evaded scientists because of a lack of a direct marker for internal experience. Here we show that periods when the mind has wandered from the constraints of the task are associated with reduced cortical analysis of the task environment. We present the first combined behavioral and subjective evidence that the amplitude of the p3 event related potential was reduced during mind-wandering. Our data thus converge on the conclusion that not only does our attention to the outside world vary in intensity over time, but that when ongoing thought is not constrained by the task environment cognitive analysis afforded to events in the extrapersonal environment is reduced.

A 14

FUNCTIONAL GRADIENTS FOR MOTOR AND COGNITIVE PREDICTION IN THE HUMAN BRAIN *Uta Wolfensteller, Ricarda I. Schubotz, D. Yves von Cramon; Max Planck Institute for Human Cognitive and Brain Sciences* – Previous findings suggest posterior-anterior functional gradients for motor and cognitive processes from premotor to prefrontal areas rather than an abrupt change. Here, we were interested in the general cerebral overlap and distinctiveness of cognitive and motor tasks that share a predictive component. We employed serial prediction tasks requiring the prediction of stimulus patterns (cognitive prediction) and motor imagery tasks requiring the prediction of own movements (motor prediction). In principal, one could expect three patterns: (a) Comparable activation in both tasks; (b) Preference for one task; and (c) Selectivity for one task. Conjunction analyses and direct contrasts of the fMRI data revealed both comparable and task-selective activity in the medial frontal cortex. More specifically, motor prediction selectively engaged the supplementary motor area. Anteriorly adjacent parts of the pre-supplementary area and the rostral cingulate zone were comparably engaged by cognitive and motor prediction, i.e. activity did not differ between the two task types. In contrast, a more anterior part of the frontomedian cortex was selectively engaged by cognitive prediction. Together, the present findings fit nicely with previous data showing functional gradients from more motor-related to more cognitive processes in medial frontal areas – including a transition area located in between which subserves both types of processes.

A 15

TOO STRESSED TO LISTEN: AN ELECTROPHYSIOLOGICAL MEASURE OF MULTI-TASKING WHILE DRIVING *Jonathan Page, Kasee Page; Minnesota State University* – One effect of stress on the attentional system is a narrowing of focus. Depending on the task and the circumstances, this can be advantageous or disadvantageous. A specific disadvantageous example is when a police-officer is pursuing a suspect in a car. In this case, the narrowing of attention can have serious or even fatal consequences. Using students and instructors from London's police driving school at Hendon, we tested the effect of stress on an officer's ability to listen while driving by measuring the P300 recognition response to auditory distracters. Brain activity was measured to standard (p = 0.85) and target (p = 0.15) audio tones while participants drove a predetermined route of figure-eights on the training skid pan. Participants were instructed to covertly count the number of target tones in six successive trials. Using heart rate, behavioral, and self-report measures, students were found to be experiencing performance-related anxiety during this task. This was due in part to an evaluative instructor being in the vehicle. The result was poor student performance in attending to the distracter, which is objective evidence for visual tunneling. However, instructors—who were not experiencing performance stress—were able to successfully shift their attention between negotiating the skid pan course (driving) and counting the target tones (listening). Moreover, instructors most familiar with the driving course were the most successful at this task. This suggests that stress does affect attention while driving, and further implies that practice/training facilitates the ability to multi-task while driving.

A 16

P3A AND P3B SUPPRESSION 30 YEARS POST-CONCUSSION: A DOUBLE COHORT STUDY. *Louis De Beaumont, David Boutin, Martin Theriault, Dave Ellemeberg, Maryse Lassonde; Centre de recherche en neuropsychologie expérimentale et cognition, Université de Montréal* – Background: A recent study showed that retired professional football players with three or more concussions had a fivefold prevalence of MCI diagnosis compared with retirees without a history of concussion (Guskiewicz et al. 2005). In parallel, recent ERP studies disclosed persistent P3 amplitude suppression in active University football players who sustained their last concussion years prior to testing despite normal performance on neuropsychological measures (De Beaumont et al. submitted). Objectives: To assess the effects of aging with a remote history of sports concussion on neuropsychological tests and on an oddball paradigm used to elicit both P3a and P3b waveforms. Participants: 20 former University football/hockey players between the ages of 50-65 with a history of concussion were matched according to age, education and socioeconomic status with former teammates with no history of neurological insults. Participants were screened for the following exclusion criteria: Currently taking medications, history substance abuse, psychiatric illness, learning disability, neurological history, and TBI unrelated to contact sports. Results: We found that former athletes with a history of concussion showed significant P3a and P3b suppression coupled with lower scores on memory and attention-mediated neuropsychological tests. In addition, Pearson correlations suggested that electrophysiological and neuropsychological differences observed between those with a prior concussion history and controls were exacerbated with age. Discussion: Residual P3 suppression observed in young/active University football players is still observed more than 30 years later and the process of aging not only exacerbate this P3 size difference, but it is associated with the early manifestation of clinical symptoms related to memory and attention.

A 17

TIME AND MUSIC: ATTENTION TO EITHER DURATION OR PITCH ACTIVATES SIMILAR CORTICAL STRUCTURES *Elaine Wencil, Eugene Narmour, John Detre, Anjan Chatterjee; University of Pennsylvania* – Neuropsychological data have suggested that different subcomponents of music perception, such as rhythm and pitch, can be independently disrupted following brain injury. However, a paucity of research examining the neural representations of musical components (i.e., neural structures supporting pitch and duration) remains. We previously demonstrated that the inferior parietal cortex mediates attention to brief durations. It remains unknown whether the inferior parietal regions activated during interval timing tasks subserve a general selective attention function or are specific to temporal attention. In the current study we identified neural regions that support attention to musical intervals and probed these regions to determine if attention to pitch is anatomically distinct from attention to duration. Eleven subjects performed an auditory discrimination 1-back task to identical sequences of complex tones that varied in duration and pitch during fMRI acquisition. Subjects were trained to attend to either the duration or final pitch of the current tone and then compare it to the previous tone. Behavioral measures suggest equivalent levels of difficulty for the two conditions (RT: t=0.18; p=0.86, Accuracy: t= 0.19; p=0.86). Attention to duration revealed bilateral superior temporal, cerebellum, superior frontal, SMA, right frontal operculum, inferior parietal and middle frontal activations. Similarly, attention to pitch revealed bilateral superior temporal, cerebellum, frontal operculum and SMA activations. Critically, bilateral superior temporal and inferior parietal cortex showed greater activation when attention to duration was directly compared to attention to pitch. Attention to durations might rely on parts of a general auditory attentional system that controls attention to pitch.

A 18

INCREASING ATTENTION TO RESOLVE RESPONSE CONFLICT RESULTS IN ENHANCED ACTIVITY IN MOTOR REGIONS UNDERLYING THE CORRECT RESPONSE *Daniel Weissman[1], Lindsay Warner[2], Marty Woldorff[2]; [1]University of Michigan, [2]Duke University* – Current models posit that the dorsolateral prefrontal cortex (DLPFC) and the anterior cingulate cortex (ACC) participate in a brain network that underlies attentional control. One important aspect of attentional control is resolving response conflict, which occurs when identifying an irrelevant stimulus activates a response that differs from the response that should be made to a relevant stimulus. Using fMRI, we investigated whether increasing attention to resolve response conflict results in enhanced activity in motor regions underlying the correct response. Participants identified a visual letter while ignoring a simultaneous auditory letter that was mapped either to the same hand as the visual letter (no response conflict; congruent trials) or to the opposite hand (response conflict; incongruent trials). We observed significant conflict-related activity (i.e., greater activity for incongruent versus congruent trials) in the ACC, consistent with this region's posited role in detecting response conflict. Additionally, conflict-related activity in the ACC became greater as response time increased, suggesting higher conflict for trials in which participants took longer to respond. In line with our hypothesis, relatively long response times (i.e., high amounts of conflict) were associated with greater conflict-related activity in the primary motor cortex contralateral, but not ipsilateral, to the responding hand. Moreover, we observed similar patterns in bilateral regions of the DLPFC, suggesting these regions may have been driving the effects in primary motor regions. These findings indicate that the contributions made to resolving conflict by the DLPFC and the ACC include increasing attention to motor processes underlying the correct response.

A 19

TIMING VARIABILITY AND ACCURACY AS MEASURES OF ATTENTION AND LONG-TERM MEMORY CAPACITY IN OLDER ADULTS *Cynthia Gooch, Yaakov Stern, Brian Rakitin; Columbia University* – Effective interval timing relies on a variety of cognitive faculties, such as attention, working memory, and long-term memory. Recent data has indicated that not only are basic timing mechanisms affected by aging, but that combining timing with other cognitive tasks magnifies these changes. The data from the current experiment further examines this issue by comparing simple time production (matching a response's latency to a target time interval) with a "choice timing" task that adds a spatial discrimination component to a time production task. This latter task requires subjects to determine not only when to emit a response, but also which response to make. Difficulty of this concurrent response choice task was manipulated by making the stimulus spatially compatible with the response, or spatially incompatible. This study therefore examined the effect of increasing attentional demands of a concurrent response choice task on temporal production ability. Time production accuracy was affected equally in both age groups, although older participants' responses became more variable with increasing nontemporal task complexity. Furthermore, testing occurred over the course of three consecutive days in order to compare the retention of memories for time intervals. Results indicated that simple time productions by young participants increase in duration over the two-day retention interval. In contrast, older participants' simple time productions shorten substantially over testing. One implication is that variability in timing behavior may be more sensitive to differences in attentional capacity between older and younger adults, while timing accuracy is a better measure of long-term memory changes.

A 20

ANTERIOR CINGULATE ACTIVATION DURING TASK SWITCHING: DIPOLE SOURCE MODELING OF THE N2B/P3A COMPLEX WITH FMRI ACTIVATIONS *Adam Craig, Laura Jelsone, Yuliya Komarova, Scott Meek, Veena Nair, Michelle Phillips, Carmen Sanchez, Deepa Vijayakumar, Jennifer Vendemia; University of South Carolina* – College-aged students (N=18) attended two experimental session in which they performed a task with directed deceptions during a sentence verification task. The task consisted of a sentence with autobiographical information, such as, "My name is Pat Buzan" followed by a fixation prompt, and then the word "TRUE" or "FALSE". During one session their ERPs to the second stimulus were recording using a 128-electrodesic net (Electrical Geodesics, Inc.). During a second session their BOLD activations were recorded. Structural T1 and T2 scans were segmented into white matter, gray matter, cerebro-spinal fluid (CSF), and nasal cavities using MR-Viewer (Source Signal Imaging, Inc.). The segmented regions were used to create realistic head models for each participant. Data from the fMRI activations were used to seed dipole models of the event-related potential between 220-300ms. These seeds were further constrained to anatomical regions within the anterior cingulate based on previous findings related to fMRI and ERP studies of deception in a two stimulus task (for review see Vendemia et al., 2006). Evidence for the differential impact of exogenous and endogenous attention systems during deceptive responding is discussed.

A 21

PATCHING OF COGNITIVE DEFICITS: NICOTINE PATCH ENHANCES NOVELTY DETECTION AND LONG-TERM MEMORY IN ABSTINENT HABITUAL SMOKERS *Brett Froeliger, David G. Gilbert, Amber Dillon, Chelsea Vanderpool; Greg Asgaard; Southern Illinois University Carbondale* – In tobacco-deprived habitual smokers, nicotine improves performance on a variety of cognitive tasks requiring sustained attention and vigilance, as well as working memory tasks such as the N-Back. However, relatively little research has assessed the effects of nicotine and smoking deprivation on long-term memory and reaction times to emotionally novel situations. Nicotine administration has been reported to modulate activity in brain regions playing a role in attention processes (e.g., the anterior cingulate gyrus) as well as regions involved with memory (parahippocampal gyrus). In habitual smokers, nicotine abstinence has been shown to result in sustained overall slowing of EEG and decrements of sustained attention. The present study investigated the beneficial cognitive effects that nicotine patch replacement therapy may have on novelty detection and delayed recognition memory in habitual smokers. Smokers (n = 43) participated in 2 experimental sessions in a double-blind, counterbalanced, within-subjects design. After subjects were biochemically verified for overnight smoking deprivation (12+hr), active 14mg nicotine patches were applied to participants during one of two sessions. Placebo patches were applied during the other session. Approximately five-hours after patch application, reaction times to target identification in an emotional oddball task were assessed and found to be significantly faster in the nicotine condition (667ms) as compared to the placebo condition (695 ms). In the memory task, corrected recognition was significantly better in the nicotine condition (M=.45) as compared to placebo (M=.38). These findings suggest that the nicotine patch, relative to placebo patch, can reduce attention and memory deficits associated with quitting smoking.

A 22

EXPERT MEDITATORS SHOW ENHANCED VIGILANCE, ALERTING AND CONFLICT RESOLUTION *Jason Buhle[1], Hedy Kober[1], Alex Millner[2], Amir Raz[1], Kevin N. Ochsner[1], Tom McCarry[2], BJ Casey[2]; [1]Columbia University, [2]Weill Medical College, Cornell University* – Recent studies suggest attention may be trained as a skill. While a large body of literature suggests that expertise in domains like chess or music requires 5,000 to 10,000 hours of practice, most previous studies examined changes in attention following far less training. We report performance on different attention tasks by 32 Buddhist meditators, who engage in attentional training for up to 10 hours per day. Fourteen meditators with over 5,000 hours of training showed improved alerting, vigilance, and conflict resolution compared to age- and gender-matched controls, while 18 meditators with less training showed only improved conflict resolution. These studies indicate that attention can be modulated by meditation training; while some attentional components require the 5,000 hours of training typical for expertise across domains, others may require less.

A 23

PREPARATORY MODULATION OF VISUAL CORTEX DURING AUDITORY PERCEPTUAL DISCRIMINATION IN CONGENITALLY BLIND HUMANS. *Alexander Stevens, Matthew Snodgrass, Kurt Weaver, Alexander Stevens; Oregon Health & Science University* – Congenitally blind (CB) individuals show enhancement of a variety of auditory perceptual abilities. Furthermore, they show task dpednent activity in psterior areas that appears to depend on allocation of attention. Evidence for modulation of visual cortex in sighted subjects has now been demonstrated repeatedly using fMRI. We hypothesize that brain networks involved in top-down modulation of early visual cortex are likely to remain intact in CB individuals, while the cortical fields on which they act undergo functional reorganization. If such is the case, then CB individuals should show anticipatory effects in visual cortex during auditory perceptual tasks. We demonstrated this using an event-related fMRI design by presenting subjects with trials of an auditory backward masking task. Each trial was preceded by a warning cue before an each trial. On a subset of trials, the trial cue was presented with no trial following. If changes in the BOLD signal occurs to a trial cue alone, this can be attributed to either a preparatory change due to expectation of a trial. We also included a "no trial" cue, indicating no trial would occur to rule out general arousal effects. Backward masking trials elicited robust BOLD responses in calcarine sulcus as did trial cues alone. Following no-trial cues, the calcarine sulcus responded with a transient increase followed by a negative undershoot. The EB but not SC subjects showed similar modulatory effects in auditory cortices. However, prefrontal cortical areas involved in attentional control showed similar preparatory effects in both blind and sighted subjects.

A 24

ANTICIPATION AND NOCICEPTIVE PROCESSING IN THE HUMAN CEREBELLUM *Merle Fairhurst, Chantal Berna, Irene Tracey; University of Oxford* – Neuroimaging studies have shown brain activity both previous to and during the application of noxious stimuli. To further our understanding of the circuitry involved in anticipation of pain, we used functional magnetic resonance imaging (FMRI) to characterize previously described cerebellar activity. Methods:Twelve healthy volunteers received a visual cue followed by a thermal noxious stimulus, which they then rated. The paradigm consisted of four conditions where cue and stimulus were either matched or unmatched: i) left hand cued and stimulated; ii) left hand cued – right hand stimulated; iii) right hand cued and stimulated; iv) right hand cued – left hand stimulated. Results:Psychophysical data showed a significant reduction ($p < 0.05$, two-tailed) in perceived pain intensity in matched vs. unmatched right hand conditions and a similar trend on the left. Imaging data using regression analysis revealed correlated cerebellar activity during anticipation in Crus I and deep nuclei as well as brainstem activation in the periaqueductal grey (PAG) and ventral tegmental area (VTA). Using a subtraction analysis (right hand matched vs. unmatched), cerebellar activity, was observed in the lateral anterior hemisphere (Crus I) and the deep cerebellar nuclei, specifically in the fastigial nucleus. Conclusions: From the data we suggest that decreased levels of pain perception in the unmatched conditions may be attributable to brainstem and cerebellar attentional mechanisms. During anticipation, cerebellar activity includes previously described hemispheric activity including Crus I, implicated in attentional shifting, as well as activation in the deep cerebellar nuclei, specifically the fastigial nucleus, which has been implicated in cognitive/affective processing.

Attentional Processes: Visual

A 25

THE EFFECTS OF AGE, SEX AND TASK DEMANDS ON VISUAL SELECTIVE ATTENTION *Paula M. McLaughlin[1,2], Donald T. Stuss[2], Carolyn Szostak[3], Malcolm A. Binns[2], Steven P. Tipper[4]; [1]York University, [2]Rotman Research Institute, Baycrest Centre for Geriatric Care, [3]University of British Columbia, Okanagan, [4]University of Wales* – Visual selective attention was investigated as a function of age, sex and task demands. A "select what, respond where" paradigm was used to measure interference, negative priming and inhibition of return effects across three conditions that varied in cognitive demand. Sixty-five adults (35 females, 30 males) between the ages of 24 and 86 were tested. The results indicate that selective attention is dependent on age, sex and task demands. The female participants displayed a consistent vulnerability to task demands, while showing no age-related changes in selective attention. In contrast, the male participants displayed an age-related deficit in selective attention, and were minimally influenced by cognitive demand. As the task became more complex, the females displayed an increase in interference and negative priming scores and a decrease in inhibition of return effects. In general, the female participants displayed larger negative priming scores, and showed greater interference effects on the most demanding condition. The males also revealed an increase in interference with the increase in task demands; however, negative priming and inhibition of return scores were not affected by task complexity. A general age-related increase in interference and inhibition of return scores was found for the male participants, suggesting that age-related changes in selective attention are dependent on sex and the specific measure of attention. The present results have not been previously reported in literature, and their theoretical implications on selective attention and cognitive aging are discussed.

A 26

MAPPING SPATIAL ATTENTION WITH A TOJ TASK IN PATIENTS WITH SPATIAL NEGLECT *Elena Natale[1], Anna Dal Molin[1], Carlo A. Marzi[1], Bianca de Haan[2], Hans Otto Karnath[2]; [1]University of Verona, [2]Hertie-Institute for Clinical Brain Research, University of Tübingen* – Evidence has been reported that in neglect patients the spatial attention bias, as witnessed by manual and saccadic performance in speeded light detection tasks, specifically affects an off-centred sector of the ipsilesional space. Typically, accuracy and speed of neglect patients' responses progressively increase from the periphery of the contralesional to an off-centred sector of the ipsilesional field. To study whether or not a similar spatial distortion may also apply to mechanisms of attention selection in time, we analysed the performance of neglect patients on a temporal order judgement (TOJ) task. A couple of asynchronous stimuli was randomly displayed to a location within either the left or the right visual hemifield and patients were asked to judge which stimulus appeared first by a forced choice between a left or right precedence. In healthy and brain-damaged control subjects, we found the point of subjective simultaneity (onset asynchrony where the two judgements are equally distributed) close to the objective simultaneity. Neglect patients showed a comparable performance to that of control subjects when stimuli were presented in the ipsilesional field, whereas they needed the left stimulus to lead by several milliseconds in order to perceive simultaneity in the contralesional field. In conclusion, in neglect patients we found a similar bias of spatial attention in temporal judgements as in speed of stimulus detection and this strongly argues for a common basis of disorders of conscious visual processing in space and in time.

A 27

WHEN MOVING FACES ACTIVATE THE HOUSE AREA: AN FMRI STUDY OF OBJECT FILE RETRIEVAL. *André Keizer[1], Lorenza Colzato[1], Wouter Teeuwisse[2], Serge Rombouts[1], Bernhard Hommel[1]; [1]Leiden University, [2]LUMC* – The primate brain is assumed to integrate the features of perceived objects into object files--pointers to the neural codes of these features. Object files are assumed to outlive the event they represent and, if reactivated upon object reviewing, to reactivate all the features they point to in a pattern-completion process. Our results show compelling evidence for this mechanism in humans: we demonstrate that encountering a moving visual object automatically reactivates the neural codes of the object that previously moved in the same direction.

A 28

PROBABILISTIC SEARCH: A NEW THEORY OF VISUAL SEARCH *Lingyun Zhang, Gary Cottrell; UCSD* – Visual search has been extensively researched in recent decades. Numerous psychological experiments have provided abundant data. It is well accepted that bottom up saliency attracts attention and that knowledge of the target affects the search. A number of theories and models have been developed to address how these two factors interact and computational implementations of saliency maps have shown some agreement with human data. However, so far, no research has asked the fundamental question: "what is the goal of the computation?" In this paper, we begin to address this question. We will start from an intuitive assumption concerning the goal of the visual system, and develop a Bayesian probabilistic framework that describes the calculation the system should perform. We propose a model of bottom-up saliency, why it made its way into the visual system over evolution and how top-down information is used in visual search. The observation that feature targets "pop out" but conjunction targets do not falls out naturally, as a result of optimization by the visual system. Within this probabilistic framework, we account for "parallel search", "serial search" and the continuum in between, without the assumption of two separate processes. The classical putative mechanisms of "parallel processing" and "serial processing" are two sides of one probabilistic coin, and there is a continuum between the two. Our model also qualitatively accounts for a large body of phenomena in visual search, such as "search asymmetry" and the quite recent observation of "rare items are often missed", without fitting any parameters.

A 29

INHIBITION OF RETURN AT ENDOGENOUSLY ATTENDED LOCATIONS: AN ERP STUDY. *Ana Chica, Juan Lupiáñez; University of Granada* – Inhibition of Return (IOR) refers to slower reaction times to respond to targets appearing at a previously cued as compared with uncued, new locations. Since the effect was first reported (Posner & Cohen, 1984) and named (Posner, Rafal, Choate, & Vaughan, 1985), most researchers in the field assume that IOR reflects the inhibition of the return of attention to a previously attended location. This hypothesis have been challenged by a growing number of studies showing that IOR is observed even when endogenous attention remains at the cued location, and thus no return of attention is necessary (Berger, Henik, & Rafal, 2005; Chica & Lupiáñez, 2004; Chica, Lupiáñez, & Bartolomeo, 2006). In the present study, we investigate event-related potential (ERP) modulations associated with IOR while participants endogenously oriented attention either to the same or the opposite location of the exogenous cue. The results revealed that P1 and N1 were diminished for cued versus uncued trials (IOR), with independence of endogenous attention being oriented to the cued location or being disengaged from the cued location and reoriented to the opposite location. These results will be discussed in terms of exogenous and endogenous attention as two independent systems in the brain.

A 30

FEATURE-BASED VISUAL ATTENTION AND BIASED COMPETITION IN THE HUMAN BRAIN *Matthias Mueller, Soeren Anderesen, Sandra Fuchs; University of Leipzig* – In a series of studies we investigated neural mechanisms of feature-based attention and biased competition in the human brain by recording the steady state visual evoked potential (SSVEP). The SSVEP is the continuous brain response to a flickering stimulus and allows one to investigate neural dynamics of the allocation of attentional resources in multi-element stimulus displays. Importantly, the SSVEP not only allows one to investigate the cortical mechanisms of amplification and suppression but also the temporal dynamics thereof. By presenting coloured stimuli that flickered in different frequencies, we were able to demonstrate a key prediction of the feature similarity gain model, which is the amplification of the to-be-attended feature of a certain feature dimension throughout the visual field. Shifting attention from one feature to another within the same feature dimension was related to different temporal dynamics of amplification and suppression compared to shifting attention in space. Furthermore, we were able to demonstrate biased competition as a function of spatial distance between two coloured stimuli by investigating the time course of SSVEP amplitude as a function of spatial separation when one stimulus moved continuously away or towards a stationary stimulus.

A 31

ATTENTIONAL MODULATION OF EARLY AND LATE STAGES OF VISUAL WORD PROCESSING *Maria Ruz, Anna C. Nobre; University of Oxford* – Research on attention has extensively explored the effects of focusing attention on spatial locations or spatially-laden perceptual objects or their features. Electrophysiological research in this field has shown that attention enhances the selected representations at early stages of processing. Much less is known however about the temporal dynamics of attentional deployment to abstract categories such as the different levels of linguistic representations. The present experiment explored the effects of cueing attention to the orthographic, phonological or semantic dimensions of visually presented words. On every trial, a cue instructed participants to make a decision about the consonant-vowel pattern, the syllabic structure or the meaning of upcoming words while their brain activity was measured by means of a high-density EEG recording system. Behavioral results showed that task difficulty and performance were matched across tasks. Analyses of the early ERP components showed that focusing attention on different linguistic attributes of words modulates the bilateral P1 and also the amplitude of the posterior N2 component over the left hemisphere. These early effects occurred in the absence of change in the spatial distribution of the electric fields over the scalp across tasks. Attention to specific linguistic attributes also modulated the amplitude of later, language-related potentials, such as the N350 and the N400. In contrast to earlier modulations, these were accompanied by topographical change, implying a differential engagement of brain regions across tasks. These results suggest that attention can differentially affect the processing of different types of linguistic representations depending on the task at hand.

A 32

THE EFFECT OF EXPECTANCY ON INHIBITION OF RETURN: DETECTION VS. DISCRIMINATION PARADIGMS *Shai Gabay, Avishai Henik; Ben Gurion University of the Negev* – In exogenous attention experiments with a non-predictive cue, there is an early facilitation (valid trials faster to process than invalid ones) that is replaced by inhibition (valid trials slower than invalid trials). The latter is termed inhibition of return (IOR). Whereas the cue is non-predictive with respect to the location of the target, it is commonly predictive with respect to when it will appear. In most experiments there are an equal number of trials for each cue-target interval (stimulus onset asynchrony, SOA), and as time passes from the appearance of the cue, the probability of target presentation increases. It was suggested that this temporal information influences IOR. In this research temporal cue predictability was manipulated by using three SOA distributions. In the non-aging distribution, the cue was non-predictive of target appearance, and in the accelerated distribution, the cue was more predictive than in the commonly-used aging distribution. A detection paradigm revealed that IOR was not modulated by temporal information, regardless of the amount of attention allocated to the cue. In addition, a sequential inhibitory effect was found, which was modulated by temporal information. In a discrimination paradigm it was found that the time course of the IOR was modulated by expectancy and that in the case of no temporal predictability, there was no IOR. This research demonstrates a dissociation between detection and discrimination tasks in their susceptibility to temporal predictability.

A 33

MODULATION OF WORKING-MEMORY RETRIEVAL BY SPATIAL ORIENTING *Anna C. Nobre, Ivan C. Griffin, Anling Rao; University of Oxford, UK* – We investigated whether orienting attention to a spatial location within an array maintained in working memory could facilitate retrieval functions. Participants viewed arrays of one, two or four differently coloured crosses, followed by a spatially informative or neutral retro-cue (1500-2500 ms after the array), and later by a probe stimulus (500-1000 ms after the retro-cue). The task was to decide whether the probe stimulus had been present in the array. In "spatial" trials, the retro-cue indicated the critical spatial location within the remembered array with 100% validity. In "neutral" trials, the retro-cue provided no spatial information. Behavioural results showed that spatially informative retro-cues improved both accuracy and response times for making decisions based upon retrieval from working memory. In addition, spatial retro-cues attenuated performance decrements in accuracy and response times related to increasing working-memory load. Event-related potentials recorded during retrieval of the probe item showed effects of working-memory load over a frontal-central potential peaking around 220ms (P220) and a broadly distributed central potential peaking around 320ms (N320). Spatial orienting significantly diminished load effects in the ERPs. The mean amplitude of the N320 increased linearly with increasing working-memory load in trials with neutral retro-cues. However, this potential was greatly diminished and showed significantly less load-related modulation when spatial retro-cues facilitated working-memory retrieval. The findings provide the first evidence that the facilitatory effects of spatial orienting in the working memory domain are at least partially mediated by modulating working-memory retrieval.

A 34

COMPETING FUNCTIONAL BRAIN NETWORKS AND INTRA-SUBJECT VARIABILITY *A.M. Clare Kelly, Lucina Q. Uddin, F. Xavier Castellanos, Michael P. Milham; The Phyllis Green and Randolph Cowen Institute for Pediatric Neuroscience, NYU Child Study Center, New York* – Competitive relationships between brain networks observable during resting states may represent a fundamental functional characteristic of the brain, influencing goal-directed behavior. It has been proposed that an antagonistic relationship exists between the medial wall-based "default mode network", commonly implicated in stimulus-independent, self-referential functions, and a "task-positive" network that comprises brain regions implicated in goal-directed cognitive tasks (Greicius, 2003). Here we scanned 26 healthy controls (TR = 2000ms; TE = 30ms; flip angle =90, 40 slices) while they performed a slow event-related version of the Eriksen flanker task. We found a relationship between the strength of the negative correlation between the default mode and task-positive networks and behavioral variability on the flanker task, measured by either RT standard deviation (SD) or coefficient of variation (CV; SD divided by mean). The stronger the anticorrelation between spontaneous activity in the default mode network and the task-positive attentional network, the more consistent the behavioral performance. This effect appears to depend on attentional demands; behavioral variability on higher demand (incongruent) trials showed a stronger relationship with the anticorrelation than on low demand (congruent) trials. Intraindividual variability may be an endophenotype for Attention Deficit/Hyperactivity Disorder (ADHD), thus this method may prove useful in characterizing abnormalities present in this and other clinical disorders. Comparison of this control group to participants with ADHD awaits acquisition of additional data.

A 35

VISUOSPATIAL NEGLECT IN CHILDREN FOLLOWING STROKE *Sabrina Smith[1,2], Gray Vargas[2], Anjan Chatterjee[1]; [1]University of Pennsylvania, [2]Children's Hospital of Philadelphia* – Introduction: Spatial neglect is more common and severe following right hemisphere injury in adults. However, little is known about the nature and anatomic correlates of spatial neglect in children. Objectives: To determine if spatial neglect occurs in children following perinatal or childhood stroke, and to characterize the relationships between lesion location, age at time of injury and the presence of neglect. Methods: Children (2-18 years) with perinatal or childhood stroke were eligible. Neglect was assessed using 5 tasks: line bisection, cancellation, pre-attentive visual search, attentive visual search and visual extinction. Results: 18 subjects (2y 0m-17y 8m) participated. Neglect was present on at least one task in 67% of subjects (8/17 line bisection, 4/17 cancellation, 3/18 pre-attentive visual search, 6/17 attentive visual search and 3/17 visual extinction). In addition, there was a trend toward slower response to contralesional targets during attentive search (paired t-test, p=0.061). Neglect was seen after perinatal (6/9 subjects) and childhood (6/9 subjects) stroke, and following injury to either left (8/12 subjects) or right (4/6 subjects) hemisphere. Of subjects with neglect, 4 were tested within 1 month of stroke, and 8 were tested at least 6 months after stroke (10 months – 9 years 8 months). Conclusions: Mild spatial neglect often follows stroke in children and can be detected years after stroke in some cases. Neglect occurs following injury to either hemisphere, sustained perinatally or later in childhood. The right hemisphere dominance for visuospatial attention seen in adults may not yet be consolidated in pediatric populations.

A 36

EMOTIONAL WORD PROCESSING IN ATTENTION NETWORKS INVESTIGATED WITH ERPS *Philipp Kanske, Sonja A. Kotz; Max Planck Institute for Human Cognitive and Brain Sciences* – A processing advantage for emotional words when compared to neutral words has been found with different tasks, with different materials and in different populations. This may result from an interaction of emotional and attentional processes. Emotional stimuli automatically attract attention (see data from visual search, attentional blink, orienting and emotional Stroop tasks). However, the question remains how exactly emotion and attention interact? Posner & Petersen (1990) proposed a model of attention involving alerting, orienting and executive attention which can be studied with the Attention Network Test (ANT, Fan et al., 2002). Here we presented emotional words in a task similar to the ANT. To investigate interactions of emotion with alerting and orienting, emotional words were presented as cues in a cue-target design either predicting the spatial position of the target, or being non informative, but alerting. To test for a possible interaction of emotion and executive attention the "Ericson flanker task" was adapted. Emotional and neutral words were presented at fixation flanked by the same word above and below the target word. Participants had to judge the color of the target word which was either congruent or incongruent with the flanker words. Effects of attention and emotion were found in the ERP, such as a congruency effect that was modulated by emotional word status in the N2. We discuss the results in regard to the theoretical implications of the attentional networks.

A 37

NEURAL MECHANISMS OF VISUAL BIASED COMPETITION IN HUMAN EEG *Sandra Fuchs, Matthias Müller; Institut für Allgemeine Psychologie, Universität Leipzig* – The biased competition model (Desimone & Duncan, 1995) hypothesises the mutually suppressive interaction of objects in the visual field. This suppressive interaction is predicted to be greatest when stimuli share the same receptive field of a neuron. Attending to one of the stimuli releases that stimulus from suppression. The present studies used frequency-coded steady-state visual evoked potentials (SSVEPs) to test this prediction in multi-element displays in human EEG. In a first experiment, subjects were instructed to perform a target detection task at fixation while a flickering coloured picture stream was either moving away or towards an additionally presented stationary picture stream. Both streams flickered at different rates. We looked at the time course of the SSVEP amplitude as a function of eccentricity. The SSVEP amplitude for the stationary picture stream increased (outward motion) and decreased (inward motion) at the time point, when the distance between stimuli reached roughly 4 degrees of visual angle. Thus, enabling us to pinpoint the exact distance of beginning and ending sensory suppression between stimuli. In a second experiment, we included an additional condition in which participants attended to the stationary picture stream while a second stream was moving away. For the attended stationary picture stream sensory suppression was cancelled out in case of close picture stream separation. The results support the idea of suppressive interactions between competing stimuli and their release of suppression when attended and are in line with findings from intracranial recordings in monkeys and recent fMRI findings in humans.

A 38

PARIETAL STIMULATION DESTABILIZES SPATIAL UPDATING ACROSS SACCADIC EYE MOVEMENTS *Jason Mattingley[1], Adam Morris[2], Chris Chambers[3]; [1]University of Queensland, [2]University of Melbourne, [3]University College London* – Mechanisms of spatial updating are required to maintain accurate representations of visual space across eye movements. Neurophysiological evidence suggests that spatial updating is subserved by spatially-tuned neurons within the intraparietal sulcus (IPS), which integrate the locations of visual stimuli on the retina with signals from the eye muscles that indicate the position of the eyes within the orbits. Here we examined the role of the IPS in spatial updating in human observers. We used transcranial magnetic stimulation (TMS) to transiently disrupt cortical activity while human subjects performed double-step saccades. Participants made successive saccades to targets such that the retinal location of the second target had to be updated using information about the first saccade. We stimulated three right hemisphere sites: anterior and posterior IPS (IPSa and IPSp), and primary somatosensory cortex. TMS was delivered at the onset or offset of the first saccade. Accuracy of the second (remapped) saccade was affected only for TMS over IPSp, and only for trials in which the first saccade was directed contralaterally. Specifically, we observed a significant rightward rotation in second-saccade trajectories and an increase in gain regardless of the timing of TMS, consistent with an over-estimation of the eye displacement caused by the first saccade. In addition, TMS applied at the offset of the first saccade increased variable error of the second saccade. Our findings suggest that the human IPSp integrates visual and saccade-related information to calculate metrics for spatial updating, and implements this coordinate transformation at the completion of the saccade.

A 39

FASTER, MORE INTENSE! THE RELATION BETWEEN ATTENTION-INDUCED EVENT-RELATED POTENTIAL AMPLITUDES, AND SPEED OF RESPONDING *Durk Talsma, Manon Mulckhuyse, Jan Theeuwes; Vrije Universiteit, Amsterdam* – Recent studies have provided evidence for a neurobiological model of attention, in which a fronto-parietal network of brain areas is responsible for orienting, shifting, and maintaining the focus of attention. These control areas are hypothesized to send biasing signals to perceptual brain areas, which have the effect that the sensitivity of perceptual areas responding to the attended (i.e. relevant) stimulus features are increased, whereas the sensitivity of perceptual areas responsive to irrelevant stimulus features are attenuated. Such a model would predict that a direct relation between the strength of attentional orienting and; a) an enhancement of sensory responses in visual cortex to attended stimuli, and b) a decrease in response time. Here we examined this prediction by relating the amplitude attention-shift related ERP components to reaction-times. This was done using Posner's symbolic cueing paradigm. A cue predicted the location of an imperative stimulus (60% valid, 20% non-informative, and 20% invalid) to which participants were required to make a speeded two-choice response. Validly cued trials were sorted according to reaction time. ERPs differed systematically as a function of response time. All validly cued trials showed a shift-related positivity in the cue-target interval, but this effect was attenuated on the slowest trials, indicating a reduction of attentional effectiveness. Imperative stimuli elicited P1 and N1 components, of which the N1 varied as a function of reaction time. Faster responses corresponded with a larger N1 amplitude, suggesting a direct correspondence between the efficiency of stimulus processing and the sensitivity of visual cortex..

A 40

MECHANISMS CONTRIBUTING TO AGE-RELATED DECLINE IN WORKING MEMORY *Hyemi Chong[1,2] Jenna Riis[1,2], Scott McGinnis[1,2], David Wolk[3], Phillip Holcomb[4], Kirk Daffner[1,2]; [1]Harvard Medical School, [2]Brigham and Women's Hospital, [3]University of Pittsburgh School of Medicine, [4]Tufts University* – Studies have suggested that the behavioral cost (reaction time (RT) and accuracy) of increasing working memory (WM) load is greater in old than young individuals. Event-related potential (ERP) studies using the n-back task, which requires frequent updating of WM, may help elucidate the mechanisms underlying age-related decline in WM performance, with P3 amplitude serving to index the amount of processing resources allocated to updating WM. While ERPs were recorded, old and young subjects completed a visual n-back paradigm with 3 levels of difficulty (0-back, 1-back, 2-back). Preliminary analyses indicate that the magnitude of the increase in RT and decrease in hit rate between the 1-back and 2-back conditions was greater for old than young subjects. The overall P3 amplitude was substantially larger for old than young subjects under the 0-back and 1-back conditions, but of similar magnitude under the 2-back condition. Subjects produced the following patterns for P3 amplitude—young: 0-back = 1-back << 2-back; old: 0-back < 1-back = 2-back. The results suggest that old subjects perform the 0-back and 1-back tasks less efficiently, appropriating more resources than young subjects. Old subjects increase resource allocation needed for the 1-back task, with only a mild decline in performance, but appear to approach the upper limit of their capacity at that level. Under the 2-back task, the mismatch between limited resources and task demands produces a large decrement in performance not observed in young subjects, who successfully appropriate additional resources to manage the 2-back task.

A 41

DISRUPTION OF REMAPPING OF IOR AFTER TMS STIMULATION OF THE PARIETAL CORTEX *Martijn van Koningsbruggen[1], Shai Gabay[2], Avishai Henik[2], Robert Rafal[1]; [1]University of Wales, Bangor, [2]Ben-Gurion University of the Negev* – Converging evidence suggests that a corollary discharge signal, generated in the superior colliculi, is used to update the visual scene following eye movements. Inhibition of return (IOR), a tag that biases against detecting new signals at a recently stimulated location, is also updated with every eye movement. Patients with unilateral lesions in the intraparietal cortex are impaired in the remapping of IOR in both visual fields. In 14 healthy participants we applied TMS over the right parietal cortex 3cm posterior and lateral to the vertex, and at a vertex control site. Two pulses at 110% were applied 150ms after the onset of an eye movement that was made after a visual cue. Next, subjects responded, by means of a simple key-press, to onset of a target that appeared either at a previous cued or uncued location. We found that rTMS over the right parietal cortex, but not vertex, resulted in a remapping deficit similar to the one found in patients, i.e. a remapping deficit in both visual fields. In a second experiment we demonstrated that rTMS had no effect on IOR when re-mapping of the visual was not required. MRI was obtained in 5 participants to confirm stimulations site. The location corresponded to the region of maximal overlap in the patient study: the anterior intraparietal sulcus near its junction with the post-central sulcus. We are now mapping the IPS to determine the specificity of the location required for spatial remapping and testing for hemispheric asymmetries.

A 42

ANXIETY MODULATES AN ATTENTIONAL BLINK TO FEARFUL AND NEUTRAL FACES *Polly Peers, Andrew Lawrence, Andy Calder; MRC Cognition & Brain Science Unit, Cambridge* – Selective attention involves the differential processing of different stimuli, and has widespread psychological and neural consequences. Attentional mechanisms act to prioritise information on the basis of both “bottom-up” stimulus saliency and “top down”, behavioural relevance. Another source of bias may come from the influence of emotion states, for example fear and anxiety. The attentional blink (AB) paradigm is thought to measure the time course of attention to a particular target. Participants are required to report the identities of 2 targets presented within a stream of distractors. Performance on the 2nd target (T2) is markedly impaired if it appears within 500ms of the 1st (T1). Here we use neutral and fearful T1 faces and examined the differential effects of emotion expressions on attention to the 2nd neutral target (T2), in both a behavioural study and a version of the task adapted for fMRI. Behaviourally we found the usual recovery of T2 performance as the SOA between T1 & T2 increased, but no effect of T1 expression or interaction. Dividing the sample into low and high anxiety groups, however, revealed an interaction between anxiety and T1 expression on T2 performance, with low anxious individuals showing a smaller blink following a fearful T1 and high anxious individuals showing the reverse effect. These data are consistent with the notion that the competitive advantage for threat-related stimuli can be modulated by emotion state. The neural basis of differential attentional effects of processing neutral and fearful stimuli is examined.

A 43

SPATIAL DISTRIBUTION OF VISUAL ATTENTION ACROSS CUED AND UNCUED LOCATIONS: AN ERP STUDY *William Bush, Lisa Sanders, Kyle Cave; University of Massachusetts, Amherst* – Behavioral and event-related potential (ERP) studies have shown that visual attention can be spread across multiple locations in a flexible manner. However the results of these studies do not all support the same model of how attention is distributed. This experiment tested whether the typical attention-related amplification of visually evoked potentials is evenly distributed across locations or graded such that attention effects decrease as distance from the central cued location increases. Using a sustained attention ERP paradigm, we examined the spatial distribution of attention across one, three, and five adjacent cued locations within an array of 12 locations equidistant from a central fixation point. The paradigm also afforded a comparison of ERPs elicited by visual stimuli at uncued locations to address hypotheses concerning the sharpness of attentional boundaries. Selective attention modulated the amplitude of the posteriorly distributed P1 and N1 components. Within a set of cued locations, differences in the attention effects on visually evoked components contralateral to stimulus presentation suggest selective attention is applied in a graded manner under these conditions. Additionally, the response to stimuli at uncued locations adjacent to the cued area is larger in amplitude than that evoked by visual onsets in the same uncued location when the cued area is further away. We also found evidence that the amount of attentional resources allocated to a central location is not decreased when attention is spread over 1, 3, or 5 locations. Results will be discussed in terms of competing models of visual spatial attention.

A 44

THREAT-EVOKED ANXIETY MODULATES ATTENTIONAL RESOURCE DISTRIBUTION *Heleen Slagter, Iseult Beets, Tom Johnstone, Alexander Shackman, Carien Van Reekum, Richard Davidson; University of Wisconsin* – The brain has difficulty processing two temporally close meaningful events, as is evidenced by the “attentional blink” (AB) deficit: If two targets are presented within 500 ms and among distracters in a rapid sequence, correct identification of the first target (T1) hinders identification of the second target (T2). This deficit is thought to result from competition between the two targets for limited attentional resources. To gain a better understanding of the mechanisms underlying resource distribution, in two experiments, a threat-of-mild-electric-shock procedure was used to manipulate the emotional relevance of T1 and T2. In both experiments, participants performed an AB task while safe from getting shocked and under two shock conditions, ThreatT1 and ThreatT2, in which T1 and T2, respectively, were associated with delivery of a shock. We hypothesized that more attentional resources would be devoted to the target paired with the shock, resulting in a bigger blink in ThreatT1 compared to ThreatT2. Results from the first psychophysiological experiment (n=16) showed that the threat-of-shock manipulation induced anxiety (amplified corrugator electromyography under threat) and affected attentional resource allocation: A bigger AB was observed in ThreatT1 compared to ThreatT2. In addition, results from a second functional magnetic resonance imaging experiment investigating the neural mechanisms underlying effects of threat-evoked anxiety on attentional resource distribution, suggested greater activation in a network of fronto-parietal brain areas in T2 seen vs. T2 not-seen trials under safety conditions. Results from further analyses examining effects of threat-evoked anxiety on brain activation patterns will be presented.

A 45

FLEXING SELECTIVE ATTENTION: ELECTROPHYSIOLOGICAL CORRELATES OF SHIFTING BETWEEN EARLY AND LATE SELECTIVE ATTENTION *Jane Couperus; Hampshire College* – Behavioral and electrophysiological studies suggest that the level of perceptual load can shift attentional selection between early and late stages of visual processing (Lavie et al., 2004, Vogel et al., 2004). However, only behavioral work has shown the ability to move flexibly between early and late selection within a single task. The present investigation extends this work to show flexibility in the locus of selective attention within a single task using electrophysiological methods. A modified spatial oddball task at high perceptual load was presented under two conditions, 1) when early attentional selection was possible due to a predictive spatial cue, and 2) when only late selection was possible due to the simultaneous presentation of the spatial cue and target. Behavioral results replicate previous findings showing selective attention can shift between early and late stages of processing as a function of task demands. ERP results paralleled behavioral findings showing greater P1 and P300 amplitude in the predictive cue condition. However, no P1 differences were found in the simultaneous cue condition while the P300 amplitude differences remained.

Memory: False Memory

A 46

FALSE RECOGNITION IN ALZHEIMER’S DISEASE AND IN NORMAL AGING *Francesca De Anna[1,2], Serge Kinkinghneum[1], Eve Attali[1], Bruno Dubois[1,2], Gianfranco Dalla Barba[1], [1]INSERM U610, [2]Hôpital Pitié-Sâlpetrière, Paris, France* – False recognition in Alzheimer’s disease (AD) patients has been explored experimentally using the Deese/Roediger-McDermott (DRM) paradigm, in which subjects are presented with semantically associated words that converge on a critical non-presented item. The aim of this study is to investigate the mechanisms underlying the production of false recognitions in Alzheimer's disease (AD) and in normal aging. Three groups of subjects participated in the study: 14 very mild impaired AD patients, 13 elderly age and education matched controls, and 10 young normal controls. In order to study false recognition, we used the DRM paradigm. Subjects studied six lists of 12 words, adapted for the French population from the original DRM paradigm. Immediately following the study phase, subjects were given a recognition memory task, in which subjects were presented with a list of 48 words which included studied words, critical lure, and unrelated words. The results showed that patients produced significantly less false recognitions of the critical lure (52%) than elderly normal controls (71%), and less, but not significantly, than young normal controls (63,5%). About correct detections, the AD patients performed worse (53%) than both elderly (69%) and young normal controls (74%). These results show that AD patients produced less false recognition that both elderly and young normal control, suggesting that a semantic memory deficit, that our AD patients have, is likely to decreases the probability of producing false recognition of semantically associated lures.

A 47

PRODUCTION OF INTRUSIONS IN PATIENTS WITH ALZHEIMER'S DISEASE:EFFECTS OF DIVIDED ATTENTION ON ENCODING AND RETRIEVAL PROCESSES. *Eve Attali, Francesca De Anna, Bruno Dubois, Gianfranco Dalla Barba; INSERM U610* – Alzheimer's disease patients (AD) do not only show a memory deficit, but also suffer from memory distortions like intrusions. Several authors showed that divided attention at encoding, but not at retrieval, significantly reduce memory performance. This study investigates the effects of divided attention at encoding and at retrieval on episodic memory in AD and its possible differential role in the production of intrusions. Methods: Twenty AD patients and 20 normal controls (NC) participated in the study. They were instructed to remember three different types of stories (unknown stories, well known fairy tales, and modified fairy tales) under three conditions: -1: free encoding/ free recall -2: divided attention at encoding/ free recall -3: free encoding/ divided attention at recall. Results: -Group effect: AD patients produced fewer correct responses but more intrusions than NC. Condition effect: divided attention at encoding was associated with both a decrease of memory performance and an increase of intrusions whereas divided attention at retrieval had little effect on both the accuracy of the recall and the number of intrusions. Type of story effect: the well known fairy tales were the best recalled and the modified fairy tales generated the most intrusions. Conclusion: The greater number of intrusions when divided attention was provided at encoding than at retrieval suggests that encoding processes might be strongly involved in the generation of intrusions. The type of intrusions demonstrates that the firmly established semantic information interferes with the recall of the episodic representation of the modified version.

A 48

IMPULSIVE- AND PREMEDITATED- VIOLENT OFFENDERS DISPLAY DIFFERENT PATTERNS OF ATTENTIONAL DISENGAGEMENT FROM NEGATIVE FACIAL EXPRESSIONS *Chiao-Yun Chen[1,2], Chi-Hung Juan[1,3], Daisy Hung[1], [1]National Yang-Ming University, Taipei, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan, [3]Institute of Cognitive Neuroscience, National Central University, Jhongli, Taiwan, [4]Institute of Cognitive Neuroscience, University College London, United Kingdom, [5]Institute of Linguistics, Academia Sinica, Taipei, Taiwan* – Angry faces contain potentially provoking information, thus anger-prone individuals may tend to allocate their attention to angry faces longer than normal people. Using behavioral and ERP measures, this study adopted a Posner's orienting task to determine whether negative stimuli draw visual attention, or whether the violent offenders are incapable to disengage from threatening stimuli efficiently once such stimuli have been attended to. A face cue was presented in one of the peripheral boxes followed by a target. The cue correctly predicted the target location in 75% of the trials. In the remaining trials, the target appeared in the location opposite to the cue. The behavioral results showed that impulsive-violent offenders took longer to localize a target in invalid trials in which the angry faces were served as cues. This pattern of results did not appear in invalid trials with sad, fearful, happy or neutral faces cues. The ERP data also showed that the centrofrontal N2 for impulsive-violent offenders was absent in the angry-invalid condition. As for premeditated-violent offenders, the behavioral data indicated that premeditated-violent offenders could easily disengage from the wrong cued location with a sad face. Compared with the control group, the premeditated-violent group showed an earlier N2 latency in sad invalid condition. The data obtained here suggest that such a task is likely to reflect different underlying mechanisms between impulsive and premeditated violence.

A 49

THE IMPACT OF INTENTIONAL DECEPTIONS ON THE MISINFORMATION EFFECT *Scott Meek, Michelle Phillips, Adam Kirk, Jennifer Vendemia; University of South Carolina* – The influence of memory encoding on deceptive responses was measured across two experiments that investigated reaction times (RTs) and event-related potentials (ERPs) with 120 college-aged participants. Previous studies of deception required manipulations of information that was considered familiar knowledge for participants. The current study created participant responses that were dependent on information presented through a misinformation paradigm. In this paradigm post-event information interferes with the encoding and storage of original events. These effects are then examined during the retrieval phase. Participants were balanced across truthful and deceptive groups and asked to respond to questions related to the information presented. Data from the first study indicated when responding to misinformation participants had significantly longer reaction times (M = 870.98, SE = 42.22) than when responding to truthful information (M = 734.52, SE = 26.75, $F(1, 68) = 10.52$, $p = .002$). HD-ERPs were recorded in the response phase of the second experiment using a high-density geodesic sensory net (Electrical Geodesics, Inc), and then analyzed with principal components. The appearance of a late occurring negative (N4) waveform, commonly related to response congruity, indicates the desired memory encoding effects. Additionally, evidence from both studies supports the role of workload in deception. The findings are used to support the relationship between memory processing, executive functions, and the act of deception.

A 50

REMEDIATING FALSE MEMORY ERRORS WITH CORRECTIVE FEEDBACK: AN ERP STUDY *Jennifer Mangels, Brian Maniscalco, Taylor Joerger; Columbia University* – Many studies find that presentation of semantic associates elicits high-confidence false alarms (HCFAs) to non-presented, but highly-related lures (Desse-Roediger-McDermott [DRM] paradigm). Although this effect has proven difficult to eliminate or even reduce, we recently demonstrated that corrective feedback was effective in correcting erroneous responses to general knowledge questions, particularly when answers were initially endorsed with high compared to low confidence ("hypercorrection effect"). Extending this finding to the DRM paradigm, we examined whether HCFAs to related lures could similarly exhibit hypercorrection when immediate feedback was provided. Thirty subjects studied 28 DRM lists, then took a recognition test (first test) in which they made old/new decisions (with confidence ratings) to targets, highly-related lures, and unrelated lures. ERPs were measured to immediate feedback that awarded points based on accuracy (+/-) and confidence (1-4) of retrieval. Subjects then took a surprise retest for old and new items presented at first test, providing an opportunity to correct initial errors. Highly-related lures elicited higher-confidence FAs compared to unrelated lures. Feedback to HCFAs, which resulted in greater point penalties, elicited a larger frontal P3 compared to LCFAs. Replicating the hypercorrection effect, HCFAs also were more likely to be corrected at retest than LCFAs. However, a strong orienting response to the negative feedback was not necessarily beneficial to error correction, as individuals demonstrating a larger hypercorrection effect had smaller frontal P2 and P3s overall. The ability of error feedback to update response associations appears to be a non-monotonic function of the neural orienting response.

A 51

NEGATIVITY-INDUCED RECOGNITION BIAS FOR EMOTIONAL FACES IS PRESERVED IN ELDER ADULTS: EVIDENCE FROM EVENT-RELATED BRAIN POTENTIALS. *Katja Werheid, Sandro Knorr, Maria Gruno, Norbert Kathmann; Humboldt University at Berlin* – Recent cognitive research has evidenced that negative emotion can induce a recognition bias in terms of enhanced true and false recognition. Assuming that biased recognition may result from superior encoding paired with a tendency to consider studied as well as non-studied emotional items as familiar, we investigated if this phenomenon is subject to age-related change. Event-related potentials and recognition performance were investigated in young and elder adults (n=16, mean age 25 vs. 67 years) who performed an old/new classification task for neutral and angry faces. Half of the faces had been previously studied, the remaining faces were lures. The analysis of event-related potentials focused on the late parietal positivity between 400 and 700 ms after stimulus presentation, which is known to be enhanced by emotional content as well as by successful recollection in terms of a 'parietal old-new effect'. Young adults were better at discriminating studied faces from lures and showed a larger parietal old-new effect than elder adults. However, both groups showed enhanced true and false recognition for negative compared to neutral faces, thereby confirming previous findings of a negativity-induced recognition bias. Correspondingly, negative compared to neutral faces elicited larger parietal old-new effects and larger amplitude differences between correctly and erroneously classified lures in both groups. In sum, both behavioural and electrophysiological data support the view that the negativity-induced recognition bias is preserved in elder adulthood and relies both on superior encoding and biased responding during retrieval.

A 52

OLDER ADULTS CANNOT LEARN TO AVOID MAKING HIGH-CONFIDENCE MEMORY ERRORS *Sameer Bawa, Chad Dodson; University of Virginia* – The current study shows that whereas younger adults can learn to avoid making high-confidence memory errors, older adults cannot. Participants viewed a series of word pairs. On a subsequent memory test, we presented participants with the first word of each pair and asked them to generate the second, and we also asked them to rate their confidence in the accuracy of each response. Following the memory test, we showed participants a graph depicting the correspondence between their confidence ratings and their actual memory performance (i.e., confidence-accuracy calibration) and trained them on how to interpret the graph. After training, participants viewed another series of word pairs. Just as before, we presented participants with the first word of each pair and asked them to generate the second, and we also collected confidence ratings for each response. Our findings indicated that both younger and older adults showed improved confidence-accuracy calibration from the first test to the second test as a result of training. However, whereas younger adults showed a reduction in high-confidence memory errors from the first test to the second test, older adults did not. We take these findings to suggest that 1) older adults are prone to committing high-confidence memory errors, and even after training these errors account for aging related differences in memory performance and that 2) there is a "realism" to high-confidence memory errors for which decision-making biases alone cannot account.

Memory: Memory Disorders

A 53

ROLE OF THE MEDIAL TEMPORAL LOBES IN RELATIONAL MEMORY: NEUROPSYCHOLOGICAL EVIDENCE FROM A CUED RECOGNITION PARADIGM *Irene Kan[1], Kelly Giovanello[1,2,3], Mieke Verfaellie[1]; [1]Boston VA Healthcare System, [2]Harvard University, [3]Athinoula A. Martinos Center for Biomedical Imaging, MGH/MIT/HMS* – In this study, we examined the role of the hippocampus in relational memory by comparing item recognition performance in amnesic patients with medial temporal lobe (MTL) damage and their matched controls. Specifically, we investigated the contribution of associative memory to item recognition using a cued recognition paradigm. Control subjects studied cue-target pairs once, whereas amnesic patients studied cue-target pairs six times. Following study, subjects made recognition judgments about targets that were presented either alone (no cue), with the originally presented cue (same cue), or with a cue that had been presented with a different target (recombined cue). Controls had higher recognition scores in the same cue than in the recombined cue condition, indicating that they benefited from the associative information provided by the same cue. By contrast, amnesic patients did not. This was true even for a subgroup of patients whose item recognition was matched to that of the controls. These data provide further support for the idea that the hippocampus plays a critical role in relational memory, even when associative information need not be retrieved intentionally.

A 54

IMPAIRMENT OF SOURCE MEMORY IN PATIENTS WITH OBSESSIVE-COMPULSIVE DISORDER: EQUIVALENT CURRENT DIPOLE ANALYSIS *Young youn Kim[1], Myung-Sun Kim[2], Hwee Wee[1], So Young Yoo[1], Jun Soo Kwon[1]; [1]Seoul National University College of Medicine, [2]Sungshin Women's University* – We investigated cortical source localization of old/new effects in source memory task in patients with obsessive-compulsive disorder (OCD) by employing the equivalent current dipole (ECD) model with 64 channels EEG and a realistic head model. Event-related potentials (ERPs) were recorded while 14 OCD patients and 14 age-, sex-, handness-, and educational level-matched healthy control subjects performed recognition tasks for spoken words (items) or for the voice of the speaker in spoken words (sources). In the item memory task, both the controls and OCD patients showed more positivity to correctly recognized old words than to correctly judged new words at 300-700 ms and faster response time to the old words than to the new words. In the source memory task, the controls showed ERP old/new effect at 400-600 ms, while the OCD patients did not. OCD patients showed significantly lower source accuracy and prolonged response times to the old words with accurate voice judgments compared to the controls. For both groups, ERP generators elicited by source correct and correct rejection conditions were determined to be located in the frontal lobe. The right ECD powers of ERP generators elicited by the source correct conditions of the OCD patients were significantly higher than those of the controls. The OCD patients showed significantly altered hemispheric asymmetry of ECD power during source memory retrieval. These results indicate that OCD patients have preserved item memory, but impaired source memory.

A 55

EXPLORING THE RELATIONSHIP BETWEEN ALZHEIMER'S DISEASE, DELUSIONS, COGNITIVE DECLINE AND SEMANTIC MEMORY. *David O'Connor[1,2], Susan Rossell[2]; [1]University of Melbourne, [2]Mental Health Research Institute* – Delusions in Alzheimer's disease (AD) are a common symptom that can have a debilitating effect on the lives of sufferers and their carers. The authors reviewed studies published between 1992 and 2005 that reported on the prevalence and phenomenology of delusions in AD, as well as any relationship with cognitive decline. Empirical investigations and reviews were included in our research but were dependent upon quantitative data on the above factors being available. Data from a meta-analysis shows the overall prevalence for delusions in AD is 36%. There is, however, a broad range of reported prevalence rates across studies, from 9% to 70%. Variations in prevalence rates are due to methodological differences, such as inconsistent consideration of neuroleptics use, participants being included at various stages of AD and failure to consider other neuropsychiatric symptoms. One study addressed factors that lead to inconsistent findings, and subsequently reported that 34% of a sample of AD patients were found to experience delusions, and that these patients were at a higher risk of functional and cognitive decline. The phenomenology of AD delusions has not been adequately addressed; neither has whether AD delusions relate to specific cognitive deficits particularly semantic memory. Our review confirms that delusions in AD are common and are related to greater rates of cognitive decline. In future research, the authors will characterise the relationship between AD, delusions and cognitive decline. Using a variety of tasks, including priming, specific emphasis will be placed on semantic memory. Previous methodological issues will also be addressed.

A 56

DOES AUTOBIOGRAPHICAL EXPERIENCE ENHANCE OBJECT NAMING AND USE? NEUROPSYCHOLOGICAL EVIDENCE FROM SEMANTIC DEMENTIA AND ALZHEIMER'S DISEASE *Evangelia G. Chrysikou[1], Tania Giovannetti[2], Denene M. Wambach[2], Abigail C. Lyon[2], Murray Grossman[1], Katy Cross[1], David J. Libon[3,4]; [1]University of Pennsylvania, [2]Temple University, [3]University of Medicine & Dentistry in New Jersey, [4]School of Osteopathic Medicine* – Earlier studies have reported a familiar objects advantage for naming and use in semantic dementia (Bozeat et al., 2002a; Funnell, 1995a, 2001; Snowden et al., 1994, 1996); however, previous research has not examined performance on a variety of tasks that would address the boundaries of patients' preserved semantic knowledge for familiar items. The aim of the present research was to address whether autobiographical experience, as organized in scripts, provides support for semantic memory and can be generalized across instances of the same object category, or, alternatively, repeated exposure to an object primarily enhances one's sensorimotor skills regarding its use, which do not depend on semantic knowledge and which are generally confined to personally familiar objects. Four semantic dementia and three Alzheimer's disease patients were assessed on tasks of semantic, procedural, and episodic memory for familiar objects and for perceptually similar and different object analogs. The tasks included: naming, gesture, personal object decision, object use judgment, and script generation. Results revealed a double dissociation between SD and AD patients for semantic and episodic memory tasks. Although SD patients naming ability was impaired, they showed significant preservation of semantic memory that generalized to perceptually similar and perceptually different object exemplars. The findings support a dynamic semantic memory system that interacts with procedural and autobiographical knowledge for object identification and use. These results may have important implications for various rehabilitation interventions for semantic dementia, which would prolong the patients' independence in activities of daily living until the late stages of the disease.

A 57

MEMORY FUNCTION DURING WADA TESTING USING SODIUM AMYTAL VERSUS BREVITAL IN EPILEPSY SURGERY PATIENTS *Fani Andelman, Svetlana Kipervasser, Miri Neufeld, Irith Reider-Groswasser, Itzhak Fried; Sourasky Medical Center,* – Purpose: The intracarotid amobarbital procedure (IAP) is the standard method for lateralization of memory function, used to predict the risk of post-operative amnesia in epilepsy surgery patients (Milner et al, 1962). Because of recent shortage of amobarbital supply sodium methohexital, or brevital, has been used in some centers as an anesthetic agent (Buchtel et al 2002; Grote and Meador, 2005). The purpose of this study was to compare the neuropsychological effects of Wada testing using IAP versus intracarotid brevital procedure (IBP). Methods: 32 patients who underwent the IAP were compared with 20 patients who underwent IBP. Results of the Wada ipsilateral and contralateral memory scores in these patients were analyzed and compared. Results: No significant difference was found between Wada contralateral memory scores (first injection) using the IAP (M=81.17%) or IBP (M=84.91%). However, significant differences in memory scores of the hemisphere ipsilateral to the epileptogenic focus (second injection) were observed between IAP (M=30.74%) versus IBP (M=55.26%) (p=0.01). The relationship between ipsilateral Wada memory scores and the post-operative standard neuropsychological memory test scores was higher for the IAP than for IBP patients for most memory measures (e.g., RAVLT_5, p=0.02). Conclusion: These results suggest that although both procedures, IAP and IBP, seem to predict post-surgical amnesia, they raise the question of which of these tests more accurately reflects the extent of lateralized memory dysfunction. In conclusion, the narcotic drug used during the Wada procedure may be a significant factor in prediction of post-operative memory changes, crucial in cases of "reversed memory asymmetry".

A 58

CHANGES IN AUTOBIOGRAPHICAL MEMORY RETRIEVAL NETWORK FOLLOWING REMOVAL OF FUNCTIONALLY ACTIVE REGIONS IN THE MEDIAL TEMPORAL LOBE *Mary Pat McAndrews[1,2], Donna Rose Addis[1,2,3], Morris Moscovitch[4,2], Monica Shah[1]; [1]Toronto Western Research Institute, University Health Network, [2]University of Toronto, [3]Harvard University, [4]Rotman Research Institute, Baycrest Hospital, Toronto* – Neuroimaging and lesion evidence show the hippocampus is a key structure in the network supporting autobiographical memory (AM) retrieval. We were interested in how damage to, and removal of, this critical node alters the engagement and connectivity of the AM network. Participants included 11 left temporal lobe epilepsy (LTLE) patients and 14 age-matched controls. An event-related fMRI paradigm was used; participants retrieved AMs to personalized cues and completed semantic retrieval tasks. AM-related activity in the hippocampus and across the AM network was significantly reduced in LTLE patients relative to controls. Furthermore, the strength of effective connections involving the left hippocampus was also reduced, but those between left parahippocampal/retrosplenial cortex and left medial prefrontal cortex (LMPFC) were increased. Using a case-study approach, three LTLE patients were re-scanned approximately one year after surgical removal of the left hippocampus, and AM-related activity from presurgical and post-surgical scans was compared. Two of the three patients engaged residual left hippocampal tissue pre-surgically; removal of this functionally-active tissue resulted in increased activity in LMPFC but not in the undamaged right hippocampus. Furthermore, there was evidence of significant increases in correlations between left retrosplenial and LMPFC regions. The third patient did not engage residual left hippocampal tissue pre-surgically, engaging only the right hippocampus; post-surgically, there were no changes in hippocampal or LMPFC activity. In summary, removal of functionally-active tissue in the left hippocampus has significant consequences for the engagement and connectivity of the AM network, over and above those changes associated with left hippocampal damage in LTLE.

A 59

DIFFERENTIAL BRAIN AREAS ARE INVOLVED IN ASSOCIATIVE LEARNING IN ALZHEIMER'S DISEASE AND ELDERLY CONTROLS *Jorien van Paasschen, Linda Clare, David Linden, Robert Woods, Michael Rugg; University of Wales, Bangor* – Memory impairments observed in Alzheimer's disease (AD) are thought to be distinctly different from age-related memory decline in nondemented aging. It has been suggested that AD patients make use of alternative networks during a memory task to compensate for loss of function in medial temporal lobe regions. We explored differences in brain activation pattern in encoding and retrieval processes during an associative learning task, using functional magnetic resonance imaging (fMRI). Using a blocked design, 7 people with AD and 11 nondemented older adults (older controls) were scanned while performing a face-name association task. During encoding, nondemented older adults demonstrated higher activation than AD patients in bilateral frontal regions, right parietal lobe, and bilateral fusiform gyrus. During retrieval, higher activations were found in older adults in bilateral middle frontal gyrus, left parietal lobule, fusiform gyrus and extrastriate cortex. Notably, AD patients did not demonstrate memory-related activation in left middle frontal areas or in left parietal lobule. Compared to the older controls, AD patients showed increased activity during encoding in the left precuneus, which was not observed in the older control group. During retrieval AD patients recruited the left posterior cingulate, whereas this area did not seem to be involved in memory processes in the older control group. In line with previous findings, we suggest that AD patients show a different pattern of brain areas recruited during associative memory processes. The recruitment of areas not involved in memory in older adults may indicate that certain regions play a compensatory role in AD.

A 60

RESPONSE BIAS IN ALZHEIMER'S DISEASE: EXAMINING PICTURES VERSUS WORDS *Ellen Beth, Brandon A. Ally, Jill D. Waring, Andrew E. Budson; Edith Nourse Rogers Memorial Veterans Hospital, Bedford, MA* – Response bias is an important aspect of memory performance in Alzheimer's Disease (AD) patients, as they show an abnormally liberal response bias compared to healthy older adults. In a previous study we found that despite changes in discrimination produced by varying the study and test list length, response bias remained remarkably stable in both patients with AD and older adult controls. We concluded that memorial response bias is not affected by changes in discrimination or study-test length. In the present experiment we investigated whether changing study and test stimuli from words to pictures would alter response bias in patients with AD. If so, it would suggest that these individuals demonstrate different memorial biases for different classes of materials. If not, it may be that recognition response bias is stable for an individual. Here we measured memory and frontal lobe function with standard neuropsychological tests as well as recognition memory accuracy and response bias for pictures versus words in an experimental paradigm given to patients with mild AD. We found that the patients showed a similar response bias for pictures and words—despite their higher level of discrimination for pictures. Response bias did not correlate with standard measures of frontal function, but a more liberal bias was related to worse performance on standard neuropsychological tests of recognition memory. This correlation suggests that response bias for an individual patient is associated with the severity of his or her memory deficit and that it is unaffected by changes in stimulus modality and discrimination.

A 61

RECOLLECTION AND FAMILIARITY IN ALZHEIMER'S DISEASE: AN EVALUATION OF RECOGNITION MEMORY USING RECEIVER OPERATING CHARACTERISTICS ANALYSES. *Carl A. Gold, Brandon A. Ally, Andrew E. Budson; Edith Nourse Rogers Memorial Veterans Hospital, Bedford MA, Boston University Alzheimer's Disease Research Center, Boston University, Boston MA; Brigham & Women's Hospital, Boston MA* – Several studies of recognition memory in the Alzheimer's disease (AD) population have reported diminished veridical recognition and elevated false recognition compared to healthy older adults. Dual-process models of recognition memory posit that recognition decisions may be based on recollection or familiarity, one or both of which may be impaired in AD. In an effort to characterize the recognition memory deficits observed in AD in terms of recollection and familiarity, we followed the procedures of Yonelinas, Kroll, Dobbins, Lazzara, and Knight (1998) with AD patients and healthy older adult controls. Subjects studied unrelated words under deep and shallow encoding conditions. At test, subjects rated their memory for studied and unstudied items on a six-point confidence scale. Hit rate and false alarm rate data were used to form confidence-based receiver operating characteristics (ROCs). Examination of the ROCs of healthy older adults revealed robust recollection for deeply encoded items and familiarity for shallowly encoded items. The ROCs of AD patients were symmetrical for both deeply encoded and shallowly encoded items, suggesting the presence of familiarity, but the absence of recollection. The ROC of AD patients for deeply encoded items was similar to the ROC for healthy older adults for shallowly encoded items, suggesting the use of familiarity-based decisions. The ROC of AD patients for shallowly encoded items depicted a nearly complete failure of memory. Our findings suggest that AD-related deficits in recognition memory may be due to an absence of recollection, but a relative sparing of familiarity.

Memory: Memory Systems

A 62

PHYSICAL ACTIVITY AND THE AGING BRAIN *Agnes Floel[1], Claus Willemer[1], Karsten Kruger[2], Caterina Breitenstein[1], Frank Mooren[2], Stefan Knecht[1]; [1]University Of Muenster, Germany, [2]University Of Giessen, Germany* – Introduction: Human epidemiological and animal studies have suggested beneficial effects of exercise on brain health and function, particularly in aging populations. Methods: In an ongoing interventional study examining the effects of regular physical activity on cognition and learning abilities (finished in 12/06), baseline testing and analysis have been completed so far.. 54 healthy elderly subjects (aged 55-78, mean 68; BMI 24-39, mean = 28, education 8-20 years, mean = 11, RR syst. 90-166 mmHg, mean = 126; 34 female,) were assessed for level of physical activity and training status (questionnaire, lactate threshold, VO2max), peripheral neurotrophin/neurotransmitters levels, cerebral gray and white matter density, neuropsychological testing, and performance on verbal and motor learning tasks. Results: Multiple regression analysis revealed that frequent physical activity positively predicted success in associative verbal learning and category fluency, after controlling for possible confounders (age, sex, BMI, blood pressure, and education). Physical activity or aerobic fitness did not significantly predict long-term memory or cognitive speed and flexibility in this cohort. Discussion: Associative verbal learning and category fluency crucially depend on hippocampal and prefrontal cortical structures. Better performance on those tasks in elderly individuals that exercise regularly is well in line with data showing that hippocampal and prefrontal structures are particularly sensitive to age-related decline, and may thus benefit most from interventions like regular aerobic exercise that increase neurotransmitter/neurotrophin levels as well as neurogenesis. Analysis of neurotrophin /neurotransmitter levels, cerebral gray and white matter density, and the interventional part of the study are ongoing.

A 63

DISSOCIABLE FRONTALLY MEDIATED EPISODIC RETRIEVAL PROCESSES REVEALED BY EVENT-RELATED POTENTIALS *Carina Fraser, Jane Herron, Ed Wilding; Cardiff University* – Event-related potentials (ERPs) were acquired during the test phases of two source memory experiments in order to investigate the sensitivity of ERPs to pre-frontally mediated memory retrieval processing operations. In both experiments, an equal number of studied words were shown in red and in green. The test list comprised words previously shown at study (old) and unstudied words (new). Only half of the old words were shown in the same colour at study and test. Experiment 1 required a single three-way old same colour/old different colour/new judgment at test, while Experiment 2 required an initial old/new judgment, followed by a same/different judgment. The accuracy of old/new and same/different judgments was very similar across experiments, while there were differences between the neural activity associated with correct source judgments and correct new judgments (ERP old/new effects). From 700 ms post-stimulus onwards, the ERP old/new effects over frontal scalp were right-lateralised to a greater degree in Experiment 2 than in Experiment 1, suggesting that not entirely the same regions of prefrontal cortex (PFC) were associated with correct source judgments in the two cases. In addition, the neural activity distinguishing correct versus incorrect source judgments was not equivalent in the two experiments. These findings are one of the first demonstrations that ERPs acquired during source retrieval tasks index functionally distinct retrieval processing operations that are likely to be supported by distinct regions of pre-frontal cortex.

A 64

CONSOLIDATION AND RETENTION IN PROCEDURAL-BASED CATEGORIZATION *W. Todd Maddox[1], J. Vincent Filoteo[2], Darrell A. Worthy[1]; [1]The University of Texas at Austin, [2]UC San Diego/VASDHS* – Information-integration (II) category acquisition is thought to be mediated by a procedural-based categorization system in the striatum. To our knowledge no work has addressed consolidation and retention processes within this system. The motor learning literature suggests that some procedures lead to good acquisition but poor retention, whereas others lead to poor acquisition but good retention. II categorization might share some characteristics of motor learning given their joint reliance on the striatum. Maddox, Filoteo et al (2003, 2005) showed that continuous II categories (composed of contiguous stimulus clusters) lead to better acquisition then discontinuous II categories (composed of distinct stimulus clusters). We argued that the neural architecture of the striatum, in which distinct cortical regions project to distinct sub-regions of the striatum, might account for this finding. This finding, along with the motor learning literature, led to the hypothesis that continuous categories lead to good acquisition but poor retention, whereas discontinuous categories lead to poor acquisition but good retention. Participants completed 600-trials of acquisition training in a 4-category continuous or discontinuous II task. On each trial they saw a single line (with some length and orientation) and classified it into one of four categories. One-week later, participants returned to the laboratory and completed a second 600-trial retention session. The results suggested good acquisition and poor retention for the continuous categories, but poor acquisition and good retention for the discontinuous categories. One potential explanation of this interesting dissociation is that cholinergic striatal interneurons are vital for developing a good long-term representation.

A 65

FMRI EVIDENCE FOR SELECTIVE EFFECTS OF NEGATIVE EMOTION ON MEMORY FOR DETAIL *Elizabeth Kensinger[1,2], Rachel Garoff-Eaton[3,2], Daniel Schacter[3,2]; [1]Boston College, [2]Martinos Center for Biomedical Imaging, [3]Harvard University* – Although some types of details are better remembered for negatively emotional items than for nonemotional ones, emotion does not enhance memory for all types of details. In the present fMRI study, we examined the encoding processes that lead a person to remember the exact visual details of an object (an ability that is enhanced for negatively emotional objects) and those that correspond with accurate memory for which of two decisions were made about an object (an ability not enhanced for negatively emotional objects). Results revealed that activity in the right amygdala corresponded with enhanced memory for a negative item's visual details but not with enhanced memory for the decision made about an item. Furthermore, activity in an affective-attentional network including the orbitofrontal cortex, striatum, and anterior cingulate gyrus corresponded with enhanced memory for the visual details of a negative item but was negatively correlated with memory for the decision made about an item. These results emphasize that amygdala engagement does not ensure successful encoding of all details of a negative item's presentation. The results further suggest that some of the focal effects of emotion on memory for detail arise from encoding factors: When individuals are more affectively focused on a negative item, they appear to remember intrinsic item attributes (such as the visual details of an item) but not details extrinsic to the item (such as the decision made about an item).

A 66

AN ERP STUDY OF IDIOSYNCRATIC AND RULE-GOVERNED ASPECTS OF MUSIC AND LANGUAGE *Robbin Miranda, Michael Ullman; Georgetown University* – The neurocognition of idiosyncratic and rule-governed knowledge in both music and language was examined with an event-related potential (ERP) study of violations. In music, violations of idiosyncratic knowledge were in-key pitch deviants (in familiar melodies) that followed musical rules but deviated from the actual melodies; rule violations were out-of-key pitch deviants that violated rules of tonal harmony (in both familiar and unfamiliar melodies). In the language condition, in which auditory sentences were presented, idiosyncratic violations were semantically anomalous nouns, whereas rule violations involved either subject-verb agreement violations or phrase structure violations. We hypothesized that idiosyncratic violations in both music and language would elicit N400 components previously found for semantic violations in language, whereas rule violations in both domains would elicit anterior negativities previously found for grammatical violations in language and tonal violations in music. Moreover, based on our previous research of sex differences in language, we expected females to show larger N400s than males to idiosyncratic violations in both domains. Rule violations in both music and language elicited anterior negativities followed by P600s, whereas idiosyncratic violations in language elicited N400s. Idiosyncratic violations in familiar melodies elicited anterior negativities and P600s, similar to those elicited by rule violations in music. However, both types of violations in familiar but not unfamiliar melodies also elicited a posterior negativity that may be related to the N400. Differences between males and females, and between musicians and non-musicians, will also be discussed.

A 67

THE BUILDING BLOCKS OF "DEFAULT" BRAIN ACTIVITY *Moshe Bar[1], Elissa Aminoff[2,1], Malia Mason[1]; [1]Martinos Center for Biomedical Imaging at MGH, Harvard Medical School, [2]Harvard University* – It is clear that the brain is highly active independent of a task. What is remarkable about the activity that corresponds to such a resting, default, state (Gusnard & Raichle 2001) is that the same network of regions is active across participants, despite the fact that they are not engaged in an explicit task during these periods. This suggests that the activity observed in these regions reflects a set of cognitive operations spontaneously employed when people are mentally unconstrained, rather than simply reflect a random noise. Perhaps the most dominant account for the spontaneous activity is that it arises when people engage in thought that is unrelated to the external environment, and that this activity attenuates during attentionally demanding tasks. We argue that this account is incomplete. Specifically, because the tasks in which this default activity was observed did not recruit the same cognitive processes that are engaged spontaneously, the differences during task performance were seen as a relative deactivations. However, when the task itself relies on the same cognitive elements that mediate spontaneous activity, which we propose is the continuous processing of associations, activity in the default network should be significant also during task. This proposal stems from the striking overlap observed between the default network regions and regions that are consistently activated in tasks that recruit extensive associative processing (Bar & Aminoff 2003, Bar 2004, Aminoff et al. 2006). This overlap is proposed here to reflect the extent to which associations provide the principle basis of spontaneous thought.

A 68

SUPPRESSING RETRIEVAL OF AN UNWANTED MEMORY ALSO DISRUPTS NEW EPISODIC ENCODING FOR EVENTS CLOSE IN TIME *Justin Hulbert, Ean Huddleston, Michael Anderson; University of Oregon* – Often, people confront reminders to experiences that they would prefer not to think about and attempt control these unwanted remindings by suppressing retrieval, a process shown to have lasting consequences for that memory's later accessibility (Anderson & Green, 2001). In the Think/No-Think (TNT) procedure used to empirically study such memory control, subjects typically learn a set of word pairs. In the subsequent TNT phase, participants are presented a subset of the cue words and, for each, are either instructed either to think of the associated word (Think condition) or to prevent it from coming to mind (No-Think condition). Subsequent cued-recall is worse for previously avoided responses than for baseline items, which were initially learned but did not participate in the TNT phase. In the current study, we examined whether, in addition to the persistent inhibition of the targeted memory, unrelated episodic experiences inserted between periods of Not-Thinking would also be harder to retrieve later on. Participants made size or animacy judgments for novel words presented between TNT trials. Later, we assessed recollection and familiarity for these incidentally encoded items in a surprise recognition test. Recollection, as measured by source memory, was selectively impaired for items encoded prior to No-Think trials, compared to items encoded prior to Think trials. Importantly, the magnitude of the source deficit correlated with the degree of TNT-induced memory suppression. These findings indicate that suppressing episodic retrieval also interrupts memory consolidation for episodic memories encoded immediately prior to the epoch of retrieval suppression.

A 69

CONTROLLING RETRIEVAL PROCESSING IN MEMORY RETRIEVAL TASKS: ELECTROPHYSIOLOGICAL DATA. *Nicole Bridson, Edward Wilding; Cardiff University, Wales, UK* – Event-related potentials (ERPs) were acquired in the test phases of memory tasks where three classes of word were presented visually: (i) words encountered in a study phase (studied words), (ii) words presented at test for the first time (new words), and (iii) new words repeated after a lag of 7-9 intervening words (repeated test words). In both experiments, participants responded on one key to studied words (targets) and on another to repeated test words (non-targets) and to new words. Study and test lists were shorter in Experiment 2 than in Experiment 1, and the likelihood of a correct target response was higher in Experiment 2. In both experiments, the focus for the ERP analyses was the left-parietal ERP old/new effect, which is assumed to index recollection – recovery of qualitative details about an event. There were reliable left-parietal ERP old/new effects for targets and non-targets in Experiment 1, but for targets only in Experiment 2. These findings are consistent with previous suggestions that, when the likelihood of recollecting information about targets is high, participants use the success or failure of an attempt to recollect target information as the basis for distinguishing between targets and all other classes of test words. The findings in these two experiments are important, because they generalise those obtained in previous work to a different paradigm. They also emphasise that a reasonable degree of control over recollection of information associated with non-targets can be exerted event when non-targets are likely to be associated with strong memory traces.

A 70

DISSOCIABLE FRONTALLY MEDIATED EPISODIC RETRIEVAL PROCESSES REVEALED BY EVENT-RELATED POTENTIALS *Carina Fraser, Jane Herron, Edward Wilding; Cardiff University* – Event-related potentials (ERPs) were acquired during two memory experiments in order to investigate the sensitivity of ERPs to retrieval processing operations supported by the pre-frontal cortex (PFC). While informal inspection across studies suggests that ERPs index distinct retrieval processing operations that are likely supported by PFC, there is little statistical evidence for this. In both experiments, an equal number of study words were shown in red and in green. Test lists comprised studied (old) and unstudied (new) words. Only half of the old words were shown in the same colour at study and test. Experiment 1 required a single three-way old same colour/old different /new judgment at test. Experiment 2 required an old/new judgment followed by a same/different judgment. The accuracy of old/new and same/different judgments was similar across experiments, while there were differences between the neural activity associated with test words attracting correct colour and correct new judgments (ERP old/new effects). From 700 ms post-stimulus onwards, these ERP old/new effects over frontal scalp were right-lateralised to a greater degree in Experiment 2 than in Experiment 1, suggesting that not entirely the same regions of prefrontal cortex (PFC) were associated with correct source judgments in the two cases. In addition, the neural activity distinguishing correct versus incorrect source judgments was not equivalent in the two experiments. These findings are one of the first demonstrations that ERPs acquired during source retrieval tasks index functionally distinct retrieval processing operations that are likely to be supported by distinct regions of PFC.

A 71

DIFFERENCES IN PREFRONTAL INVOLVEMENT DURING TEMPORAL CONTEXT AND SPATIAL SOURCE MEMORY *David Crane, M. Natasha Rajah; McGill University* – Functional neuroimaging and neuropsychological studies have consistently found that the prefrontal cortex (PFC) is involved during the retrieval of past personal experiences. Recently neuroimaging studies have reported differential patterns of PFC activity during the retrieval of perceptual and spatial source information versus the retrieval of temporal context information, in comparison to item recognition. However, only two studies have directly compared spatial source and temporal memory retrieval. While these studies showed differential activation in PFC, the structure of spatial versus temporal retrieval tasks and the instructions employed were not parallel. Thus, the differential PFC activity observed between these two retrieval tasks may not reflect inherent differences in the processes involved for source versus temporal recollection. They may instead reflect the difference in the retrieval task demands, resulting in a differential recruitment of PFC-mediated executive control processes. In the current study we equate the structure and complexity of the encoding tasks and retrieval questions so that equivalent executive control processes are recruited. Healthy adult subjects participated in an event-related functional magnetic resonance imaging (fMRI) study in which they performed temporal context memory and spatial source memory tasks, for faces. The number of stimuli and responses were parametrically manipulated to control for task difficulty and strategic organization. Behavioral results indicate that both temporal and spatial tasks have equivalent accuracy results, while accuracy varies with task complexity. Preliminary event-related results identified regional differences in PFC activity related to stimulus and response number variance that were common across temporal context and spatial source tasks.

A 72

AN ELECTROPHYSIOLOGICAL INVESTIGATION OF PROCESSES SUPPORTING RECENCY JUDGMENTS. *Kerrie Grove, Edward Wilding; Cardiff University* – Event-related potentials (ERPs) were acquired during a continuous recognition memory task, where visually presented words were repeated after 5, 15 or 25 intervening words. For each word old/new recognition memory judgments were made. Old judgments also required judgements of recency (JORs), indicating how far back in the list the old words had been encountered. According to cognitive accounts, in continuous recognition memory tasks a strength-based signal that decays over time is the principal basis on which JORs are made. Two aspects of the ERP data acquired time-locked to the test words are consistent with this view. First, for words repeated after 5 intervening items, ERPs associated with correct JORs were more positive-going than those associated with incorrect JORs. Second, for words repeated after 25 intervening items, the greater relative positivity was associated with incorrect JORs. The ERP differences obtained were evident primarily at anterior locations from 300-700 msec post-stimulus, consistent with the view that a graded strength-based process supports JORs in this task. The distribution of the effects predicting correct and incorrect JORs bears correspondences with the distribution of ERP activity that, in previous studies, has been linked to the process of familiarity. These findings therefore provide some support for the view that familiarity is the process that supports JORs under some circumstances. In addition to addressing these conceptual issues, these findings illustrate the utility of acquiring ERPs alongside behavioural measures as a means of investigating the bases of numerical JORs.

A 73

NEURAL COMPONENTS OF SPATIAL AND TEMPORAL SOURCE MEMORY IN HEALTHY YOUNG AND OLDER ADULTS *Audrey Duarte, Richard Henson, Kimberly Graham; Cambridge, UK* – When people make episodic memory judgments, they may retrieve spatial and temporal details from the previous event. Older adults exhibit impairments in such judgments but little is known about the effects of aging on neural activity associated with attempts to retrieve contextual information and successful source recollection. We used event-related fMRI to investigate the effects of aging on the neural correlates of these processes for both spatial and temporal contexts. Healthy young and older adults studied pictures of objects in distinct temporal and spatial contexts and subsequently made source memory judgments. Older adults demonstrated reduced source accuracy for both spatial and temporal details. Activations associated with attempts to retrieve spatial versus temporal contexts were found in distinct extrastriate, posterior parietal and inferior frontal regions across groups. Similar effects were also observed in the left hippocampus and medial orbital frontal gyri for spatial and posterior frontal cortex for temporal retrieval attempts in young adults only. None of these regions distinguished successful from unsuccessful source recollection. In contrast, successful spatial and temporal recollection were associated with activity in hippocampal and middle frontal areas, respectively, across groups. While the right inferior frontal gyrus was more active for successful temporal recollection in young adults, the inverse pattern was observed in the elderly. These data suggest that distinct patterns of brain activity support attempts to retrieve versus successful recollection of spatial and temporal contexts. Furthermore, age-related deficits in recollection for these details may be due to impaired neural activity associated with both of these processes.

A 74

SIMILAR YES/NO AND FORCED-CHOICE RECOGNITION MEMORY PERFORMANCE IN PATIENTS WITH LIMITED HIPPOCAMPAL LESIONS *Peter Bayley[1], John Wixted[1], Ramona Hopkins[2], Larry Squire[3]; [1]University of California, San Diego, [2]Brigham Young University, [3]VA Healthcare System, San Diego* – It has been suggested that yes/no recognition is more impaired by hippocampal lesions than forced-choice recognition. This idea was raised in recent studies in which patients with mild cognitive impairment and presumed hippocampal dysfunction were given recognition tests with similar targets and foils. The suggestion was that the yes/no procedure requires recollection, whereas the forced-choice procedure can be performed by familiarity alone. We gave the same tests to 15 controls and five patients with damage limited to the hippocampus (forced-choice test: 12 study items, 12 test items; yes/no test: 12 study items, 60 test items). Patients were impaired on both the yes/no test (patients, $d'=0.88$; controls, $d'=1.92$, $p<.05$) as well as on the forced-choice test (patients, $d'=1.21$; controls, $d'=1.90$, $p<.05$). Further, patients were more impaired on the yes/no test than on the forced-choice test (.88 vs. 1.21, $p=.04$). However, as most yes/no tests consist of N study items and 2N test items, data from the yes/no test were also analyzed across the first 24 trials (average of 8.5 targets, 15.5 foils). Again, patients were impaired on the yes/no test (patients, $d'=1.09$; controls, $d'=1.87$, $p=.02$). Yet, the patients now scored similarly on the yes/no and forced-choice tests (1.09 vs. 1.21, $p=.6$). We suggest that the full yes/no test of 60 items is difficult relative to the forced-choice test due to increased study-test delay and increased interference, not because of any fundamental difference between yes/no and forced-choice recognition. The results indicate that both kinds of recognition are similarly dependent on the hippocampus.

A 75

EFFECTS OF TRIAL SEQUENCE ON ELECTROPHYSIOLOGICAL CORRELATES OF MEMORY-RETRIEVAL OPERATIONS. *Jane Herron, Edward Wilding; Cardiff University* – Electrophysiological studies of recognition memory have identified two old/new effects linked to recollection; the left parietal old/new effect indexes the retrieval of contextual information, whereas the right frontal old/new effect may reflect post-retrieval monitoring processes. The present experiment examined the degree to which these two effects were elicited according to a test item's position in the trial sequence, and, therefore, the degree to which participants were able to engage in appropriate task sets (or 'retrieval orientations'). Participants were cued prior to each test item either to retrieve item location or to retrieve encoding task. The same cue-type was maintained for four consecutive trials. Event-related potentials (ERPs) were time-locked to test items, and separated according to accurate old/new judgements and serial position. Source accuracy was equivalent across the test sequence. A double dissociation was observed between the left parietal and right frontal old/new effects; whereas the former increased in magnitude as the trial sequence progressed, the latter was significant only on 'switch' trials and declined in magnitude over successive trials. Successful recovery of contextual information therefore appeared to increase across the trial sequence, whereas the right frontal old/new effect appeared to reflect post-retrieval monitoring processes that compensated for impoverished reollection. It is proposed that the recovery of contextual information is influenced by the degree to which participants have engaged in appropriate retrieval orientations, and that compensatory monitoring processes indexed by the right frontal effect are engaged to a greater degree when orientations have not yet been fully adopted.

A 76

LESIONS AFFECTING THE HIPPOCAMPAL FORMATION YIELD CONJUNCTIONAL SHORT-TERM MEMORY DEFICITS IN HUMANS *Mischa Braun, Carsten Finke, Florian Ostendorf, Thomas-Nicolas Lehmann, Karl-Titus Hoffmann, Ute Kopp, Christoph J. Ploner; Charité Berlin* – The medial temporal lobe has long been considered essential for long-term memory whereas the frontal lobe is generally seen as the anatomical substrate of short-term memory. This traditional view is challenged by recent studies suggesting hippocampal involvement in tasks requiring short-term maintenance of conjunctional information. However, this inference is mainly based on data from patients with brain lesions resulting from global cerebral hypoxia. Furthermore, a clear delay-dependency of these deficits has not been demonstrated. The role of the hippocampus for short-term memory has therefore not yet been clarified. To settle this issue, we investigated visual working memory for features and conjunctions in three patients with post-surgical lesions to the right hippocampal formation and in ten healthy controls. We used three delayed-match-to-sample tasks with two delays (900/5000 ms) and three set sizes (2/4/6 items). Subjects were instructed to remember either colors, locations or conjunctions of both. In color-only and location-only conditions, performance of patients did not differ from controls. By contrast, a significant group difference was found in the conjunction condition at 5000 ms delay. This difference was largely independent of set size, thus suggesting that it cannot be explained by the increased complexity of the conjunction task compared to single-feature conditions. These findings demonstrate that the hippocampus plays an essential role in the maintenance of conjunctional information already at delays of a few seconds. Encoding of conjunctions appears to depend on extrahippocampal brain regions.

A 77

MEDIAL TEMPORAL LOBE ACTIVATIONS IN RECOGNITION MEMORY: IS STIMULUS CATEGORY OR RECOLLECTION VERSUS FAMILIARITY THE CRUCIAL FACTOR? *Karen J. Taylor, Kim S. Graham, Christian Schwarzbauer, Richard N. A. Henson; MRC Cognition and Brain Sciences Unit, Cambridge, UK* – We have recently demonstrated that whilst amnesic patients with broad medial temporal lobe (MTL) damage are impaired in recognition memory (RM) for faces and spatial scenes, patients with damage limited to the hippocampus show a selective preservation of RM for faces. We proposed that it is the nature of scene versus face stimuli that produced the selective RM deficit associated with hippocampal damage. An alternative explanation, however, is that RM for scenes relies more heavily on hippocampally-dependent recollective processes, whereas RM for faces can be mediated by familiarity signals in adjacent cortical regions; i.e. it is the type of memory process, rather than nature of stimuli, that best explains the division of labour in the MTL. In order to disentangle these two possibilities, we conducted an fMRI study involving RM for faces and scenes, that incorporated measures of both subjective and objective levels of recollection and familiarity. Preliminary analysis of the encoding phase, contrasting subsequent "remember" responses with subsequent misses, revealed bilateral amygdala and parahippocampal activations for faces and scenes respectively. Notably, the analysis revealed no subsequent memory effects common to both stimulus categories. At retrieval, a comparison of "remember" responses with "familiar" responses revealed bilateral amygdala activation for faces, and notably bilateral mid/posterior hippocampal activation common to both stimulus categories. These results suggest that consideration of both stimulus category and recollection versus familiarity are essential when investigating the division of labour in the MTL.

A 78

AN UNEXPECTED SEQUENCE OF EVENTS: MISMATCH DETECTION IN THE HUMAN HIPPOCAMPUS *Dharshan Kumaran, Eleanor Maguire; Wellcome Trust Centre for Neuroimaging* – The ability to identify and react to novelty within the environment is fundamental to survival. Computational models emphasize the potential role of the hippocampus in novelty detection, its unique anatomical circuitry making it ideally suited to act as a comparator between past and present experience. The hippocampus, therefore, is viewed to detect associative mismatches between what is expected based on retrieval of past experience and current sensory input. However, direct evidence that the human hippocampus performs such operations is lacking. We explored brain responses to novel sequences of objects using functional magnetic resonance imaging (fMRI), whilst subjects performed an incidental target detection task. Our results demonstrate that hippocampal activation was maximal when prior predictions concerning which object would appear next in a sequence were violated by sensory reality. In so doing, we establish the biological reality of associative match-mismatch computations within the human hippocampus, a process widely held to play a cardinal role in novelty detection. Our results also suggest that the hippocampus may generate predictions about how future events will unfold, and critically detect when these expectancies are violated, even when task demands do not require it. The present study also offers broader insights into the nature of essential computations carried out by the hippocampus, which may also underpin its unique contribution to episodic memory.

A 79

ELECTROPHYSIOLOGICAL EVIDENCE THAT THE NEURAL CORRELATES OF RECOLLECTION ELICITED BY FACE AND NAME RETRIEVAL CUES ARE QUALITATIVELY DISTINCT. *Graham MacKenzie, David Donaldson; University of Stirling* – Dual process models propose that 'recollection' and 'familiarity' are retrieval processes supporting recognition memory. These amodal retrieval processes are thought to operate on any type of stimulus. Event-related potential (ERP) studies using lexical stimuli have identified a left parietal effect (500 – 700ms) that indexes recollection, and a mid frontal effect (300 – 500ms) often associated with familiarity. Recently, Yovel and Paller (2004) found that the neural correlates of face retrieval differ from those typically observed, raising the possibility that recognizing faces recruits a different neural response from recognizing words. Here, we directly compared face and name recognition under the same experimental conditions to see if there is any variation in the neural correlates of retrieval for different stimulus materials. Compound face-name stimuli were studied, and at test either a face or a name was presented alone. Participants discriminated studied from unstudied stimuli, and made a Remember/Familiar decision for all 'old' stimuli. Names were easier to discriminate than faces, and were associated with a more conservative response bias. Recollection was inferred from Remember responses; face recollection was associated with a right superior frontal effect (500 – 700ms) and name recollection was associated with a topographically dissociable left parietal effect (500 – 700ms), demonstrating that faces and names evoke distinct neural correlates of recollection. We discuss whether the ERP findings reflect a common retrieval process that is operating on different representations or whether there are different retrieval processes for faces and words – a possibility that would challenge current dual process theories of episodic memory.

A 80

SPEED - A NEUROBIOLOGICAL THEORY OF CATEGORIZATION AUTOMATICITY *John Ennis, Brian Spiering, Greg Ashby; UC, Santa Barbara* – SPEED (Subcortical Pathways Enable Expertise Development) is a biologically detailed computational model that describes how categorization judgments become automatic in tasks that depend on procedural learning. The model assumes there are two neural pathways from the relevant sensory association area to the premotor area that mediates response selection. The longer and slower pathway is as follows: sensory association cortex – striatum – globus pallidus – thalamus – premotor area. A faster, purely cortical pathway projects directly from the sensory association area to the premotor area. SPEED assumes that the subcortical pathway, although slower, has greater neural plasticity because of a dopamine mediated learning signal from substantia nigra. In contrast, the fast cortical-cortical pathway learns via classical Hebbian learning. Because of its greater plasticity, the subcortical pathway determines early performance, but over time the cortical-cortical pathway contributes more and more to the response selection. Eventually the cortical-cortical pathway dominates the response selection and at this point the responses are automatic. The model includes differential equations that describe activation in each of the relevant brain areas as well as a set of difference equations that describe learning on each trial. A variety of simulations are described showing that the model accounts for some classic single-cell recording and behavioral results.

A 81

THE DUAL-TASK PARADIGM AS AN ERROR INDUCTION TECHNIQUE WITH NOVEL NATURALISTIC ACTIONS. *David Gold, Sabrina Lombardi, Erica Barbuto, Norman Park; York University* – Routine naturalistic actions (NAs) are familiar multi-step actions involving the manipulation of objects that must be completed in a serial order to achieve a goal (e.g., preparing coffee). Other NAs are novel (NNAs) and consist of unfamiliar multi-step actions such as learning how to build an arts and crafts style project (e.g., making a pinhole camera). The dual-task paradigm was used to selectively interfere with attention during the encoding of NNAs (n = 27). Under single-task conditions, participants viewed videos demonstrating the construction of NNAs, and then built a NNA with the same materials. Under dual-task conditions, participants performed an attention demanding secondary task (lag 1) while viewing the video (encoding). Results indicated that participants were able to learn and physically enact NNAs with a high degree of accuracy after a single viewing. However, under dual-task conditions at encoding, subsequent enactment declined dramatically. Semantic processing may have been disrupted when attention was divided at encoding while viewing a NNA because conceptual errors such as tool omissions and object substitutions increased, and the most central actions were more likely to be committed in error. The dual-task paradigm was demonstrated as a technique to induce NA errors, normally found in neurologically impaired populations, in undergraduates. Thus, the paradigm can be employed in future investigations to better understand impaired NA performance with more experimental control.

A 82

FAST RECOLLECTION IN SEMANTIC TASKS *Lillian Park[1], Morris Moscovitch[1,2], Mary Pat McAndrews[3]; [1]Rotman Research Institute, [2]University of Toronto, [3]Toronto Western Hospital* – The premise that recollection is a slow consciously controlled process and familiarity is a fast automatic one is taken for granted by many scientists. Predictions made by dual-process theories have born out in experiments demonstrating that under a deadline procedure any influence by recollection is eliminated. However, current research on recollection and familiarity questions the assumption that recollection is a slow process. Dewhurst, Holmes, Brandt, and Dean (2006) found that items in a recognition that were later associated with remember responses were recognized more quickly than for those associated with know. The following studies investigate the role of recollection on semantic tasks, which circumvent certain weaknesses inherent in recognition tests that look at recollection and familiarity. The results of the first study replicated the findings of Westmacott and Moscovitch (2003). Participants made quicker judgments about famous names that were associated with personal memories. In the second study, participants were required to make judgments under a deadline condition. According to standard views of recollection and familiarity processes, the advantage seen for items associated with episodic memory will be impaired. However, results demonstrate that the episodic advantage is preserved for tasks that do not require strategic decision-making even under a deadline procedure. Thus recollection does not appear to be a slow consciously controlled phenomenon, but one that is rapidly and automatically activated. Preliminary evidence from a functional neuroimaging study will be presented to determine whether recollection associated with semantic tests also activates the hippocampus as does recollection associated with episodic memory.

A 83

EFFECTS OF DETAIL AND TEMPORAL DISTANCE OF PAST AND FUTURE EVENTS ON THE ENGAGEMENT OF A COMMON NEURAL NETWORK *Donna Rose Addis, Daniel L. Schacter; Harvard University, Athinoula A. Martinos Center for Biomedical Imaging* – Behavioral, lesion and neuroimaging evidence show striking commonalities between remembering past events and imagining future events. In a recent event-related fMRI study, we instructed participants to construct a past or future event in response to a cue. Once an event was in mind, participants made a button press, then generated details (elaboration) and rated them. We found that the elaboration of past and future events recruited a common neural network. However, regions within this network may respond differentially to event characteristics, such as temporal distance and the amount of detail generated, depending on whether the event is in the past or future. To investigate this further, we conducted parametric modulation analyses, with temporal distance and detail as covariates. The analysis of temporal distance (independent of detail) revealed that for past events, right parahippocampus exhibited increasing activity with decreasing temporal distance. In contrast, numerous regions exhibited increasing activity with increasing temporal distance of future events, including bilateral hippocampus, which may reflect increasing novelty and/or more intensive relational processing when recombining disparate details. Temporal poles also showed increasing activity, suggesting more remote future events rely on more conceptual information. The analysis of detail (independent of temporal distance) showed increasing detail in past events modulated activity in right precuneus. Increasing detail in future events also modulated precuneus, as well as right frontal and left temporal pole. Notably, bilateral hippocampus responded most strongly to increasing detail, again highlighting the involvement of this structure in relational processing during elaboration of future events.

A 84

CHANGES IN EFFECTIVE CONNECTIVITY DURING DIFFERENTIAL RETRIEVAL ORIENTATION *Melina R. Uncapher[1], Adam P.R. Smith[2], C. Chad Woodruff[1], Michael D. Rugg[1]; [1]University of California Irvine, Irvine, CA, [3]University College London, London, UK* – The present study employed fMRI and dynamic models of effective connectivity to address the questions of how specific cortical regions interact to support maintenance of both retrieval mode different retrieval orientations. Retrieval mode refers to a sustained state associated with intention to retrieve information from episodic memory, which does not vary as a function of the nature of the retrieval task. A retrieval orientation is also conceived of as a sustained cognitive state, albeit one that varies according to demands of the particular retrieval goal. Volunteers studied words and pictures, and were then scanned during a series of short recognition memory test blocks with words as test items, in which they were cued to retrieve either studied words or studied pictures. Activity in a network of regions, including bilateral inferior frontal gyrus and lateral parietal cortex, was modulated by the requirement to retrieve studied information, regardless of the material to be retrieved (words or pictures). Effective connectivity between this common 'retrieval mode' network and other cortical regions differed according to the type of material to be remembered. Retrieval of pictures, relative to words, was associated with increased connection strength between this network and left fusiform gyrus, and decreased connection strength with right precuneus. By contrast, retrieval of words was associated with the reverse effects: increased connectivity with right precuneus and decreased connectivity with left fusiform. The findings speak to the influence of retrieval goal on the dynamics of cortico-cortico interactions that sustain cognitive states in service of episodic retrieval.

A 85

A HYPOTHESIS CONCERNING NEUROIMAGING MEASURES OF REPETITION PRIMING: PERCEPTUAL INDIVIDUATION AS NOISE-AMPLIFICATION AND ABSTRACTION AS NOISE-REDUCTION *Sonia Sciama, Ann Dowker; University of Oxford* – We suggest that, in word repetition priming, perceptual individuation is a process of noise-amplification and abstraction is a process of noise-reduction. This is because perceptual individuation requires distortion of an ideal typeface. We measured perceptual individuation by assessing the effect of multiple prime repetition on form-specificity (the effect of matching lettercase at study and test). Two experiments using a word identification test demonstrate abstraction for both an ideal and a distorted typeface; multiple prime repetition increased form-independent priming without any change in form-specificity. Thus form-specificity measured as a proportion of total priming decreased and this can be understood as noise-reduction. In a third experiment using different test conditions the distorted typeface produced perceptual individuation; multiple prime repetition increased form-specificity without any change in form-independent priming and this can be understood as noise-amplification. We suggest that these two processes are incompatible so that it is impossible for multiple prime repetition to increase both form-independent priming and form-specificity under the same conditions. Results from neuroimaging experiments have linked repetition priming to response suppression. However, experiments using degraded stimuli have demonstrated response enhancement. We propose the hypothesis that response suppression corresponds to abstraction (noise-reduction) and response enhancement corresponds to perceptual individuation (noise-amplification). Our finding that perceptual individuation and abstraction are found under different conditions is consistent with the given that suppression and enhancement are opposite modulations. The hypothesis would be strongly supported if distortion produces perceptual individuation in behavioural measures in the same conditions that produce response enhancement in neuroimaging measures.

Linguistic Processes: Syntax

A 86

SYNTACTIC OR SEMANTIC PROCESSING IN THE ANTERIOR TEMPORAL LOBE? A SELECTIVE ATTENTION FMRI EXPERIMENT *Corianne Rogalsky, Gregory Hickok; University of California, Irvine* – A number of recent studies have found that portions of the anterior temporal lobe (ATL) respond preferentially to structured sentence-level stimuli (in contrast to word-lists, for example). It is unclear, however, whether the response to sentences reflects syntactic computations or some form of semantic integration operation. This distinction is difficult to investigate with stimulus manipulations. Thus, the present study sought to answer this question via a selective attention paradigm in fMRI. In separate runs, subjects monitored for occasional semantic anomalies or occasional syntactic errors, thus directing their attention to semantic integration, or syntactic properties of the sentences. The hemodynamic response was examined to anomaly/error-free sentences only, to avoid confounds due to error detection. We have found task-specific activations in both anterior and posterior temporal lobe areas. In particular, we have found a sentence-specific ATL sub-region that is more active during the perception of correct sentences in the syntactic task compared to the semantic task. Thus, at least a portion of the ATL appears to be involved more in syntactic than sentence-level (compositional) semantic processing. In addition, this study suggests that this selective attention paradigm may be an effective means to investigate the functional diversity of sentence-processing networks. Research supported by NIH DC03681.

Memory: Memory Systems

A 87

THE NEURAL BASIS OF VIVIDLY EXPERIENCING IMAGINED AND REAL EVENTS: NEUROPSYCHOLOGICAL AND NEUROIMAGING EVIDENCE *Demis Hassabis[1], Dharshan Kumaran[1], Seralynne Vann[2], Eleanor Maguire[1]; [1]Institute of Neurology, University College London, London, UK, [2]Cardiff University, Cardiff, UK* – Amnesic patients have a well established deficit in remembering their past experiences. Surprisingly, however, the question as to whether such patients can imagine new experiences has not been formally addressed. We tested whether a group of amnesic patients with primary damage to the hippocampus bilaterally could construct new imagined experiences in response to short verbal cues which outlined a range of simple commonplace scenarios. Our results revealed that patients were markedly impaired relative to matched control subjects at imagining new experiences. Moreover, we identified a possible source for this deficit. The patients' imagined experiences lacked spatial coherence, consisting instead of fragmented images in the absence of a holistic representation of the environmental setting. The hippocampus, therefore, may make a critical contribution to the creation of new experiences by providing the spatial context into which the disparate elements of an experience can be bound. Given how closely imagined experiences match episodic memories, the absence of this function mediated by the hippocampus, may also fundamentally affect the ability to vividly re-experience the past. We followed up our neuropsychological findings with an fMRI study in healthy subjects, directly comparing imagined events with real episodic memories. Our neuroimaging data provide converging evidence for a brain network common to vividly experiencing real and imagined events which includes the hippocampus. By contrast, we identified other brain regions that discriminated between events that were imagined, and those that actually happened.

Memory: Other

A 88

BABY BOOMERS ALL GROWN UP: A RELATIONSHIP BETWEEN PERSONALITY, GENDER, AND COGNITIVE PERFORMANCE IN LATER YEARS. *Alexandra Fiocco, Sonia Lupien; McGill University* – With an aging Baby Boomer generation on the rise, research is attempting to elucidate the factors that contribute to cognitive aptitude in later years. With this in mind, the current study wanted to assess the impact of gender and personality factors on cognitive performance in male and female baby boomers between the ages of 50 and 60 years old. Cognitive tasks consisted of those that tap into hippocampal and frontal lobe functioning, including immediate and delayed explicit recall of a story, verbal fluency, and digit span. In assessing the relationship between personality and gender, correlation analysis showed that females and males did not differ on Neuroticism or Conscientiousness, but females were found to report higher scores on the Extroversion, Openness and Agreeableness scales of the NEO. Overall, Analyses of variance showed that both gender and personality significantly, yet independently, impact cognitive performance. Females performed better than males on almost all administered cognitive tasks. Neuroticism was found to negatively correlate with immediate story recall and a similar trend was found for delayed story recall. Extroversion and Openness were found to positively correlate with immediate and delay recall of story, and letter as well as category verbal fluency. Finally, a negative relationship was found between Conscientiousness and digit span and a positive trend was found for Agreeableness and immediate story recall. These findings are in accordance with the literature suggesting gender differences in cognition throughout the lifespan and further adds to the literature on personality.

A 89

AN IDEAL NAVIGATOR MODEL OF HUMAN WAYFINDING: LEARNING ONE'S WAY AROUND A NEW TOWN *Jeremy Manning[1], Michael Kahana[1], Robert Sekuler[2]; [1]University of Pennsylvania, [2]Brandeis University* – Searching for a target in an unfamiliar environment requires acquiring, storing, processing, and recalling spatial information. We use datasets from two virtual reality navigation experiments to design and validate a simple biologically-inspired computational model of these processes. Subjects in both datasets play taxicab drivers, picking up and delivering passengers in a series of small virtual towns. After just a few deliveries, subjects learn to generate minimum distance, novel paths between passengers and their destinations. Subjects' rapid learning and near-ceiling performance inspires the creation of an ideal navigator model, which makes optimal use of sensory information to learn navigationally relevant spatial information about the environment as quickly as possible. We use MAGELLAN, a simple, two-parameter, ideal navigator model, as a benchmark against which to assess possible sources of subject error. By systematically degrading the ideal navigator's vision and memory, MAGELLAN accounts for human subjects' mean performance in both datasets, and correctly predicts the difficulty that subjects encounter in navigating different environments.

A 90

DIFFERENTIAL RECRUITMENT OF THE HIPPOCAMPUS, MEDIAL PREFRONTAL CORTEX AND AREA MST DURING PATH INTEGRATION IN HUMANS *Thomas Wolbers[1], Jan M. Wiener[2], Hanspeter Mallot[3], Christian Büchel[4]; [1]University of California, Santa Barbara, [2]Collège de France, [3]University of Tübingen, [4]University Medical Center Hamburg-Eppendorf* – Path integration, the ability to sense self-motion for keeping track of changes in orientation and position, constitutes a fundamental mechanism of spatial navigation and a keystone for the development of cognitive maps. Whereas animal path integration is predominantly supported by the head direction, grid and place cell systems, the neural foundations are not well understood in humans. Here we used fMRI and a virtual rendition of a triangle completion paradigm to test whether human path integration recruits a cortical system similar to that of rodents and non-human primates. Participants travelled along two legs of a triangle before pointing towards the starting location. In accordance with animal models, stronger right hippocampal activation predicted more accurate updating of the starting location on a trial-by-trial basis. Moreover, between-subjects fluctuations in response consistency were correlated with bilateral hippocampal and medial prefrontal activation, and bilateral recruitment of area MST was related to individual path integration capability. Given that these effects were absent in a perceptual control task, the present study provides the first evidence that visual path integration relies upon the dynamic interplay of self-motion processing in human MST, higher-level spatial processes in the hippocampus and spatial working memory in medial prefrontal cortex.

A 91

ELECTROPHYSIOLOGICAL DISSOCIATION OF RECOLLECTION AND FAMILIARITY DURING ASSOCIATIVE RECOGNITION:

INVESTIGATING THE EFFECTS OF STIMULUS REPETITION ON EPISODIC MEMORY. *Sinead M. Rhodes, David I. Donaldson; University of Stirling* – Episodic memory depends upon distinct retrieval processes of familiarity and recollection. Associative recognition tasks have traditionally been viewed as requiring recollection for correct performance, however recent research suggests familiarity may be evoked when associative-pairs are perceived as a single unit. Here we examined the influence of repeated presentation of stimuli on the engagement of episodic retrieval processes using an associative recognition task. In a pre-experiment behavioural training session (repetition condition), participants studied 10 repetitions of word-pairs containing an association (traffic-jam) or an unassociated semantic relationship (violin-guitar). In study phases of the main experiment, participants studied word-pairs from repetition conditions and first presentation (non-repetition) conditions. At test, participants had to recognize if word-pairs were presented in the same pairing as study, were rearranged, or new. As expected, recognition was stronger for repetition than non-repetition conditions; however repetition improved recognition accuracy for both associative and semantic word-pairs. Neuroimaging data (Event-Related Potentials recorded at test) also differed depending on repetition condition but varied according to stimulus properties. Retrieval of all four conditions of word-pairs elicited bilateral frontal (familiarity) and left parietal (recollection) effects. Comparisons of the magnitude of effects revealed a larger bilateral frontal effect following repetition but only for association word-pairs. In contrast, a larger left parietal effect was observed for both associative and semantic repetition conditions than for their respective non-repetition conditions. Our findings suggest repetition a) encourages familiarity but only for information already perceived to reflect a unit, and b) increases recollection based responding irrespective of stimulus properties.

A 92

THE ROLE OF FEATURE OVERLAP IN SOURCE MEMORY ACCURACY AND BRAIN ELECTRICAL ACTIVITY *Trudy Kuo, Cyma Van Petten, Kate Cody; University of Arizona* – Retrieval of feature conjunctions, as in a source memory test, is believed to depend on control processes subserved by prefrontal cortex (PFC) based on converging neuropsychological, haemodynamic and electrophysiological evidence. As source memory is most often studied with two different source attributes, each repeatedly paired with a large number of items, interference from the highly familiar source attributes may arise during source recognition test. This idea has been supported by the consistent observation that source accuracy suffers when a test item is presented with a source feature different from what was associated with the item at study. Specifically, the highly familiar source feature in this case may promote endorsement of the item-source conjunction as studied when the correct response is to reject the pairing. We hypothesized that PFC may be engaged, in part, to overcome such interference during source recognition. The present study contrasted source memory performance and brain electrical activity between a condition where each of 16 line drawings on a study list occurred in a different color and another condition where 16 drawings occurred in only 2 different colors at study. Mapping condition influenced the accuracy of discriminating old items in the studied colors from old items in different (but also studied) colors. The disadvantage of different-source trials was reduced in the 16-color condition. The effect of mapping condition on brain electrical activity will be discussed in terms of the role of PFC in source memory versus associative memory where feature mapping tends to be unique.

A 93

BEHAVIORAL AND ERP APPROACHES OF COMPENSATION IN EPISODIC MEMORY RETRIEVAL: AGING AND COGNITIVE SUPPORT EFFECTS *Michel Isingrini[1,2], Lucie Angel[1,2], Séverine Fay[1,2], Badiâa Bouazzaoui[1,2], Granjon Lionel[3,2], Laurence Taconnat[1,2]; [1]University of Tours, France, [2]UMR CNRS LMDC, [3]University of Poitiers, France* – Two experiments, involving manipulation of cognitive retrieval support, examined compensatory mechanisms in memory using behavioral and electrophysiological approaches. The first experiment aimed at confirming the possibility of a cognitive compensation during aging, expressed by a reduction of age-related differences in episodic memory when a high cognitive support is provided at retrieval. Memory performances of 18 young and 18 old subjects were compared using two cognitive support conditions (low vs. high), operationalized by manipulating the number of letters of each retrieval cue (3 vs. 4 letters). In the high support condition, age-related differences were significantly smaller than in the low support condition. Thus, older subjects benefit much more than young subjects from the high cognitive support condition, suggesting a possible age-related cognitive compensation. Using the same procedure, the second experiment investigated whether the magnitude of the ERP "old/new cued recall effect", associated with retrieval operations, was modulated by the level of cognitive support. ERPs were recorded while participants (10 young adults) performed the cued recall task in the high and low support conditions. Between 300-500 ms post-stimulus, "old/new cued-recall" effects were observed for each retrieval condition. They varied in magnitude being larger in the high support condition, than in the low support condition, at right frontal and right parietal sites. These findings confirm that the ERP "old/new effect" can be modulated by the level of cognitive support provided at retrieval, suggesting that the age-related cognitive compensation (experiment 1) could be studied, at the brain level, through the "old/new effect".

A 94

AGING AND STRATEGIC RETRIEVAL IN A CUED-RECALL TEST: THE ROLE OF EXECUTIVE FUNCTIONS AND FLUID INTELLIGENCE *Laurence Taconnat, Séverine Fay, Lucie Angel, Badiâa Bouazzaoui, Michel Isingrini; Université François Rabelais* – Cued recall in episodic memory was investigated in relation to low and high cognitive support at retrieval, executive function level and fluid intelligence level in 81 healthy adults divided first into two age groups (young and elderly adults). The first analyses showed that age-related differences were greater when a low cognitive support was provided to recall the words. An individual index of loss of performance when the number of cues was decreased was then calculated. Hierarchical regression analysis revealed that the executive functions measure (perseverative errors on the Wisconsin Card Sorting Test) was a better candidate than the fluid intelligence measure (Cattell's Culture fair test) to account for the age-related variance of the size of performance loss. These findings suggest that age differences in implementing strategic retrieval may be mainly due to a decline in executive functions.

A 95

THE EFFECT OF PERCEPTUAL FLUENCY ON RECOGNITION AND EVENT-RELATED POTENTIALS (ERPS) *Vinaya Raj[1], P. Andrew Leynes[1], Charan Ranganath[2], April Drumm[1], Anne Lewis[1], Rebecca Martin[1], Jessica Wong[1]; [1]The College of New Jersey, [2]University of California, Davis* – Perceptual fluency, the speed and ease of perceiving a stimulus, may serve as a basis for feelings of familiarity in recognition memory judgments. The present experiment manipulated perceptual fluency by blurring word stimuli. Participants studied 150 words using a shallow encoding task. The fluency of studied words was reduced by applying a light filter that blurred the words slightly. At test, participants made old/new recognition judgments and confidence ratings for 300 words (150 old, 150 new). Test probes either matched the clarity condition seen at study (light mask), increased in clarity from study (very light mask), or decreased in clarity (heavy mask). Participants were unaware of the perceptual manipulation. Memory was more accurate when the fluency matched the study item (light mask) than when fluency increased or decreased in clarity. Behavioral data was modeled using traditional Signal Detection Theory measures and ROC curves, which indicate that changing the fluency caused participants to use a more conservative decision criterion. ERP amplitude measures associated with familiarity (FN400) indicated that the fluency manipulation did not influence processing of old items, whereas the FN400 elicited by new items varied as a function of visual mask. The results are interpreted as evidence that fluency can selectively influence familiarity levels of unstudied information and that changes in response criterion can account for recognition differences when fluency is manipulated in some contexts.

A 96

EVENT-RELATED POTENTIAL (ERP) EVIDENCE OF BLOCKED RETRIEVAL *Olga Rass[1], P. Andrew Leynes[1], Joshua D. Landau[2], Tim Curran[3], Vinaya Raj[1], Jenna Scisco[1]; [1]The College of New Jersey, [2]York College of Pennsylvania, [3]University of Colorado* – The Memory Block Effect (MBE) occurs when orthographically similar words inhibit retrieval in word fragment completion paradigms. In two studies, event-related potentials (ERPs) were measured in the MBE paradigm used by Logan and Balota (2003) to explore the neural correlates of retrieval blocks. In both experiments, exposure to the blocking primes decreased fragment completion (relative to control fragments). Blocking occurred when the relevant primes were observed only a few seconds before the fragment (Exp 1) or when the solutions to all fragments were studied before the fragment completion test (Exp 2). The ERPs indicate that exposure to blocking primes prevents an active search of memory, and retrieval fails because blocking primes are active in memory and unable to be inhibited.

A 97

ON THE REPRESENTATION OF COMPLEX SEQUENCE KNOWLEDGE BETWEEN MANUAL AND OCULOMOTOR RESPONSE MODALITIES *Clive R. Rosenthal[1], Tammy W. C. Ng[1], Masud Husain[2,1], Christopher Kennard[1]; [1]Imperial College London, [2]University College London* – Little or no general consensus has been reached regarding the nature of the representation underlying sequence knowledge acquired in the serial reaction time task (SRT task). One way to address this issue is to examine sequence learning for evidence of reciprocal transfer between different response modalities. Accordingly, participants were trained on a second-order conditional sequence, using a 4-choice SRT task implemented under either manual (m, responding to target stimuli with manual key presses) or saccade-contingent (o, responding by directing gaze to target stimuli) response conditions. After 14 blocks of trials, half of the participants transferred to the alternate response modality for three blocks of trials, whereas the other half performed these blocks in the same response modality; there were, therefore, four modality of learning conditions: m, o, m>o, o>m. Sequence knowledge was assessed by conjoint performance on either manual or saccade-contingent versions of a cued-generation task implemented under the two instructional conditions of the PD procedure and on a recognition test. Transfer of sequence knowledge was demonstrated in all modality of learning conditions, indicating that sequence learning is effector-independent. In the o, o>m, and m conditions, training led to explicit knowledge of the sequence, whereas in the m>o condition, training led to implicit knowledge. Training in the m>o condition, therefore, did not yield knowledge that was fully available to the oculomotor response modality. Implications of these results and differences in the sensitivity of indirect and direct tests to sequence knowledge acquired under manual and oculomotor response modalities are discussed.

Perceptual Processes: Auditory Processing

A 98

NEURAL BASIS FOR PERCEPTUAL MAPPING OF MUSICAL TONES IN ABSOLUTE PITCH POSSESSORS: AN FMRI STUDY *Nobuko Hara[1], Kimihiro Nakamura[1], Chihiro Kuroki[2], Yoshihiro Takayama[1], Seiji Ogawa[2]; [1]Graduate School of Medicine, The University of Tokyo, [2]Hamano Life Science Research Foundation* – Introduction: For absolute pitch (AP) possessors, pitch perception is currently thought to represent a highly automatic process comparable to the perception of spoken language. To explore this neural basis without the top-down influence, repetition priming paradigm was used with functional magnetic resonance imaging. Methods: Thirty-three students were recruited from Tokyo National University of Fine Art and Music. AP possessors were screened by a solfege test. To observe the priming effect, we used two types of stimulus pairs. One was a repetition of same triad chords (SC) whereas the other was a pair of triad chords in octaval relation (COR). Experimental task was major/minor discrimination. Imaging data were obtained using Siemens Allegra 3T scanner with the following scanning parameters; TR=1.5s, TE=30ms, flip angle=80. Statistical analysis was made using SPM2. Results: The priming effect in reaction time was significant only for the AP possessors. For SC, direct comparison between subject groups revealed no significant difference except for supplementary motor area, while for COR there were significant between-group differences in right superior temporal gyrus (rSTG), left inferior parietal lobe (lIPL). Discussion: The activity in rSTG is interpreted as reflecting the specialized ability of AP possessors which is to map the sound signal onto more abstract feature such as pitch notation, while the activity in lIPL presumably represents mental recall for visual imagery of musical scores of the stimulus items. Our results suggest that these brain regions are responsible for the processing of different musical sounds to same pitch notation in AP possessors.

A 99

CROSSLANGUAGE DIFFERENCES IN PREATTENTIVE PROCESSING OF PITCH DIMENSIONS AS REVEALED BY MULTIDIMENSIONAL SCALING ANALYSIS OF THE MISMATCH NEGATIVITY *Bharath Chandrasekaran, Jackson Gandour, Ananthanarayan Krishnan; Purdue University* – A crosslanguage auditory electrophysiological study was conducted to explore the influence of language experience on the saliency of dimensions underlying cortical pitch processing. Chinese and English subjects (n=10 per group) were presented with Mandarin tones while the MMN (mismatch negativity) response was elicited using passive oddball paradigms. Stimuli consisted of three tones (T1, high level; T2, high rising; T3, low falling-rising). There were three oddball conditions (standard/deviant): T1/T2, T1/T3, T2/T3. In the T1/T2 and T1/T3 conditions, each tonal pair represented a contrast between a level and a contour tone; the T2/T3 condition, a contrast between two contour tones. A dissimilarity matrix was created using the MMN mean amplitude measured from the Fz location for each of these conditions per subject. The resulting twenty matrices were analyzed by the INDSCAL multidimensional scaling model. Two pitch dimensions were revealed, interpretively labeled 'height' and 'direction'. The latter was found to be more important for the native Chinese group relative to the English. Using subject weights on the direction dimension, a cross-validated discriminant function showed that 17 out of 20 subjects were correctly classified into their respective language groups. These findings lead us to conclude that the MMN can serve as an index of pitch features that are differentially weighted depending on a listener's experience with lexical tones and their acoustic correlates within a particular tone space. By applying INDSCAL to MMN data, we now have a tool to investigate crosslanguage effects on perceptual dimensions of tone at the level of the cerebral cortex.

A 100

I'VE HEARD IT ALL BEFORE: THE SPATIO-TEMPORAL DYNAMICS OF REPETITION PRIMING OF SOUNDS OF OBJECTS *Micah Murray[1,2], Christian Camen[3], Lucas Spierer[1], Stephanie Clarke[1]; [1]Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland, [2]University of Lausanne, Switzerland, [3]University of Geneva, Switzerland* – Repetition priming is considered an index of the plasticity in (accessing) representations in the brain. Electrical neuroimaging of 64-channel auditory evoked potentials (AEPs) in humans identified the spatio-temporal brain mechanisms of repetition priming involving sounds of environmental objects. Subjects performed an 'oddball' target detection task, based on the semantic category of stimuli (living vs. man-made objects). Comparing responses to initial and repeated presentations of physically identical sound stimuli, these analyses tested for modulations in 1) individual AEP waveforms, 2) global response strength, and 3) the topography of the electric field at the scalp. Repetition priming effects were observed behaviorally as a speeding of reaction times and electrophysiologically as a suppression of the strength of responses to repeated sound presentations over the 156-215ms post-stimulus period. There was no evidence of changes in the topography or latency of the AEP at the scalp, supporting the hypothesis that repetition priming manifests as a modulation in the strength of responses in a statistically indistinguishable network of active brain regions. A distributed linear inverse solution and statistical analysis thereof localized the priming effect to the left middle temporal gyrus and superior temporal sulcus (BA22), which have been implicated in associating sounds with their abstract representations and actions. These effects are subsequent to and occur in different brain regions from what has been previously identified as the earliest discrimination of auditory object categories. Repetition priming of sounds of objects may thus reflect plasticity in associative-semantic, rather than perceptual-discriminative functions.

A 101

EFFORTFUL COMPREHENSION OF NOISE VOCODED SPEECH RECRUITS A FRONTO-TEMPORAL NETWORK *Alexis Hervais-Adelman[1], Ingrid Johnsrude[2], Robert Carlyon[1], Matt Davis[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK, [2]Queen's University, Kingston, Ontario, Canada* – Noise vocoding renders speech hard to understand, and may recruit the same neural systems as does speech heard in more natural challenging listening situations. We conducted a neuroimaging investigation into the neural basis of the comprehension and perceptual learning of noise vocoded (NV) speech. 15 naïve participants were scanned using fast sparse whole-brain imaging. During three test sessions (TA=1.3s, TR=2.5s), we examined neural responses to NV words incomprehensible distorted speech and natural clear speech. Training sessions (TA=1.3s, TR=3.5s) interleaved between test sessions consisted of presentations of pairs of NV (D) and clear (C) words, ordered so as to provide effective perceptual learning (CD pairs). Ineffective orders (CC, DD, DC) were also included so that activity for effective and ineffective training could be compared. Behavioural data collected after each of the test sessions showed significant improvements in listeners' comprehension of NV words as a consequence of training. No significant differences between naïve and trained responses to NV speech were observed. Listening to NV speech during test sessions activated left insula, pre-motor, pre-frontal and inferior parietal regions, and right inferior frontal, motor and inferior temporal regions, and thalamus bilaterally. The activations found are consistent with existing results relating to the processing of distorted or degraded speech (e.g. Giraud et al., 2004; Davis & Johnsrude, 2003). Effective training stimuli produced significantly more activity than ineffective stimuli in left inferior parietal, motor, and frontal areas, and in bilateral posterior temporal areas. These areas may play a role in guiding perceptual learning of NV speech.

A 102

PERCEPTUAL DISCRIMINABILITY AND NEURONAL PROCESSING OF SOUND MOVEMENT IN THE HUMAN BRAIN *Ulrike Zimmer, Emiliano Macaluso; NeuroImagingLaboratory SantaLucia IRCCS, Rome* – Often we have to identify many stationary and moving sounds simultaneously. For example, crossing a street requires the ability to discriminate moving cars versus stationary cars waiting at the traffic light. Our ability to discriminate between different sound-sources depends on the background noise (e.g. the level of traffic) that will also influence the spectro-temporal input reaching our ears (binaural sound coherence = BSC). Aim of the current study was to investigate if the perceptual discriminability of moving versus stationary sounds varies as a function of BSC; and whether these perceptual changes have a specific neuronal correlate. During fMRI, we presented sound-pulses either with changing Interaural-Time-Differences (typically resulting in the perception of sound movement) or with constant ITD (typically perceived as a train of sounds from a single location). Orthogonally to this, we manipulated the level of BSC, varying the perceptual discriminability of the sound-source location. On each trial and irrespective of BSC-level, the task of the subject was to discriminate "moving" versus "stationary" sounds. Behaviourally, we found that sound-movement discriminability decreased with decreasing BSC. The fMRI analyses highlighted a network of fronto-parietal regions that was more active for high versus low BSC-sounds. Critically, in the IPS and STG the correlation between brain activity and perceptual discriminability was present only for "changing-ITD" sounds. Thus, these areas activated selectively when the sound-stimuli contained ITD-changes and BSC was high: i.e. when the subjects perceived sound-movement. We conclude that IPS and STG play a pivotal role for sound-movement perception, combining BSC and ITD information.

A 103

FUNCTIONAL MRI AND PSYCHOPHYSICAL STUDIES OF MUSICAL PITCH PROCESSING BY ABSOLUTE-PITCH MUSICIANS *I-Hui Hsieh, Kourosh Saberi; University of California, Irvine, CA* – Recent theories of absolute-pitch (AP) processing propose an intrinsic symbolic association between linguistic cues and stored pitch representations in facilitating the extraction and accurate labeling of pitch from long-term memory. The current study describes results of psychophysical and fMRI experiments on processing of conflicting linguistic and pitch cues by AP individuals. In the first set of experiments, AP musicians identified the pitch of randomly selected mismatched syllable-pitch hybrids while attempting to ignore their speech content. Results showed that mismatched hybrid stimuli cognitively interfered with pitch identification by AP musicians trained during childhood in the Solfeggio system (fixed-Do solmization) but not with those trained in the western labeling system (movable-Do solmization). Interference persisted after thousands of trials but diminished as the stimulus spectrum was increasingly lowpass filtered to remove its broadband speech features. In fMRI experiments, Solfege and Western-trained AP musicians either passively listened to hybrid syllable-pitch stimuli or identified the pitch of hybrids during fMRI acquisition. Previously, the left dorsolateral frontal cortex considered to be involved in maintaining conditional associations, and the right frontal cortex involved in working memory have been implicated in AP processing. Findings from the current fMRI study on contrasting cortical activation patterns in Solfege and Western-trained AP musicians at these two brain regions are described and combined with psychophysical findings to evaluate the theory that association of pitch information with linguistic cues underlies AP ability.

A 104

NON-LINGUISTIC AUDITORY PROCESSING IN ADOLESCENTS WITH SPECIFIC AND NON-SPECIFIC LANGUAGE IMPAIRMENT: AN ERP STUDY OF TEMPORAL CONSTRAINTS *Amanda Hampton[1], Christine Weber-[1], Bruce Tomblin[2]; [1]Purdue University, [2]University of Iowa* – It has been hypothesized that deficits in auditory perception may contribute to the development of specific language impairment (SLI) (e.g., Bishop & McArthur, 2004; Leonard, 1998; Neville, et al., 1993; Tallal et al., 1998; Tallal, 2000). The current study investigates nonlinguistic processing of brief (50 ms) tones to determine how rapid temporal processing (200 ms versus 1000 ms interstimulus interval (ISI)) may differ for adolescents with and without language impairments. A standard oddball paradigm was utilized to examine both the early perceptual and later cognitive potentials indexing target detection processes. We studied 17 typically developing adolescents, 14 to 18 years old, and those diagnosed with SLI (n=17) and non-specific language impairment (NLI), who displayed reduced abilities in both verbal and non-verbal skills (n=10). These diagnoses were consistent from kindergarten through 8th grade. The normally developing adolescents showed high levels of accuracy in detecting infrequent target tones, while detection accuracy was significantly reduced for the SLI and NLI groups. Amplitudes and peak latencies of the early cortical potentials (N100, P200, and N200) did not distinguish the groups for the short or long ISI conditions.

However, compared to the typically developing participants, the P300 peak and mean amplitudes were reduced in the SLI and NLI groups for the short, 200 ms ISI condition. These findings suggest that for adolescents with reduced linguistic abilities, the neural functions underlying working memory updates during rapid auditory processing are more sensitive to the temporal relationships between successive stimuli. [Supported by NIDCD P50DC02746]

A 105

ASSOCIATIONS BETWEEN AUDITORY ERPS, LANGUAGE AND COGNITIVE ABILITIES FROM 6- TO 24-MONTHS IN INFANTS WITH A FAMILY HISTORY OF SLI *Naseem Choudhury, Cecylia Chojnowska, April Benasich; Rutgers-Newark* – Evoked response potentials (EEG/ERPs) to transient auditory signals have been shown to differ in infants with a family history of specific language impairment (FH+) as compared to controls without such a history (FH-). FH+ infant's responses to fast transient stimuli in an oddball task systematically diverge from those of FH- controls and are predictive of later language outcome. Such findings suggest that the ability to decode auditory input occurring within tens of milliseconds may be a key deficit in individuals with SLI. However, it is unclear if the observed differences in infant ERP waveforms are associated with performance on behavioral measures of language and cognition. Thus, we investigated the relations between ERP waveforms and behavior in a group of normally-developing FH- children (N=26) and in FH+ children (N=10). ERPs were recorded at 6, 9, 12, 16 and 24 months to complex tone-pairs with 300 or 70ms ISIs using an oddball paradigm (standard=100-100Hz: deviant=100-300Hz [15%]). Standardized assessments of language and cognition were administered at 16 and 24 months. Preliminary analyses revealed that the amplitude of 6- and 9-month ERP components (P-N complex and the mismatch response) were associated with 16-month language (r's=.48 - .40) and cognition (r's=.34 - .58). Further, 16-month language was associated with 24-month ERPs (r's=.30 - .48). The associations were more robust for FH+ infants as compared to controls and for the 70ms ISI stimuli. These results converge on behavioral data documenting differences in FH+ infants' auditory processing abilities as early as 3-6 months of age.

A 106

DAILY TRAINING REQUIREMENTS FOR BYPASSING THE STIMULUS SPECIFICITY OF PERCEPTUAL LEARNING *Karen Banai, Jeanette Ortiz, Jason Oppenheimer, Beverly A. Wright; Northwestern University* – Perceptual learning is often highly specific to the trained stimuli. In auditory temporal-interval discrimination, studied here, learning is specific to the trained temporal-interval, suggesting that in order to improve perception of multiple intervals each must be practiced. Our goals were to determine whether practicing two standard intervals within each of multiple daily training sessions yields learning on both, and if so whether the presentation pattern of the standards affects the amount of improvement. Temporal-interval discrimination of 1-kHz tones was trained using a 2-alternative forced-choice adaptive protocol for a total of 720 trials/day for 6 days (standard temporal-intervals: 100 and 350 ms; 360 trials each), in one of three daily regimens: (1) Blocked – standard changed after 360 trials; (2) Interleaved – standard alternated every 120 trials; (3) Random – standard randomly determined on each trial. Only listeners in the Blocked regimen improved significantly on both intervals from pre- to post-training relative to untrained controls. Listeners in the other regimens typically improved during training, but only on one interval, and not significantly when compared to controls. These data demonstrate that improvement on temporal-interval discrimination on two intervals between which learning normally does not generalize can be induced by training both intervals within each training session. However, robust learning does not occur if training switches too frequently between the two intervals. It is possible that with frequent alternation between intervals, either learning is not initiated or the presentation of one interval interferes with retention or consolidation of learning initiated during practice on the other interval.

A 107

PERCEIVING NEW MUSIC RECRUITS FLEXIBLE NEURAL MECHANISMS *Psyche Loui[1], David L. Wessel[1], Elaine H. Wu[1,2], Robert T. Knight[1,2]; [1]University of California at Berkeley, [2]Helen Wills Neuroscience Institute* – One of the intriguing characteristics of human cognition is its tendency to form expectancies, which are important for language and music. To investigate neural activity during the formation and violation of expectations for sound patterns, we examined human electrophysiology during the perception of a novel system of musical sounds. The new musical system consists of chord progressions in the Bohlen-Pierce scale (which is based on 13 logarithmic divisions of a 3:1 frequency ratio) instead of the Western scale (based on 12 divisions of a 2:1 ratio). Three types of chord progressions were presented with different probabilities: Standard (70%), Deviant (20%), and Fadeout (10%). Participants detected the fadeout chords while their EEG was recorded. ERPs elicited by unexpected chords revealed a frontal Early Anterior Negativity (EAN) at 150-210ms ($F(1,22) = 5.77$, $p = 0.02$ over site Fz), followed by a prefrontal Late Negativity (LN) at 400-600ms ($F(1,22) = 13.91$, $p = 0.001$ over site Fpz). These effects increased over the course of the experiment, and were dictated by the relative probability of the chords. In addition, increased low Gamma-band activity (30-40Hz) was observed for unexpected chords over frontal sites, consistent with other mismatch studies. Findings in the new musical system parallel those obtained in Western music (Loui et al, 2005) and suggest that perception recruits flexible neural processes which rapidly integrate and form expectations for probable events in a novel context. Supported by NINDS NS21135. References Loui, P.; Grent-'t-Jong, T.; Torpey, D.; Woldorff, M.G. (2005). Cognitive Brain Research, 25, 678-687.

A 108

SUCCESS-RELATED AND ERROR-RELATED FEEDBACK ACTIVATE REGIONS ASSOCIATED WITH AUTOMATIZATION AND RECONCEPTUALIZATION, RESPECTIVELY. *Matthew S. Shane, Kent A. Kiehl; The MIND Institute, University of New Mexico* – Success-related and error-related feedback may be theorized to play very different roles in the shaping of goal-directed behavior. Whereas success-related feedback promotes consolidation and automatization of performed action patterns, error-related feedback promotes reconsideration of the performed action, as well as the problem space within which the action was performed. Within this framework, the receipt of positive and negative feedback may be anticipated to lead to substantially different neural activity, associated with automatization and reconceptualization, respectively. In the present study, functional magnetic resonance imaging (fMRI) was utilized during performance of a time-estimation task wherein participants were provided with contingent positive and negative feedback indicating the accuracy of their time estimations. This task was chosen strategically, as a task that minimized both learning-related and expectancy-related activations. Within this task, we report robust activity in subcortical regions including nucleus accumbens, caudate, and pallidum upon receipt of success-related feedback. In contrast, error-related feedback was associated with increased activity in dorsal anterior cingulate cortex. We interpret these results as indicating that success-related feedback, even within a context minimizing learning-related processing, activates neural regions association with automatization and habit formation. Error-related feedback, in contrast, activates regions with well-established roles in executive functions including action-monitoring and motor-selection.

A 109

EFFECTS OF COMPUTERIZED AUDITORY TRAINING ON EVENT RELATED POTENTIALS ELICITED BY RAPIDLY PRESENTED TONES IN 6 – 9 YEAR-OLD CHILDREN WITH A LANGUAGE-BASED LEARNING IMPAIRMENT *Jennifer T. Friedman, Naseem Choudhury, April A. Benasich; Rutgers University* – Rapid auditory processing (RAP) is believed to underlie successful language acquisition, and conversely, impaired RAP may be a key deficit in language-based learning impairments (LI). In this study, RAP was evaluated in 6–9 year old LI children (n=23) before and after completing a computerized auditory intervention program (Fast ForWord) that targets impaired auditory processing. Age-matched controls (n=15) with normal language skills received no intervention. Pre- and post- intervention event-related potentials (ERPs) were passively elicited in an oddball paradigm (standard stimulus = 100-100Hz tone pair [80%]; deviant = 100-300Hz). Each tone was 70 ms in duration, with 70 ms between the two tones. Inspection of the control group's P1-N1-P2 complex in the deviant waveform revealed that all three of these components were distinct, peaking at ca. 110, 220, and 240 ms, respectively. This complex was followed by a prominent N2 with a latency of ca. 270 ms. In the pre-intervention LI group, only the P1 and N2 peaks were observed. Following successful intervention, verified by significant improvement in standardized language score (CELF-4, p<.001), the LI group exhibited a typical P1-N1-P2 complex with three identifiable components that resembled that of controls in morphology and latency. No changes were observed in the P1 and N2 peaks. These data suggest that RAP is altered in children with LI after completing Fast ForWord such that they are better able to automatically process two brief, rapidly presented, successive auditory stimuli.

A 110

CENTRAL AUDITORY PROCESSING DEFICITS IN PATIENTS WITH AUDITORY HALLUCINATIONS AS REVEALED BY EVENT-RELATED POTENTIALS. *Susan Rossell[1], Hamish Innes-Brown[1], Katherine Henshall[2], Alex Sergejew[1], Tracey Shea[1], Melissa Wright[1], Colette McKay[3], Gary Egan[4]; [1]Mental Health Research Institute of Victoria, [2]University of Melbourne [3]School of Life and Health Sciences, Aston University, [4]Howard Florey Institute* — It has been proposed that auditory hallucinations (Ahs) result from cortical or cortico-subcortical disconnection. The results presented here are an initial event-related potential (ERP) exploration of data examining central auditory function and cortical connectivity. Twenty-two controls, twenty-six non-hallucinating patients with psychosis (nAVH), and twenty-two currently hallucinating patients (AVH) with psychosis were recruited. ERPs to words and tones (left-ear, right-ear and bilaterally) were recorded during a passive listening task. Data from the left- and right-ear stimuli are presented here. The auditory N1 ERP was measured in two seven-channel composite regions - left-temporal and right-temporal. Words: N1 is enhanced contralaterally in the control group. With left words, both patient groups show reduced N1 in the right hemisphere. With right words both patient groups show a reduction in the left hemisphere. Only AVH patients show a reduction in the ipsilateral hemisphere. Tones: No contralateral N1 enhancement is evident. With left stimuli both patient groups show reduced N1 compared to controls in both contra- and ipsi-lateral hemispheres. With right stimuli only the AVH group show a reduction in both hemispheres. The tones data confirms previous studies showing a reduced right ear advantage behaviourally in schizophrenia patients, especially in those that hallucinate – suggesting a neurobiological origin for such behaviour. The word data suggests that more complex stimuli have a unique linguistic quality that has been more strongly lateralized. Having shown basic ERP differences in the processing of lateralized words and tones, our next step is to look specifically at left-right hemisphere connectivity.

A 111

COMPLEX SOUNDS IN THE BRAIN: NEUROELECTRIC CORRELATES REPRESENTING PITCH AND HARMONICITY INFORMATION *Ben Dyson[1], Claude Alain[2], Yu He[2]; [1]University of Sussex, [2]Rotman Research Institute* — The joint representation of pitch and harmonicity information is essential in partitioning our sound world into multiple and concurrently available acoustic objects. The recording of auditory ERPs facilitates our understanding of these mechanisms as a result of the fine temporal resolution and use of both passive and active listening conditions that auditory ERP recording affords. Data will be presented describing the passive representation of complex sounds varying in pitch and harmonicity at primary cortical areas (Experiment 1), the effect of repetition and change on such representations (Experiment 2), the influence of top-down effects in modulating stimulus representation during responding (Experiment 3) and the distinction between different stimulus tokens (Experiment 4) in organising complex sound. The data will be discussed in terms of mandatory and optional constraints in acoustic processing and current models of processing harmonically related and unrelated sound.

A 112

CHARACTERIZING INDIVIDUAL DIFFERENCES IN SPEECH PERCEPTION USING A COCHLEAR IMPLANT SIMULATION *Carolyn McGettigan, Stuart Rosen, Frank Eisner, Sophie Scott; Institute of Cognitive Neuroscience, University College London, UK* — The recipient of a cochlear implant (CI) is faced with the challenge of learning to recognize sounds in a brand new auditory environment; this can be a lengthy process, with highly variable levels of success across patients. We describe a project investigating inter-individual variability in speech recognition and perceptual learning in normal-hearing adults listening to a CI simulation (noise-vocoded speech). Noise-vocoded (NV) speech is degraded in the spectral domain, sounding like a harsh, noisy whisper (Scott et al., 2000). Intelligibility improves as the number of bands of information in the stimulus is increased. We quantified speech recognition performance along this acoustic parameter (number of bands for criterion recognition), and explored cognitive correlates of this performance. NV sentence recognition scores were significantly correlated with measures of verbal IQ, nonword repetition and rhythm perception. However, a study comparing recognition of NV sentences, words, consonants and vowels indicated a complicated pattern of correlations between these tasks i.e. high recognition scores for one stimulus type does not guarantee a similar performance for all other categories. This suggests that the cognitive correlates of recognition performance may depend on the linguistic and attentional demands of the perceptual task; for instance, recognition of a highly predictable sentence loads on top-down semantic processes while an isolated consonant demands attention at a lower, acoustic-phonetic level. We conclude that noise-vocoded speech is a useful tool with which we can quantify variability in speech recognition and identify significant cognitive correlates, even within a relatively homogenous group of University-educated volunteers.

A 113

REPETITIVE TMS OF CEREBELLUM INTERFERESWITH MILISECOND TIME PROCESSING *Giacomo Koch[1], Miguel Fernandez del Olmo[2], Binith Cheeran[3], Sara Torriero[1], Silvia Salerno[1], Emanuele Lo Gerfo[1], Carlo Caltagirone[1], John Rothwell[3]; [1]Fondazione Santa Lucia IRCCS, [2]INEF Galicia, [3]Institute of Neurology, University College London* — Time processing is important in several cognitive and motor functions, but it is still unclear how the human brain perceives time intervals of different durations. Processing of time in millisecond and second intervals may depend on different neural networks and there is now considerable evidence to suggest that these intervals are possibly measured by independent brain mechanisms. Using repetitive transcranial magnetic stimulation (rTMS) we determined that the cerebellum is essential in explicit temporal processing of millisecond time intervals and motor timing in the same intervals. In the first and second experiment, subjects' performance in a time reproduction task of short (400-600 ms) and long (1600-2400 ms) intervals, were evaluated immediately after application of inhibitory rTMS trains over the left and right lateral cerebellum (Cb) and the right dorsolateral prefrontal cortex (DLPFC). We found that rTMS over the lateral cerebellum impaired time perception in the short interval (millisecond range) only when the time intervals were encoded but not when they were retrieved from memory; for the second range intervals, impaired timing was found selectively for stimulation of the right DLPFC. In other series of experiments the rTMS over the right lateral cerebellum affected the variability in the right index finger tapping task in presence of auditory cue at 2 Hz but not at 1 or 0.5 Hz and neither in the continuation phase or visual cue. Our results are consistent with the hypothesis that the cerebellum can be considered as an internal timing system, deputed to assess millisecond time intervals.

A 114

SCHIZOPHRENIA ALTERS SPECIFIC MISMATCH COMPONENTS IN MEG AND EEG *Klaus Mathiak[1], Mikhail Zvyagintsev[1], Klaus C. Harke[1], Frank Boers[2], Jürgen Dammers[2], Christine Norra[3], Heike Thönneßen[1], [1]RWTH Aachen, Germany, [2]Research Center Juelich, Germany, [3]Max-Planck-Insititute for Experimental Medicine, Goettingen, Germany* – The mismatch negativity (MMN) is an event-related potential reflecting automatic information processing and auditory sensory memory. This measure of early cognitive function is well documented to be impaired in schizophrenia. Different paradigms and methods (EEG and magnetoencephalography, MEG), however, are applied to measure MMN and it is unclear whether they reflect one unitary mechanism. We investigated the change of MMN and its MEG counterpart in schizophrenia for a standard oddball design (80% standards, 10% duration and 10% frequency deviants) and a new optimum design (Näätänen et al. 2003; 50% standards and 10% deviants each reflecting change of one of 5 auditory features). Twelve patients with schizophrenia (DSM IV) and 12 healthy controls were investigated with EEG (64-channel) and 148-channel whole-head MEG. Data analysis was performed with fully observer-independent automatized Matlab-routines based on localization from probabilistic cytoarchitectonic maps. For the schizophrenia group, the mismatch response was reduced most significantly and with the highest amplitude difference in the neuromagnetic optimum design. We conclude that optimized MMN designs are most promising for diagnostics of endophenotypes in schizophrenia. The differences in effects of schizophrenia on the different MMN measures suggest (a) that MEG captures more early cortical processes as compared to EEG which are mostly affected in schizophrenia and (b) that adaptation/habituation, feature representation, and auditory memory trace may contribute to MMN depending on its measurement technique and the design parameters. The abstract feature representation as addressed by the optimum design may be the core dysfunction in schizophrenia.

A 115

INDUCED GAMMA ACTIVITY IN YOUNG AND ADULT MUSICIANS FOR THE PREFERRED STIMULI *Antoine Shahin[1], Larry Roberts[2], Wilkin Chau[3,4], Laurel Trainor[2], Lee Miller[1]; [1]University of California Davis, California, [2]McMaster University, Ont, Canada, [3]University of Toronto, Ont Canada, [4]Rotman Research Institute* – Induced gamma band activity (IGBA) is associated with object representation, specifically for objects exhibiting the neurons' preferred stimulus. We examined IGBA in young pianists (4-5 years) trained in the Suzuki method, adult (> 18 years) musicians (violinists and pianists) and age-matched non-musicians. The adult violinists were members of Canada's National Academy Orchestra and the pianists were college music students. Participants listened passively to piano and violin tones and pure tones matched in pitch to the music tones. When compared to pure tones, the highly trained adult violinists and young pianists showed enhanced IGBA for their preferred timbre, while the IGBA for the adult pianists was enhanced for violin and piano tones equally. The Suzuki pupils' IGBA were equally present prior to and a year after commencement of musical practice, suggesting an intrinsic musical aptitude. Non-musicians did not exhibit any IGBA specificity between tones. The current work suggests that induced gamma activity reflects a mechanism where sounds of the preferred timbre are uniquely distinguished in the musician's brain. This likely comes about when stimulus characteristics are matched to previously encoded templates in memory.

A 116

NEUROELECTRIC CORRELATES OF RAPID PERCEPTUAL LEARNING OF SPEECH SOUNDS *Claude Alain, Sandra Campeanu, Kelly Tremblay; Rotman Research Institute, Baycrest Centre, Toronto, Canada* – Learning perceptual skills is characterized by rapid improvements in performance within the first hour of training (fast perceptual learning) followed by more gradual improvements that take place over several daily practice sessions (slow perceptual learning). While it is widely accepted that slow perceptual learning is accompanied by enhanced stimulus representation in sensory cortices, there is considerable controversy about the neural substrates underlying early and rapid improvements in learning perceptual skills. Here we measured event-related brain potentials (ERPs) while listeners were trained to identify two consonant-vowel syllables. Listeners were also presented with a broadband noise to examine whether training-related changes in ERPs were specific to the trained speech cue. Participants performed 10 blocks with 90 trials in each block. The ability to identify both speech sounds improved from the first to the fourth block of trials, and remained relatively constant thereafter. Behavioral improvement coincided with an increased negative peak (between 180-350 ms) over frontocentral sites, and an increase in sustained activity over the parietal regions. While the former was also observed for the noise, the latter was specific to speech sounds. The results are consistent with a top-down non-specific attention effect on neural activity during learning, as well as a more learning-specific modulation, reflecting behavioral improvements in speech identification.

A 117

AUDITORY CORTEX MONITORS TYPE AND SOURCE OF ACOUSTIC INPUT AS REVEALED BY SPATIAL-TEMPORAL ICA *Vincent van de Ven[1], Ingrid Christoffels[1,2]; [1]University Maastricht, The Netherlands, [2]Leiden Institute of Brain and Cognition, LUMC, The Netherlands* – The monitoring of speech production and comprehension involves a widespread cortical network, including frontal and temporal areas, but it remains unclear how these areas contribute to these processes. A previous fMRI study of overt speech and feedback monitoring identified the right auditory cortex (AC) as an important neural correlate for speech monitoring. However, how specific is AC for monitoring, and how is it functionally connected to other brain areas? Independent component analysis (ICA), an explorative, multivariate analysis technique, can be used to investigate these questions. ICA does not require an a-priori defined model of brain activity, and reveals functionally connected networks. In fMRI studies ICA is applied to either the spatial or the temporal domain; the combination can yield novel insights about the spatiotemporal dynamics of brain activity. We applied self-organizing group ICA (sogICA), which investigates components on the multi-subject level, to fMRI data of six healthy subjects. Each subject performed five tasks (overt speech production with(out) noise, covert speech production, listening to own prerecorded voice with(out) noise) across five functional runs. Spatial sogICA revealed seven spatial components (bilateral AC, bilateral central sulcus, bilateral insula, left fronto-temporal, posterior cingulate, left fronto-parietal and visual cortex) that contributed uniquely to overt speech production, comprehension and monitoring. Temporal sogICA of the AC component further showed two temporally independent sources for a) self-generated vs. perceived speech and b) language vs. noise. This study revealed that, while independent but overlapping cortical networks subserve speech processes, the AC distinguishes source and type of the acoustic input.

A 118

NEURAL RESPONSES IN HUMAN AUDITORY CORTEX TO VARYING STIMULUS RATES *Roy Mukamel[1], Yuval Nir[2], Amos Arieli[2], Rafael Malach[2], Itzhak Fried[1,3]; [1]UCLA, Los Angeles, [2]Weizmann Institute of Science, Rehovot, Israel, [3]Tel-Aviv University, Israel* – While imaging techniques have provided important insights about the topographical organization of human auditory cortex – little is understood about the principles that govern it at the single neuron level, especially during natural audition. We recorded extra-cellular spiking activity of neurons in human auditory cortex of patients undergoing a clinical procedure. In order to assess the effect of stimulus speed on the neural responses, patients were presented with an audio-visual movie clip at various speeds while pitch level across speeds was maintained. Despite the 2-4 fold increase in stimulus rate, no significant effect on firing rate was observed (average firing rates for normal, double, and quadruple speeds were 3.46±0.44Hz, 3.45±0.40Hz, and 3.62±0.44Hz respectively). The overall distribution of inter spike intervals (ISI) was similar even for short ISIs reflecting strong bursts of evoked activity. In order to directly compare the neural responses evoked by the normal and double speeds, the spike train of the double speed was artificially "stretched" so that the durations will be identical. The average level of correlation between the normal and the "stretched" double speed was 0.44±0.03 and 0.47±0.03 between the double and quadruple speeds. In comparison, the correlation between two repeats of the same stimulus was 0.37±0.03 and 0.44±0.03 for normal and double speeds respectively. Our data suggest that the dynamics of auditory responses can be explained as a combination of a precise temporal code indicating stimulus onset (within 10 ms) and a speed invariant rate coding of the stimulus content.

Perceptual Processes: Multisensory Processing

A 119

SOUND-INDUCED ILLUSORY FLASHES: ISSUES FOR A PSYCHOPHYSIOLOGICAL INVESTIGATION. *Hamish Innes-Brown[1,2], David Crewther[1]; [1]Brain Sciences Institute, Swinburne University, [2]Mental Health Research Institute of Victoria* – The first clear case where auditory information radically affects unambiguous visual perception was documented some years ago (Shams, Kamitani and Shimojo, 2000). Varying the number of auditory beeps presented coincidently with visual flashes was found to vary the number of visual flashes perceived. The illusory effect is phenomenological rather than qualitative, is stable with respect to many experimental variables and as such is thought to reflect an extensive property of polysensory mechanisms in the brain. Classic time-locked averages (ERPs) and event-related spectral perturbation (ERSP) are compared for this data set. Although the behavioural data indicated that the illusion occurred on 53% of one-flash/two-beep trials, no differences were found in the ERP's between illusion and non-illusion trials. Examination of ERSP plots revealed that illusion trials showed a transient increase in gamma-band activity (40-45Hz) at around 170ms, while non-illusion trials showed a decrease in gamma-band power at the same time, and a transient increase in beta (20-30Hz) power at around 100 ms. Although only small ERP differences were found between the illusion and non-illusion trials, non time-locked dynamic changes in brain activity were found to exhibit different patterns between illusion and non-illusion trials.

A 120

THE EFFECT OF CROSS-HAND POSITION ON VISUO-SPATIAL MAP FOR ACTION IN A PATIENT WITH LEFT PARIETAL LOBE DAMAGE *Chiharu Niki[1], Takashi Maruyama[2], Yoshihiro Muragaki[2], Takatsune Kumada[1]; [1]AIST (Advanced Industrial Science and Technology), [2]Tokyo Women's Medical University* – There is little evidence that how visual and proprioceptive representations of hands are integrated into a visuo-spatial map for action. In this study, we investigated the effect of visual representation of hands in a spatial S-R compatibility task. Participant: A 32-year-old man (GY) with left parietal lobe damage participated. Method: A target was presented either to the right or left of fixation. GY was asked to identify the side of the target by pressing a key assigned to the location. There were two hand posture conditions: uncross-hand (u) and cross-hand (c). There were two compatibility conditions: In the compatible condition (C), GY responded to the target location by spatially corresponding keys. In the incompatible condition (I), GY responded by opposite keys to the target location. These two conditions were orthogonally combined; uC, uI, cC, and cI. All conditions were performed under following three visual conditions of own hands; uncovered, covered, and fake hands. Reaction time (RT) and error rate were recorded. Results: RT of cI under uncovered hands was longer than any other visual conditions. Error rate was highest in cI under fake hands among other visual conditions. Discussion: Results suggested that the longer RT under uncovered hands reflected GY's deficit in matching of visual representations of hand to proprioceptive one, while error responses under fake hands reflected failure of matching these representations. It was difficult for GY to remap and match multiple representations of hands. These processes might involve coding a visuo-spatial map for action.

A 121

THE ROLE OF SUPERIOR COLLICULUS IN AUDIO-VISUAL INTEGRATION IN HUMANS: CLUES FROM THE REDUNDANT TARGET EFFECTS *Nadia Bolognini[1], Silvia Savazzi[2], Emanuela Bricolo[1], Carlo A. Marzi[2], Angelo Maravita[1]; [1]University of Milano Bicocca, [2]University of Verona* – The superior colliculus (SC) is a critical structure for multimodal integration in lower species and may be an important candidate for multimodal integration in human as well. In particular one could hypothesize that auditory and visual stimuli must be integrated in the SC in order to efficiently orient spatial attention in extrapersonal space. In the present study we aimed at understanding the role of the SC for audio-visual integration in humans and its spatial constraints by using a simple reaction time task. Subjects gave speeded responses to either single (auditory or visual) or audiovisual stimuli presented at fixation (experiment 1) or at lateralized right or left locations (experiment 2) . Responses to the bimodal stimuli were faster than to single stimuli of either modality for central as well as lateralized (both spatially congruent or incongruent) audiovisual pairings, the so-called Redundant Signal Effect. However, the bimodal speed advantage was related a neural co-activation mechanism (Miller 1982) only when a red monochromatic visual stimulus was presented at the same location of the auditory stimulus, while probabilistic summation occurred for spatially incongruent audiovisual pairings. Instead, monochromatic purple stimuli, invisible to the SC, always yielded probabilistic summation. The disappearance of the redundancy gain with purple or non-coincident stimuli suggests a critical role of the human SC for this mechanism. Indeed, animal studies show that SC neurons do not respond to purple stimuli (Summer et al. 2002) and that they show optimal multisensory enhancement for spatially coincident audiovisual stimuli (Stein & Meredith, 1993).

A 122

OVERCOMING DIFFERENCES IN EMBODIMENT: THE MIRROR SYSTEM AND GOAL MATCHING *Valeria Gazzola[1], Henk van der Worp[1], Theo Mulder[1,2], Wicker[3], Giacomo Rizzolatti[4], Christian Keysers[1]; [1]University of Groningen, Groningen, NL, [2]3Royal Netherlands Academy of Arts and Sciences, Kloveniersburgwal, Amsterdam, [3]Institut de Neurosciences Cognitives de la Méditerranée, CNRS, Marseille, France, [4]Universita di Parma, Parma, Italy* – The mirror system (MS) for actions is thought to contribute to the understanding of the actions of others by mapping a particular observed action onto the corresponding motor program of the observer. But would the MS contribute to the perception of hand actions even if the observer never had any hands or arms? Would it remain silent, because the observer lacks matching motor programs for hand actions, or would it respond because the observer has motor programs for the foot or mouth that have corresponding goals? We tested these hypotheses by scanning two aplasic subjects, born without any arms or hands, while watching movies of hand actions. We compared their brain activity with that of 16 control subjects. To identify the MS, all subjects additionally executed actions with different effectors (feet, mouth and, for controls, hands). Aplasic subjects activated their 'mirror areas' as strongly as controls, demonstrating the brain's capacity to mirror actions that deviate from the motor programs and embodiment of the observer. This finding suggests that the MS is not tied to the effector used by the observed agent, but instead flexibly maps the observed goal onto what-ever effector the observer may normally use to achieve similar goals. Such effector independent goal-matching sheds new light on the functional organization of the MS, indicating that the brain can mirror a much wider range of actions than previously assumed and offers a neural basis for the behavioral predominance of goals during imitation.

A 123

LOCALIZING THE SELF OUTSIDE ONE'S BODY: A FULL BODY ANALOGUE OF THE RUBBER HAND ILLUSION *Bigna Lenggenhager, Tej Tadi, Olaf Blanke; Ecole polytechnique fédéral de Lausanne (EPFL), Lausanne* – During the rubber-hand-illusion healthy subjects misidentify a foreign hand as their own hand (misidentification) and localize their own hand as shifted towards the foreign hand (mislocalization). These findings corroborate earlier data in patients suffering from somatoparaphrenia. Yet, clinical evidence from autoscopic phenomena suggests that not just body parts, but the entire body can be mislocalized and misidentified. Using Virtual Reality, the present study examined the potential of a full body analogue of the rubber-hand-illusion to induce misidentification/mislocalization of the entire body. The subject's back was stroked by the investigator and recorded with a 3D-camera from 2m distance. While being stroked, the subjects either saw their own back (condition I), the back of a mannequin (condition II) or an object (control condition) being stroked and projected directly (synchronous) or time-lagged (asynchronous) on a Head Mounted Display. After stroking, subjects were passively displaced and asked to return to their initial position (deviations were measured). Subjects filled out a modified "rubberhand-questionnaire". Results of the questionnaire showed that for the synchronous conditions I and II, subjects felt as if the virtual character was their own body. This was not the case in the control or asynchronous conditions. The synchronous experimental conditions showed also a significantly larger shift towards the projected body/mannequin than the asynchrounous and control conditions. These data suggest that self location – due to conflicting visual-somatosensory input – is prone to misidentification and mislocalization as previously reported for body parts. These findings are discussed with respect to neural and functional mechanisms of embodiment.

A 125

OCCIPITAL TMS HAS OPPOSING EFFECTS ON VISUAL AND AUDITORY PERIPHERAL STIMULUS DETECTION: IMPLICATIONS FOR MULTISENSORY INTERACTIONS *Vincenzo Romei[1], Micah M. Murray[2], Gregor Thut[1]; [1]University Medical School, Geneva, Switzerland, [2]Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland* – Recent studies show that multisensory interactions occur during initial sensory transmission, i.e. early in time and in low-level cortical areas. We investigated the mechanisms underlying early auditory-visual interactions using Transcranial Magnetic Stimulation (TMS) and a simple reaction time (RT) task to rudimentary stimuli. Brief auditory or visual stimuli were presented alone or simultaneously (A, V, AV). These peripheral stimuli were paired with visual cortex stimulation by single-pulse TMS over the occipital pole, applied at delays of 30-150ms from peripheral stimulus onset. RTs to auditory stimuli were significantly shortened (beneficial effect) when the visual cortex was stimulated by TMS at 60-75ms post-stimulus onset, whereas RTs to visual stimuli were prolonged (interference effect) by TMS at the same delays (relative to TMS over a control site). This reveals a double dissociation of TMS-effectiveness depending on input modality. No TMS-effect was observed for AV-stimulation. The beneficial effect of combined peripheral auditory and TMS-induced visual stimulation matched the RT facilitation for peripheral multisensory AV stimulation without TMS, indicative of interactions between the peripherally evoked auditory and TMS-induced visual activity. Its temporal profile relative to peripheral stimulus onset (60-75ms) is suggestive of a window of increased visual cortex sensitivity for conveying auditory-visual interactions that coincides in time with the initial volley of visual input. The data support a model of early AV-convergence where auditory input is changing the sensitivity of visual neurons (gain control) or their connectivity with 'auditory' areas (gating control) in an early time-window, and consequently affecting behavior in a multisensory setting.

A 126

ROLE OF FRONTAL CORTEX IN RELATIVE DURATION AND DISTANCE JUDGMENTS *Aldo Genovesio, Satoshi Tsujimoto; NIMH* – We recorded frontal-cortex activity from a rhesus monkey discriminating relative durations and distances. In the duration task, a blue circle and a red square appeared sequentially at the monkey's fixation point (screen center), each followed by a delay period (D1 after the first stimulus and D2 after the second). Stimulus durations ranged from 50ms to 3.2s. After D2, the two stimuli appeared simultaneously, one to the left and one to the right of screen center. To receive a reward, the monkey had to choose the stimulus that had persisted longer in its initial presentation. In the distance task, the stimuli appeared for 1s at different distances from screen center, one above and one below it. Matching the duration task, the stimuli later appeared simultaneously, and the monkey had to choose the stimulus that had been located farthest from the center. We used one-way ANOVA ($p<0.05$) on neuronal activity during the first 400ms of D2, with relative duration or distance as the factor. In the duration task, 21% of 182 neurons encoded relative duration: shorter and longer in roughly equal numbers. In the distance task, 21% of 312 neurons encoded relative distance from screen center: nearer and farther in roughly equal numbers. For 37 spatiotemporal- comparator neurons studied in both tasks, 12 encoded only relative duration, 19 only relative distance, and 6 both. These findings indicate that during comparative judgments, frontal neurons can contribute to decisions about relative magnitude in both the spatial and temporal domains.

A 128

PERCEPTUAL FUSION OF MISMATCHED AUDIOVISUAL INFORMATION REQUIRES WORKING MEMORY: AN FMRI STUDY OF THE MCGURK EFFECT *Gary E Strangman[1], Elena K. Festa[2], Lisa Moran[2], Jill C. Gitten[2], William C. Heindel[2]; [1]Harvard Medical School, [2]Brown University* – In the McGurk effect, perception of auditory speech information is altered by the presence of conflicting visual speech information. For example, subjects hearing 'ba' while seeing a speaker articulate 'ga' often fuse the conflicting information and report hearing 'da.' The neurophysiological mechanism underlying this illusory percept, however, remains unclear. We examined this question by assessing the differential brain activation associated with perceptually fused and non-fused audiovisual speech stimuli using either consistent or inconsistent information across modalities. Participants were prescreened to identify "McGurk fusers" sensitive to temporal asynchrony (i.e., they identified conflicting audiovisual stimuli as illusory percepts under temporally-synchronous conditions but as veridical audio matches under asynchronous conditions). For both temporal conditions, audiovisual stimuli consisted of video clips of an individual mouthing non-words (e.g., 'idi') while the voice provided consistent ('idi') or inconsistent ('imi') audio information. During an event-related fMRI scanning session, participants were shown all stimulus types and asked to identify the auditory percept by keypress. When audiovisual information was consistent, asynchronous (perceptually non-fused) stimuli elicited greater bilateral activation than synchronous stimuli in brain areas associated with the visuospatial and phonological working memory systems (dorsolateral prefrontal cortex, posterior parietal cortex, anterior cingulate). Among synchronous stimuli, inconsistent (but perceptually fused) information elicited greater left-lateralized activation of brain areas associated with phonological working memory than consistent information. These results suggest that while McGurk speech stimuli elicit a phenomenological experience of coherent illusory percepts, a more active engagement of the phonological working memory loop appears necessary to generate or maintain that illusory percept.

A 129

SPATIAL SELECTIVE ATTENTION MODULATES AUDITORY-SOMATOSENSORY INTERACTIONS. A HIGH-DENSITY ERP STUDY. *Jennifer Montesi[1], Mauel Gomez-Ramirez[2,1], John Foxe[2,1], Pejman Sehatpour[1]; [1]The Nathan S. Kline Institute for Psychiatric Research, [2]City College of The City University of New York* – The aim of this experiment was to determine whether selectively attending to stimuli on one side of space influences Auditory-Somatosensory interactions, and to characterize the spatiotemporal dynamics of the integration effects on the attended and the unattended sides. The somatosensory stimuli consisted of vibrations delivered to the tip of the index and the middle finger of the right or left hand. The auditory stimuli were vibratory sounds delivered through speakers that were spatially aligned with the hand positions. This was done to maintain maximal possible ecological validity. Subjects were required to selectively attend to the stimuli on just one side (right or left) while ignoring stimulation on the other side. These were counterbalanced across stimulus blocks. The task of the subjects was to respond when rare target stimuli were detected. This was done to ensure that the subjects were attending to the stimuli. Task difficulty was calibrated psychophysically on an individual subject basis. Analyses: ERP multisensory interactions for standard (non-target) stimuli on the attended side were compared to the multisensory interactions for standard (non-target) stimuli when they were presented to the same side but were ignored (unattended standards). Results: Preliminary electrophysiological results reveal attentional modulation of the unisensory and the auditory-somatosensory multisensory ERP responses.

A 130

VISUAL SUBSTITUTION LEARNING OF ABSTRACT SHAPES VIA AUDITORY INPUT *Jung-Kyong Kim, Robert J Zatorre; McGill University, Montreal Neurological Institute* – The notion behind visual substitution is to replace vision by another sensory input while conveying the essence of the visual information. The current study investigated tactile learning using auditory input in sighted subjects. We used the visual substitution algorithm called the 'vOICe' which translates visual images into soundscapes (Meijer, 1992), but applied it to tactile stimuli. Over the course of approximately three weeks, subjects participated in nine ~2-hour training sessions during which they learned the relationship of various abstract shapes to their corresponding converted sounds. In order to prevent the use of vision, subjects were blindfolded throughout each session. They used their right hands to explore a tactile shape that was embossed on a piece of paper while simultaneously hearing the sound corresponding to the given shape. Subjects were evaluated with forced-choice recognition tasks at the end of every three training sessions using both the items encountered during training and new items designed to test for generalization. Significant improvement was observed over time in recognizing the corresponding converted sounds for both old and novel shapes, suggesting generalization of learning of shapes via auditory input. In addition, at the end of the three-week training period, subjects were given a visual task where they were to recognize visual images, seen for the first time, corresponding to converted sounds. High accuracy on this task was observed even though the feedback subjects received throughout training was solely tactile in nature, suggesting crossmodal transferability of the substitution learning from the tactile to the visual modality.

A 131

DISTINCT SENSORY-MOTOR INTEGRATION REGIONS FOR VOCAL TRACT VS. MANUAL EFFECTORS: AN FMRI STUDY OF SKILLED MUSICIANS *Judy Pa, Gregory Hickok; University of California, Irvine* – There has been substantial research on sensory-motor integration within the visual system. For instance, distinct regions of parietal cortex have been linked to particular motor systems, such as AIP for grasping and LIP for ocular movements. Recent work has contributed to this body of work from the perspective of another sensory modality, namely audition. A Sylvian-parietal-temporal area (Spt) has been found to have auditory-motor response properties, and has been hypothesized to be part of a sensory-motor integration region for the vocal tract. Such a view predicts that activity in Spt will be modulated by manipulations of output modality to a greater extent than by manipulations of sensory input modality. We employed a 2x2 design in which we co-varied sensory input modality with motor output system. Skilled musicians were presented with musical notation (visual) or tonal melodies (auditory) and were instructed to either covertly hum (vocal tract) or imagine playing (manual) the melody. Spt responded more strongly to the hum than play condition, but was not affected by input modality, indicating selectivity for output, but not input manipulations. An inferior parietal site showed preferential responses to the play condition, and was similarly unaffected by input modality. These results suggest that Spt and the inferior parietal site are part of a larger sensory-motor network that is organized around motor-effector systems, and are multi-sensory in nature.

A 132

INFLUENCE OF LATERALIZED AUDITORY STIMULATION ON EGOCENTRIC REFERENCE *Eve Dupierrix[1], Théophile Ohlmann[1,2], Sylvie Chokron[1,2]; [1]CNRS - UMR/Université Pierre Mendès-France, France, [2]Fondation Ophtalmologique A. de Rothschild, Paris, France* – The present study aimed to study the role of perception in the construction of the egocentric reference position. To reach this aim, twenty-four normal participants were submitted to a proprioceptive straight ahead pointing (SAP) task before and after a lateralized auditory task (in the left or the right hemispace). In the lateralized auditory task, participants had to judge whether two sequential pure tones were identical or differed regarding their frequency. The task was divided in two conditions in which auditory stimuli were presented either in the left or in the right hemispace respectively. Data analysis consisted in comparing the position of the egocentric reference (SAP) in the pre and the post-tests. Results showed that the position of the egocentric reference is depdendent upon the perceptual experience. As a matter of fact, when the auditory judgement task was restricted to the left hemispace, it induced a subsequent leftward deviation of the egocentric reference whereas a rightward auditory stimulation did not affect the position of the egocentric reference as recorded by the SAP task. These findings indicate that the position of the egocentric reference depends on the sensory experience even in the auditory modality. These results are discussed with regards to cognitive models of spatial cognition and have some clinical and theoritical implications for spatial disorders such as unilateral spatial neglect.

Perceptual Processes: High-Level Vision

A 133

CONTEXTUAL PROCESSING OF FACES IN THE PARAHIPPOCAMPAL CORTEX *Elissa Aminoff[1,2], Alumit Ishai[3], Moshe Bar[2,4]; [1]Harvard University, [2]Martinos Center for Biomedical Imaging at MGH, Harvard Medical School, [3]Institute of Neuroradiology, University of Zurich, Switzerland* – The parahippocampal cortex (PHC) has previously been implicated in both place processing (e.g., PPA) as well as in episodic memory. We have proposed that the underlying function of the PHC should instead be perceived as contextual associative processing, which is a necessary component of both navigation and memory. We have tested this extensively (Bar & Aminoff 2003, Aminoff et al. 2006) by investigating the activation elicited by objects that are strongly associated with a place-related context e.g., a parking meter, or by objects that are strongly associated with a non-spatial context e.g. a birthday cake. Both showed significant PHC activation compared with the activation elicited by objects with weak or no contextual associations (e.g., an apple). According to our proposal, any associative object should activate the PHC. To test this generalization, we considered famous faces. Famous faces tend to be highly associative (e.g., Tom Cruise) with rich pictorial and semantic information, and are not typically associated with any specific place. Indeed, contrasting famous faces (i.e., contemporary Hollywood celebrities) with unfamiliar faces revealed significant activation within the PHC in agreement with our prediction. We will present a clear comparison of the activity elicited by place scenes, strong contextual objects, and famous faces to show that they activate overlapping regions of the PHC. This observation adds important support to our conclusion that the PHC emphasizes contextual associations. The modified perception that we propose for the role of the PHC, thus, bridges seemingly contradicting findings by placing them in a broader context.

A 134

PERCEIVING AGE AND GENDER IN UNFAMILIAR FACES: EVENT-RELATED POTENTIAL EVIDENCE FOR AUTOMATIC CATEGORY ACTIVATION *Holger Wiese, Stefan R. Schweinberger, Markus F. Neumann; Friedrich-Schiller-University of Jena* – Efficient processing of person-related information from unfamiliar faces is thought to proceed via categorization processes (e.g. old vs. young, male vs. female). However, it remains controversial whether relevant categories are activated automatically, or whether category activation is determined by controlling factors, such as processing strategies set by the experimental task. We investigated cognitive and neural processes underlying unfamiliar face categorization in an experiment consisting of two consecutive blocks, each with consecutive priming and test phases. During both priming and test phases, participants categorized unfamiliar faces according to either age or gender. Faces presented at test were either new, or were primed in a task-congruent (same task during priming and test) or incongruent (different tasks) condition. Reaction times (RTs) revealed significant priming for both congruent and incongruent faces during age categorization, and event-related potentials (ERPs) yielded an increased N170 as a result of priming. During gender categorization only congruent faces elicited an RT priming effect, although ERPs revealed a significant reduction of the N400 for both congruent and incongruent faces. These results suggest a differentiated perspective on category activation in person perception: Information about age is extracted automatically from unfamiliar faces, and priming in age categorization facilitates early structural encoding stages, represented by the N170. By contrast, while behavioural gender categorization depends on controlled processing, the N400 results suggest that priming in gender categorization automatically facilitates semantic processing of the target face.

A 135

WHEN ACTION INFLUENCES PERCEPTION: EVIDENCE FOR RAPID ACCESS TO ACTION REPRESENTATIONS DURING VISUAL OBJECT RECOGNITION *Markus Kiefer[1], Eun-Jin Sim[1], Hannah Helbig[2], Markus Graf[2]; [1]University of Ulm, Ulm Germany, [2]Max-Planck-Institute for Cognitive and Brain Sciences, Munich, Germany* – It is typically assumed that perception for action and object recognition are subserved by functionally and neuroanatomically distinct processing streams in the brain. However, in a recent behavioral action priming study we showed that action representations facilitate object recognition, suggesting an interaction between both visual processing streams (Helbig, H. B., Graf, M., & Kiefer, M. (2006). Experimental Brain Research, 174, 221-228). The present study aimed at further elucidating the role of action representations in visual object recognition. We determined the temporal and spatial pattern of brain activity underlying the action priming effect using event-related potentials (ERPs). Similar to our behavioral study, two briefly displayed manipulable objects were sequentially presented, either affording congruent or incongruent motor interactions. Participants had to name the objects after a short delay. We found an effect of action congruency (action priming effect) on ERPs starting at about 100 ms after the onset of the target object at fronto-central electrodes close to the motor cortex. As in the previous behavioral study, this effect was absent when the prime stimulus was presented as a word showing that the action priming effect relies on action representations specified by visual object information. Our present ERP findings demonstrate that the action priming effect in object recognition arises from rapid access to action representations in motor areas even though subjects did not act upon the objects. This suggests that knowledge about potential interactions with objects can influence their recognition within the first 100 ms of perceptual processing.

A 136

TRAINING BLINDSIGHT FOR DISCRIMINATING NATURAL SCENES IN HEMIANOPIA *Aimée de Vanssay[1,2], Olivier Coubard[1,2], Christian Marendaz[1,2], Nathalie Guyader[1,3], Mickaël Obadia[1], Olivier Gout[1], Sylvie Chokron[1,2]; [1]Fondation Ophtalmologique Adolphe de Rothschild, Paris, France, [2]UMR 5105 CNRS-Université Pierre Mendès-France, Grenoble, France, [3]CNRS, INPG, Grenoble, France* – Homonymous hemianopia (HH) results from a unilateral occipital lobe lesion and refers to a symmetrical loss of vision in both eyes. This experiment was designed to investigate whether hemianopic patients can learn from visual training to analyze visual information in their blind field. Eight right brain-damaged patients (RBDs/left HH), 4 left brain-damaged patients (LBDs/right HH), and 24 healthy participants were flashed city, mountain or beach scenes in either their central, left, or right visual field in two sessions (pre-test and post-test) of a forced-choice categorization task (is it a city, a mountain or a beach?). Between the pre- and the post-test, participants took part in two training sessions during which they were asked to decide if pairs of scenes were identical or not. Contrary to RBDs, LBDs exhibited greater-than-chance accuracy in the pre-test, although performing less efficiently than normals. During the post-test, reaction times were significantly reduced in all participants, and accuracy increased even in the blind visual field for some categories of scenes. These preliminary findings suggest that hemianopics can learn some complex visual information, and use it to perform visual analysis in their blind hemifield.

A 137

BLINDSIGHT IN NATURAL SCENE PERCEPTION: A STUDY ON LEFT AND RIGHT HEMIANOPIC PATIENTS *Céline Perez[1,2], Olivier Coubard[1,2], Christian Marendaz[1,2], Carole Peyrin[1,2], Nathalie Guyader[1,3], Mickaël Obadia[1], Olivier Gout[1], Sylvie Chokron[1,2]; [1]Fondation Ophtalmologique Adolphe de Rothschild, Paris, France, [2]UMR 5105 CNRS-Université Pierre Mendès-France, Grenoble, France, [3]CNRS, INPG, Grenoble, France* – Homonymous hemianopia (HH) refers to a symmetrical loss of vision in both eyes and results from a unilateral occipital lobe lesion. This study explored the ability of hemianopic patients to visually detect and discriminate natural scenes in their central, left, or right visual fields. Seven right brain-damaged patients (RBDs/left HH), 8 left brain-damaged patients (LBDs/right HH) and 32 healthy participants were submitted to a detection and a categorization task of natural scenes (city or forest images) flashed in either their central, left, or right visual field. The scenes were either filtered in high- (HSF) or low- (LSF) spatial frequencies or were non-filtered. Within their blind visual field, RBDs showed impairments in the detection of all kinds of natural scenes, whereas LBDs mostly failed in the detection of HSF scenes. Performance was better in categorization than in detection for some patients confirming that some visual judgement in a forced-choice task can be performed in the blind hemifield without any conscious detection of the stimulus (blindsight). Detection and categorization were better for LSF than for HSF scenes in all patients.These results are discussed with regard to hemispheric specialization for spatial frequencies and to neuroanatomical correlates of blindsight.

A 138

PERCEPTUAL ORGANISATION IN SCHIZOPHRENIA *Nicole Joshua, Alison O'Regan, Susan Rossell; Mental Health Research Institute* – It has been suggested visual perception using Gestalt principles is impaired in schizophrenia. However, a small number of studies suggest Gestalt processing is intact in schizophrenia. The current study investigated this discrepancy with three perceptual organisation tasks. Gestalt principles of proximity and similarity were examined in schizophrenia patients (n = 28), and healthy controls (n= 26). Participants completed the Embedded Figures Task (EFT) and the Similarity Task. Both tasks required participants to determine whether a simple figure was hidden within a more complex figure. Schizophrenia patients did not show impairments on either task. Initial results suggest they are able to utilise principles of Gestalt. However, we speculate that reaching this conclusion is premature. The working memory component of the tasks may have masked differences in Gestalt processing. To address this issue, a revised version of the EFT task was devised. The Contour Integration Task was also included to test a third Gestalt principle of continuity. Neither task involved working memory. Results showed no differential effects on the revised EFT, indicating further evidence to suggest the Gestalt principles of proximity and similarity are intact in schizophrenia. Results did indicate a difference in performance on the Contour Integration Task, suggesting schizophrenia patients may have difficulties applying the principle of continuity. Taken together, results suggest deficits in performance of schizophrenia patients do not lie with tasks involving simple, continuous, geometric shapes, but rather, with tasks involving complex, non-continuous shapes. Further investigations into continuity as well as closure capabilities in schizophrenia are planned.

A 139

SELECTIVITY OF HUMAN MIRROR SYSTEM RESPONSES DURING OBSERVATION AND EXECUTION OF CONGRUENT VERSUS INCONGRUENT HAND ACTIONS *Trevor Chong[1], Ross Cunnington[2,1], Mark A. Williams[3,1], Jason B. Mattingley[1]; [1]University of Melbourne, [2]Howard Florey Institute, [3]Massachusetts Institute of Technology* – The mirror neuron system is thought to underlie the human ability to recognise the actions and gestures of others. It does so by providing a neural mechanism through which a perceived action can be directly matched with its corresponding representation within the observer's own motor repertoire. For this direct matching mechanism to mediate action understanding, a subset of mirror neurons should be more active when the perceived and executed actions are identical, relative to when they are different. This strict correspondence has been demonstrated in monkeys, but the degree of correspondence required for activation of human mirror areas remains unclear. Here, we used fMRI to determine if areas within the mirror system are more active during the observation of matching (congruent) hand gestures compared to those that are non-matching (incongruent). Participants performed a series of pantomimed hand actions, while simultaneously observing either a congruent or incongruent action in separate, counterbalanced blocks. Crucially, the observed actions were irrelevant to participants, so any correspondence between observed and executed actions was incidental. Our analysis revealed that, while performing a specific action, particular nodes within the human mirror system were more active during the perception of congruent, relative to incongruent, actions. These findings indicate that areas within the human mirror system do indeed demonstrate a strict correspondence between observed and executed actions. We conclude that these mirror areas may be critical in the direct matching process that underlies action recognition.

A 140

EXPLAINING INDIVIDUAL VARIABILITY IN LATERALIZATION FOR WORDS AND FACES *Evelyne Mercure, Frederic Dick, Hanife Halit, Mark H Johnson; Birkbeck-University of London* – We explored potential sources of individual variability in lateralization for words and faces by examining data from 4 event-related potentials (ERP) experiments. A total of 65 typically developing adults performed a one-back task, a butterfly detection task or a target recognition task with written words and human faces balanced for low-level psychophysical properties. Over the 4 experiments, word stimuli elicited a left lateralized N170 and face stimuli a right lateralized N170. Surprisingly, there was a strong negative correlation between left lateralization for words and right lateralization for faces, suggesting that there may be stimulus-independent processing strategies influencing lateralization for words and faces. This idea is further supported by the results of a stepwise regression model on lateralization of the N170, with age, gender, handedness, schooling, and behavioral task as predictors. For both faces and words, behavioral task was the factor with by far the most influence. Specifically, the N170 to words was more left lateralized in the one-back task than in the recognition and butterfly detection task, while the N170 to faces tended to be less lateralized in the one-back task compared to the other two tasks. Schooling also accounted for significant variance in the degree of left lateralization of the N170 to word stimuli. Gender, age and handedness did not show a significant influence. These results suggest that most of the individual variability in lateralization may be best explained by differences in processing strategies that individuals apply to both words and faces, rather than by age, gender or handedness.

A 141

NEURAL CORRELATES OF COLOR CATEGORY PROCESSING *Elisabeth Fonteneau, Jules Davidoff; Goldsmiths College, University of London, UK* – Previous research using behavioral techniques reveals that the sensory color continuum can be modified by category. Within-category stimuli (Green0-Green1) now look more similar and are harder to distinguish whereas between-category stimuli (Green0-Blue0) look more different and are easier to distinguish even though their distances in color space are equal. We report the first evidence for the neurophysiological architecture of color categories. We compared event-related brain potentials (ERPs) elicited by physically identical colors (Green0) in three different color contexts in an oddball paradigm while twenty participants performed an unrelated color task. Two of the contexts were different color categories (large distance: Green0-Red0 vs. small distance: Green0-Blue0) and the third context was different colors from the same category (Green0-Green1). Our results showed that deviant colors stimuli in all three different contexts elicited a positive deflection in the posterior regions - the change-related positivity - compared to standard stimuli. In addition, both magnitude of color difference and category difference reduced the latencies of the change-related positivity (34 msec and 20 msec respectively). No amplitude effect was found to correlate with either color magnitude or color category. We conclude that the change-related positivity reflects color category as well as color deviancy processing. Moreover, category effects were not lateralised and suggest that, even if color categories are derived from the color terms of a speaker's language, the changes to color appearance have been effected at a site within visual cortex.

A 142

THE EFFECTS OF STIMULUS-ONSET ASYNCHRONY AND PRIME DURATION ON MASKED REPETITION PRIMING IN PICTURES: AN ERP STUDY *Marianna Eddy, Annette Schmid, Phillip Holcomb; Tufts University* – We previously reported a series of ERP effects in a masked picture priming paradigm in which a briefly presented prime picture (50ms) was followed at a relatively short (110 ms) stimulus-onset asynchrony (SOA) by either the same or different target. These repetition effects included an early anterior negativity/posterior positivity for unrepeated target pictures compared to repeated target pictures, peaking around 190 ms post target onset (N190/P190). The N190/P190 effects most likely index early visual processing in the ventral processing stream. Small N300 and N400 effects were also observed for unrepeated pictures compared to repeated pictures. It has been argued that the N300 effect is specific to processing of object representations while the N400 reflects a more general semantic process. The current experiments investigated how manipulating prime-target SOA (110ms, 230ms, 350ms, 470ms) and prime duration (30ms, 50ms, 70ms, 90ms) affects these early, middle, and later ERP components. In the first experiment, the SOA manipulation produced early priming effects (N190/P190) for all SOAs while middle and later processing effects (N300/N400) were only observed at shorter SOAs. When manipulating the prime duration in the second experiment, effects at all time-windows were larger with increased prime duration. In particular, with increasing exposure to the prime, larger N300 and N400 effects were observed at the two longest prime durations (70 and 90 ms). Taken together, these results suggest that higher level object specific and semantic processing in feed-forward object recognition requires a longer exposure to the prime rather than an additional head start in processing.

A 143

ARE FACES AND BODIES PROCESSED BY DISTINCT MECHANISMS? EVIDENCE FROM THE INVERSION EFFECT AND INDIVIDUAL DIFFERENCES *Galit Yovel[1], Arielle Tambini[2]; [1]Tel Aviv University, [2]Massachusetts Institute of Technology* — It is well established that faces are processed by specialized configural mechanisms. Interestingly, recent studies suggested that bodies, like faces, also engage configural processing mechanisms. Here we examined whether faces and bodies are mediated by similar or separate mechanisms. In experiment 1 and 2, we measured the inversion effect for faces or bodies that differed in identity or in head-view/body-posture. Our results show that the face inversion effect is larger than the body inversion effect for both identity discrimination and view/posture discrimination. These findings imply that faces and bodies may be dissociated. To directly assess this idea in Experiment 3 we examined the correlations between performance on memory and perceptual matching of bodies or faces. The body perception task was positively correlated with the body memory task and the face perception task was positively correlated with the face memory task. In addition, there was no correlation between perceptual discrimination of faces and bodies, but there was a positive correlation between the face memory and the body memory tasks. Our findings suggest that faces and bodies are processed by stimulus-specific mechanisms at the perceptual stage and therefore suggest that bodies and faces are not processed by the same configural mechanisms.

A 144

PRECISE ESTIMATION OF MEAN EMOTION IN CROWDS OF FACES *Jason Haberman, David Whitney; UC Davis, Center for Mind and Brain* — Although visual scenes are cluttered with individual objects, there is often some degree of similarity between the items. For processing efficiency, the visual system derives summary statistical information about crowds of items in lieu of coding individual elements. This has only been explored for low-level visual features. Here, we tested whether observers extracted the 'mean emotion' of a set of faces, even when it was impossible to code every member of the set. In experiment 1, participants viewed sets of faces displaying varying levels of happiness. Participants were more likely to indicate that a subsequently presented test face was a member of the set as the emotion of the test face approached the mean emotion of the set, even though the mean emotion was never presented in the set. The results are not due to a prototype effect, as the mean emotion changed on every trial, thereby preventing prototype formation. In experiment 2, participants were unable to identify which of two faces was a member of the previously presented set, suggesting they lacked individualized item information. In experiment 3, participants indicated whether a test face was happier or sadder than the mean emotion of the set. Participants were extraordinarily precise in deriving the mean emotion, nearly matching their performance on a face discrimination task (i.e. deciding which of two faces was happier). This evidence suggests there are visual mechanisms, perhaps at multiple stages, that efficiently extract statistical information about sets of objects ranging from low-level features to high-level objects.

A 145

ARE YOU LOOKING AT ME? NEURAL CORRELATES OF EYE GAZE ADAPTATION *Nadine Kloth[1], Stefan R. Schweinberger[1], Rob Jenkins[2]; [1]Friedrich-Schiller-University of Jena, Germany, [2]University of Glasgow, United Kingdom* — Eye gaze is an important social signal and a relevant attentional cue. Humans are extremely accurate at determining the direction of gaze in others. However, recent research shows a dramatic effect of adaptation on gaze perception: After adaptation to faces with eye gaze strongly diverted to one side, the ability to perceive smaller gaze deviations to the same direction is severely impaired (Jenkins, Beaver, & Calder, 2006, Psychological Science). We further analyzed the characteristics of gaze direction aftereffects and examined neural correlates of gaze adaptation using event-related potentials (ERPs). We compared participants' ability to correctly classify left, straight and right gaze direction before and after adaptation to eye gaze strongly diverted to either left or right. After adaptation to one side we found that correct classifications to that side decreased and incorrect classifications as straight gaze increased. Further, after adaptation gaze directed to the adapted side was more often classified as being directed to the opposite side. The latter finding is in some conflict with the assumption of distinct neuronal populations which selectively code particular directions of eye gaze. Our behavioural results also suggest that gaze direction aftereffects are more long-lasting (i.e. in the range of minutes) than previously thought. Whereas the analysis of ERPs revealed an adaptation effect from 250-350 ms, no effects were found for the N170. This suggests that, rather than changing processing of eye gaze ~170 ms in posterior temporal areas, adaptation modifies subsequent processes that may be mediated by more anterior temporal areas.

A 146

HIGH-LEVEL VISUAL AFTEREFFECTS INDUCED BY VIRTUAL IMAGES. *Jae-Jin Ryu, Avi Chaudhuri; McGill University* — Findings from numerous brain imaging studies suggest that real images and our mental representations of those images share similar neural processing mechanisms. If the patterns of neural activation elicited by visual imagery are similar to those elicited by real images, then it can be predicted that the influence of visual imagery on neural processes underlying perception would be comparable to that of real images. The current study investigated this possibility using selective-adaptation paradigm designed to induce face-identity aftereffect (FIA). FIA is a high-level visual aftereffect in which the perception of a face is influenced by previous exposure to a particular face with perceptually opposite features (anti-face). We hypothesized that if similar neural mechanisms underlie processing of visual images and visual percepts, FIA should be induced by both real and virtual face images. In the virtual image condition of our experiment, participants were shown the name of a newly-learned face and asked to visualize the face. We found that merely visualizing an anti-face was sufficient to produce shifts in the perception of subsequence face images. Our results suggest that visual imagery and real images not only recruit similar neural networks but also influence behavior in similar manners.

A 147

DYNAMIC REORGANIZATION OF FUSIFORM GYRUS: LONG-TERM BIRD EXPERTISE REDUCES FACE SELECTIVITY *Chun-Chia Kung[1,2], Colin Ellis[1], Michael Tarr[1]; [1]Brown University ,[2]Princeton University* — Category-selective neural responses in ventral-temporal cortex have often been associated with expert-level processing of homogeneous object categories. Less concern is paid to the capacity issues across multiple domains of expertise. If faces and other domains of expertise share the same (finite) neural resources, we might expect long-term competition effects: increasing expertise in a non-face domain may decrease the neural resources available for processing faces. Across two fMRI studies using different groups of bird experts, we found that higher behaviorally-measured bird expertise predicts both increasing category-selective neural responses to birds and, concomitantly, decreasing category-selective neural responses to faces. This inverse relationship between bird expertise and face selectivity in fusiform gyrus holds across various tasks and methods of analysis, and is consistent with similar results obtained with laboratory-trained experts. In a control experiment we ruled out the possibility that birders have an attentional bias to birds, or less interest to artificial face images. Interestingly, bird experts' face recognition performance was not measurably worse than novices. It may be that the tasks used in our study were not sufficiently sensitive to reveal the behavioral consequences of this neural tradeoff; or that some of the flexible and redundant neural systems underlying face processing were compromised without impairing behavioral performance. Overall, our results point to common neural coding mechanisms in the category-selective responses seen for faces and other domains of expertise. Moreover, such mechanisms appear to retain plasticity over one's lifespan, dynamically reorganizing as a consequence of experience.

Poster Session B

Higher Level Cognition: Executive Functions

B 1

NEUROCOGNITIVE MECHANISMS OF PERCEPTUAL DECISION-MAKING IN THE HUMAN BRAIN *Bruno Kopp, Sandra Tabeling, Carsten Moschner, Karl Wessel; Research Institute of Cognitive Neurology, Klinikum Braunschweig* – Decision-making is a fundamental capacity which is crucial to many higher-order psychological functions. Nevertheless, very little is known about its neurocognitive implementation. We recorded event-related potentials during a multidimensional visual target-detection (´oddball´) task to determine whether variations in perceptual distinctiveness modulate the nature of perceptual decision-making in the human brain. In particular, the decision maker had to choose between two-stage-processing of perceptual information obtained from independent sensory features or one-stage-processing performed on integrated transformations of multidimensional sensory events. The N2/P3a-complex that was recorded in response to non-target stimuli emerged as decision-related neural activity. The modulations of the N2/P3a-amplitudes indicated that two-stage-processing dominated when the perceptual distinctiveness of the sensory features differed strongly, whereas sensory features of comparable perceptual distinctiveness favored one-stage-processing. Our analysis of the neural basis of perceptual decision-making shows that the making of perceptual decisions involves an adaptive process of selecting among diverse decision rules.

B 2

SEQUENCE LEARNING AND MEDIAL-FRONTAL: EXTERNAL VERSUS INTERNAL ERROR EVALUATION *Olav Krigolson, Kyle Mathewson, Clay Holroyd; 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

B 3

ACTION AND CONSEQUENCE IN NEURAL REPRESENTATIONS OF UNCERTAINTY *Jamil P. Bhanji[1], Jennifer S. Beer[1], Silvia A. Bunge[2,1]; [1]University of California at Davis, [2]Helen Wills Neuroscience Institute, University of California at Berkeley* – Decision-making requires individuals to choose from a variety of responses to maximize outcomes. In some cases, a particular choice is clearly associated with a favorable outcome, and individuals can make a decision by following the rules of association. In other cases, individuals may be uncertain of what response to choose and/or uncertain of what outcome will result from a particular choice. Most previous functional imaging studies have focused on understanding neural regions recruited under uncertainty while choosing a response. The current study extended this previous research by examining neural systems associated with uncertainty (a) when choosing a response and (b) when anticipating an outcome. Functional magnetic resonance imaging data suggest that separable regions in the brain were recruited according to level of uncertainty at the point of choice and anticipation of outcome. Lateral orbitofrontal cortex and anterior insula showed greater activity for higher levels of uncertainty prior to choice. Dorsal striatum, subgenual cingulate cortex, and hippocampal regions showed greater activity for higher levels of uncertainty during anticipation of outcomes. In contrast, dorsolateral prefrontal and posterior parietal cortex were recruited for rule-guided decisions that involved no uncertainty. Discussion focuses on the implications of these findings for models of rule-guided behavior and reinforcement learning.

B 4

DOPAMINE AND COGNITIVE CONTROL: CANNABIS AND ECSTASY USE IMPAIRS THE UPDATING OF VISUOMOTOR BINDINGS *Lorenza Colzato, Claudia Nanninga, Pieter van Leeuwen, Roxana Asmus, Rianne van der Kleij, Bernhard Hommel; Leiden University* – Animal studies suggest that feature integration (episodic binding) across perception and action is driven by the dopaminergic system. We investigated in humans whether the updating of episodic bindings between task-relevant stimulus features and the response are affected by the use of ecstasy (MDMA) and cannabis (THC)—two drugs that strongly impact the dopaminergic system. As expected, recreational users of MDMA and THC showed more pronounced rebinding costs than never-users, that is, their performance was more impaired by a mismatch between the stimulus-response relation in the current and the previous trial. This suggests that dopaminergic pathways regulate the handling and control of episodic event representations.

B 5

THE INFLUENCE OF TASK CONFLICTS ON SWITCH-RELATED EVENT-RELATED POTENTIALS *Shulan Hsieh; National Chung Cheng University* – This study aimed to investigate how stimulus-induced task conflicts may affect task switching and how such effect may modulate switch-related event-related potentials (ERPs). In this study, a pair-wise task switching paradigm was employed where task switch and repeat trials were compared between conditions of foreknowledge and non-foreknowledge of the forthcoming task transition. The stimulus-display consisted of a target and a distractor can produce task conflicts when both are associated with two different tasks. Task conflicts were estimated by comparing stimulus displays associated with only one task (neutral) to those associated with two tasks (congruent or incongruent). The results showed that mean response time for incongruent trials was slower than that for congruent trials, and mean response time for congruent trials was further slower than that for neutral trials. Previous ERP studies of task switching have reported some switch-related ERP components. This study observed that stimulus-induced task conflicts modulated the switch-related ERP components. The results thus support the postulation that suppression processes incurred by task conflicts may take place at the level of task-set as well as the level of response-set.

B 6

ANXIETY AND ERROR MONITORING: INCREASED ERROR SENSITIVITY OR ALTERED EXPECTATIONS? *Rebecca Compton, Joshua Carp, Laura Chaddock, Stephanie Fineman, Lorna Quandt, Jeffrey Ratliff; Haverford College* — This study tested the prediction that the error-related negativity (ERN), a physiological measure of error monitoring, would be enhanced in anxious individuals, particularly in conditions with threatening cues. Participants made gender judgments about faces whose expressions were either happy, angry, or neutral. Replicating prior studies, midline scalp negativities were greater following errors than following correct responses ($F(1,25)=13.79$, $p<.001$). In addition, state anxiety interacted with facial expression to predict ERN amplitudes ($F(2,46)=3.91$, $p<.04$). Counter to predictions, increasing state anxiety was correlated with smaller ERNs following errors in angry-face blocks (partial $r = 0.58$, $p<.005$) and larger ERNs following errors in happy-face blocks (partial $r = -0.60$, $p<.004$). These results are inconsistent with the simple notion that anxiety enhances error-sensitivity globally. Rather, we interpret the findings within an expectancy violation framework, in which anxious participants have altered expectations for success and failure in the context of happy and angry facial cues, with greater ERN amplitudes elicited when expectations are violated.

B 7

ATTENDING TO MIND AND BODY: MINDFULNESS TRAINING REVEALS DISTINCT NEURAL MODES OF SELF-AWARENESS *Norman Farb[1], Zindel Segal[1], Helen Mayberg[2], Jim Bean[3], Deborah McKeon[3], Adam Anderson[1]; [1]University of Toronto, [2]Emory University, [3]St. Joseph's Health Centre* — Despite of considerable progress specifying the cognitive and neural mechanisms underlying the temporally extended self (e.g., retrieval of personality traits from memory), little is known about the neural mechanisms by which humans monitor momentary self-experience in the psychological present. To characterize these two aspects of self-awareness, we used fMRI to examine regional brain activity in individuals before or after 8 weeks of training in mindfulness meditation (MT), during 1) “narrative” self-focus (NF), characterized by monitoring the self related to enduring traits and 2) “experiential” self-focus (EF), characterized by monitoring the self related to moment-to-moment experience, while reading personality descriptors. Novice participants engaged cortical midline self-referential regions (medial prefrontal cortex, mPFC) to a lesser degree during EF than NF. Following MT, EF resulted in more pronounced and widespread reductions in midline cortical activity, which were replaced by a right lateralized network, comprised of the ventral and dorsal PFC and posterior cortical foci, including regions associated with viscero-somatic representations (right insula, inferior parietal lobule and secondary somatosensory cortex). Consistent with the importance of mPFC disengagement for EF, functional connectivity analyses demonstrated a decoupling between the right insula and mPFC following but not before MT. These results suggest a fundamental neural dissociation between distinct forms of self-awareness uncovered through mindfulness training—a mental and bodily self. Focused monitoring of moment-to-moment experience is associated with increased access to right lateralized neural representations of the bodily self, potentially representing the underlying older substrates and origins of selfhood.

B 8

VERBAL/NONVERBAL MODALITY INDEPENDENCE OF ACTIVATION IN LEFT AND RIGHT INFERIOR PREFRONTAL CORTEX DURING INHIBITORY CONTROL AS REVEALED BY FMRI *Hiroki Morimoto, Koji Jimura, Tomoki Asari, Junichi Chikazoe, Kenichiro Yamashita, Yasushi Miyashita, Seiki Konishi; The University of Tokyo School of Medicine* — One of the most prevailing views on the functional localization of human cognition is the functional hemispheric asymmetry, wherein the left hemisphere is implicated primarily in verbal processing whereas the right hemisphere is implicated primarily in nonverbal processing. Inhibitory control has been known to be involved in the lateral prefrontal cortex, particularly in the posterior inferior frontal gyrus (IFG). Although activation during inhibitory control has frequently been reported in the IFG in both the right and left hemispheres, it remains unclear what factor determines the hemispheric dominance of the activation. In this fMRI study we tested whether the hemispheric asymmetry principle applies to the IFG activation during inhibitory control. A flanker task was devised that allowed us to manipulate the modality of the presented flanker stimulus (color word or colored patch) from which interference effects originate, keeping the total stimulus modality effects balanced. Consistent with previous studies of the flanker task, the posterior part of the IFG was prominently activated. Although the dorsal frontal areas showed prominent hemisphere-by-modality interaction in simple visual effects (i.e., left frontal activation during word processing and right frontal activation during color processing), the IFG failed to show the hemisphere-by-modality interaction in inhibitory control of flanker interference. These results suggest that the left and right IFG activation during inhibitory control is independent of the modality of presented stimulus from which the interference effects originate.

B 9

NEURAL PREDICTORS OF ERRORS DURING A STOP SIGNAL TASK *Chiang-shan Ray Li, Peisi Yan, Rajita Sinha; Yale University* — The ability to detect errors and adjust behavior accordingly is essential for maneuvering in an uncertain environment. Errors are particularly prone to occur when multiple, conflicting responses are registered in a situation that requires flexible behavioral outputs. Previous studies have provided evidence indicating the importance of the medial cortical brain regions including the cingulate cortex in error processing. However, little is known about the neural processes that predict errors. Here in an fMRI study we employ a stop signal task to elicit errors approximately half of the time despite constant behavioral adjustment of the observers (n=40, healthy adults, 20 males). By comparing go trials preceding a stop error and those preceding a stop success, we showed that (at $p<0.05$, corrected for multiple comparisons) the activation of bilateral precuneus and posterior cingulate cortices, perigenual anterior cingulate cortex and rostromedial superior medial frontal gyrus (MNI coordinate: x=4mm, y=52, z=24mm) precedes errors during the stop signal task. Receiver operating characteristic (ROC) analysis based on signal detection theory showed that these three regions predict errors with an accuracy between 0.83 and 0.86 (area under the ROC curve). These results broadly support the hypothesis that deactivation of the default mode circuitry including these brain regions is associated with mental effort in a cognitive task. Furthermore, the current results indicate that the extent of activation of these brain regions can specifically be associated with performance errors.

B 10

A PDP MODEL OF CONFLICT AND ANTERIOR CINGULATE ACTIVITY IN THE GO-CHANGE TASK *Vincent van Veen, Cameron S. Carter; UC Davis* — We and others have proposed hat the anterior cingulate cortex' role in cognition is to monitor for the presence of conflicts between active representations, and to alert the attentional system to the presence of such conflicts. This theory has recently been challenged (and expanded) by Brown & Braver's (2005) "error likelihood model", according to which the cingulate detects situations in which errors are likely to occur, rather than conflict. Brown & Braver measured cingulate activation in a go/change task, and compared this to the predictions made by the conflict theory and error likelihood theory as implemented in two PDP models, and observed that the cingulate activation resembled the predictions by the error likelihood model better than the conflict model. However, here we present an alternative PDP model of Brown & Braver's go/change task in which conflict also closely resembled the pattern of activation found in the ACC in Brown & Braver's study. We conclude that the go/change task used by Brown & Braver might not allow us to distinguish between the predictions made by the error likelihood and conflict theories of anterior cingulate functioning.

B 11

SYMBOLICALLY DRIVEN PREPARATORY ADJUSTMENTS IN COGNITIVE CONTROL BY ANTERIOR CINGULATE CORTEX *Esther Aarts[1], Ardi Roelofs[1], Miranda van Turennout[2]; [1]Nijmegen Institute for Cognition and Information, University of Nijmegen, The Netherlands, [2]Behavioral Science Institute, University of Nijmegen, The Netherlands* – Adjustments in cognitive control are frequently made on the basis of environmental information. Previous studies have shown that the anterior cingulate cortex (ACC) is involved in trial-to-trial adjustments in control following response conflict. However, adjustments in control also occur in anticipation of demanding activities. The present event-related fMRI study investigates the role of the ACC in preparatory adjustments in control. Twelve participants performed an arrow-word Stroop task. They responded manually to the words LEFT or RIGHT combined with incongruent or congruent left- or right-pointing arrows or neutral rectangles. A symbolic cue informed the participants about the upcoming stimulus condition or provided no information. Response times were slower on incongruent than on neutral trials and fastest on congruent trials. These differences among stimulus conditions were smaller after informative than after uninformative cues, indicating control adjustments. ACC activity reflected these preparatory adjustments in control based on symbolic cues. The ACC was more active for informative than for uninformative cues. Importantly, the ACC did not differentiate between informative cues preceding incongruent and congruent stimuli, showing that the ACC's involvement in preparatory control is independent of upcoming response conflict. In response to the stimulus, ACC activity was larger for incongruent than for neutral stimuli and lowest for congruent stimuli, but only following uninformative cues. Following informative cues, no difference in ACC activity was obtained among stimulus conditions. Interestingly, these results suggest that when control can be adjusted in advance the ACC is no longer involved in resolving Stroop conflict.

B 12

RESPONSE MONITORING IN OLDER AND YOUNGER ADULTS *Maria Pietschmann, Tanja Endrass, Norbert Kathmann; Humboldt University Berlin, Institute of Psychology* – The comparison of actions and their outcomes with internal goals, termed response monitoring, is essential for goal-directed and adaptive behavior. Quite unknown is whether response monitoring functions decrease with age. Response monitoring can be studied using the error-related and the correct response-related negativity (ERN and CRN), two components of the event-related brain potential following incorrect respective correct responses. It was proposed that response monitoring, particularly of errors alter with learning (Holroyd and Coles, 2002, Psychol Rev), and that older adults show deficits therein (Nieuwenhuis et al., 2002, Cogn Affect Behav Neurosci). We examined changes over time in response monitoring during learning, and whether older adults differ in these processes. The electroencephalogram (EEG) was recorded at the beginning of an association-learning task and after completed learning. The results showed similar-sized ERN and CRN amplitudes in both age groups at the beginning of learning, indicating monitoring of action but no detection of errors in this learning phase. With advanced learning, response monitoring became error-specific in younger adults, reflected by decreased CRN and increased ERN amplitudes. This dissociation was observed in older adults only in later task phases, suggesting that elderly need longer practice periods to develop error-specific response monitoring.

B 13

ELECTROPHYSIOLOGICAL EVIDENCE FOR ENDOGENOUS CONTROL IN SWITCHING BETWEEN LANGUAGES IN OVERT PICTURE NAMING *Kim M. W. Verhoef, Ardi Roelofs[1], Dorothee J. Chwilla; Nijmegen Institute for Cognition and information* – Language switching in bilingual speakers requires cognitive control to select the appropriate language. Previous task-switching studies used task cues preceding the imperative stimuli to study endogenous control in preparation for a task switch. However, it has appeared to be difficult to detect brain activity specific to task-switch preparation. Interpretation of previous work is complicated by, first, a confound of cue switches and task switches, and, second, by using the color of pictures to indicate the required language thereby confounding endogenous and exogenous control. We investigated brain activity associated with endogenous control in language switching, by recording EEG while Dutch-English bilingual speakers overtly named pictures that were preceded by color-cues indicating the response language (e.g., red or yellow: name in first language, and green or blue: name in second language). The cue-stimulus interval was 750 ms and the response language varied randomly from trial to trial so that the response language on consecutive trials could be the same (repeat trials) or different (switch trials). The color-cues always changed so that language switches were not confounded with cue switches. Naming latencies were longer on switch than on repeat trials, independent of the response language. Cue-locked ERPs on switch trials relative to repeat trials elicited a negative wave starting at about 260 up to 500 ms regardless of the response language. This negative effect initially showed a centroparietal maximum which later extended to more anterior sites. These data provide the first electrophysiological evidence for an endogenous control process in language switching.

B 14

TWO REGIONS WITHIN PREFRONTAL CORTEX ARE NECESSARY FOR RESPONSE INHIBITION MEASURED WITH THE STOP-SIGNAL TASK *Ami Tsuchida, Lesley Fellows; Montreal Neurological Institute, McGill University* – The frontal lobes have long been implicated in inhibitory control. Recent neuroimaging, lesion, and TMS studies have begun to specify the network involved in motor response inhibition in more detail. This literature is not entirely consistent, with some work implicating right lateral prefrontal cortex (particularly inferior frontal gyrus), and other studies suggesting a role for dorsomedial prefrontal cortex. We administered the stop signal task to 28 human subjects with focal frontal lobe damage, and 26 demographically-matched controls. Subjects with frontal lobe damage were grouped according to the main site of damage: right lateral (N=8), left lateral (N=5), dorsomedial (N=9), and ventromedial (N=6), and the stop-signal reaction time (SSRT) for each group was compared to healthy control performance. Only right lateral and dorsomedial groups had significantly slower SSRT than controls. The precise location of damage within these areas seemed to be important, with only a subset of patients in each group demonstrating impairment. Interestingly, although right lateral and dorsomedial groups were similarly slow to inhibit a response, they differed in their 'go' reaction times. The dorsomedial group made 'go' responses as quickly as controls, while those with right lateral damage were slow to go, as well as to stop. These findings suggest that both dorsomedial and right lateral prefrontal cortex play important, but distinct roles in response inhibition.

B 15

A VOXEL BASED INVESTIGATION OF THE WHITE MATTER NETWORKS INVOLVED IN WORKING MEMORY IN NORMAL AGING *Rebecca Charlton[1], Thomas Barrick[1], Chris Clark[1], Hugh Markus[1], Robin Morris[2]; [1]St George's University of London, [2]Institute of Psychiatry, King's College, University of London* – The gray matter of the frontal lobes have been strongly implicated in working memory, although it is also apparent that multiple brain regions are activated by this ability, including the striatum, anterior cingulate cortex, temporal and parietal lobes. These multiple areas of activation are thought to represent distributed neural networks that are involved in task processing demands. Distributed neural networks must rely on the white matter of the brain to form connections between gray matter regions, enabling communication between remote areas of the brain. The purpose of this study was to identify the white matter tracts implicated in working memory in normal aging, in particular the fronto-parietal and fronto-striatal tracts that have been inferred from functional connectivity studies. 106 normal adults aged between 50 and 90 years old completed assessment of working memory abilities and whole brain diffusion tensor imaging (DTI) was acquired. Images were realigned and normalized to standard space; mean diffusivity (MD) and fractional anisotropy (FA) were calculated for each individual. Using SPM2, voxel clusters (in white matter) that were significantly associated with working memory performance were identified. Tractography was performed to determine those tracts that passed through significant clusters. White matter tracts implicated in working memory are shown to pass between the frontal, parietal, and temporal lobes, connecting areas of gray matter that fMRI has shown previously to be involved in working memory performance. These results demonstrate variations in white matter integrity in normal aging are associated with working memory networks, and visualize the tracts involved.

B 16

METHYLPHENIDATE NORMALIZES BEHAVIORAL AND BRAIN RESPONSES DURING TASK-SWITCHING PERFORMANCE IN CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (AD/HD) *Jose A. Perianez[1], IEsther Cardo[2,1], Mateu Servera-Barcelo[1], Daniel Adrover-Roig[1], Francisco Barcelo[1]; [1]Institut Universitari d'Investigacions en Ciencies de la Salut, Universitat de les Illes Balears, Palma de Mallorca (Spain), [2]Hospital Son Llatzer, Palma de Mallorca (Spain)* – This study aimed to explore the neural correlates of cognitive deficits underlying task-switching performance in children with AD/HD as suggested in previous studies (Kramer et al. 2001), and the specificity of methylphenidate effects normalizing behavioral and neural responses. Nineteen healthy and thirty AD/HD children had their event-related potentials (ERPs) measured while they performed a task-switching paradigm inspired in the Wisconsin Card Sorting Test (Barceló, 2003). The AD/HD group was evaluated under three medical treatments: Placebo, methylphenidate-immediate release (MPH-ir), and methylphenidate-sustained release (MPH-sr). Under placebo, AD/HD children showed less correct responses due to increased false alarms and to a weaker consolidation of the task rule during repetition trials. On the contrary, task-switch costs did not differ between the groups. Only MPH-ir significantly increased the number of correct responses and reduced false alarms. Brain responses to both contextual cues and targets from correct trials showed an abnormal amplitude reduction of the P2 component in AD/HD children with placebo. Healthy children showed an amplitude increase of the N4 component (peak latency 340 ms at Fz) elicited by switch cues that was absent in AD/HD children with placebo. The groups showed similar N1 and P3 brain responses to both cues and targets. Treatment with MPH-ir increased P2 amplitudes elicited by the cues, but not by the targets, in AD/HD children. The results are compatible with a task-set interruption deficit to exogenous contextual cues that was normalized with MPH-ir treatment.

B 17

ROLE OF STRATEGIC SELF-REGULATION AND EXECUTIVE ATTENTION IN SCHIZOPHRENIA. *Gricel Orellana[1], Andrea Slachevsky[1], Marcela Peña[2]; [1]University of Chile, Chile, [2]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 psychosocial 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 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. These deficits are not correlated with the disexecutive behaviours. Moreover, patients presented statistical differences with controls in Raven, WCST, Mattis' s Dementia Rating Scale and disexecutive questionnaires. Conclusions: Our results suggest that troubles in executive attention and strategic auto-regulation could explain some patological behaviours in schizophrenia.

B 18

THE EFFECT OF ALCOHOL INTOXICATION AND EXPECTANCY ON COGNITIVE CONTROL *Rebecca Gloria[1], Patrick Rothwell[2], John Curtin[1]; [1]University of Wisconsin-Madison, [2]University Of Minnesota* – The behavioral deficits associated with alcohol intoxication are often most severe when inappropriate prepotent responses conflict with incompatible but more adaptive responses. These same situations engage cognitive control processes, suggesting alcohol may impair normal cognitive control function. Current cognitive control models include an evaluative component that detects response conflict and a regulative component that executes control processes. This project used electrophysiological (ERP) measures to link alcohol effects on each component with associated behavioral consequences. Participants were assigned to a no-alcohol control group, a placebo group, or an alcohol group (target blood alcohol level = 0.08%). They performed a modified Stroop color-naming task in which the frequency of congruent, neutral, and incongruent conditions was manipulated to create mostly congruent (MC) and mostly incongruent (MI) contexts. Theoretical and empirical work indicates that evaluative and regulative control contribute differentially to performance in each context. Alcohol expectancy (control-placebo contrast) and pharmacology (placebo-alcohol contrast) produced contrasting effects on error rate and ERP correlates of regulative control function in the MC context. Expectancy led to improved performance mediated by regulative control, while pharmacology impaired both performance and regulative function. These results further delineate the cognitive mechanisms underlying intoxicated behavioral deficits and have implications for understanding the development of alcohol use disorders.

B 19

IMMEDIATE-RELEASE METHYLPHENIDATE (MPH-IR) NORMALIZES THE BEHAVIORAL AND NEURAL INDEXES OF CONTEXT PROCESSING IN CHILDREN WITH ATTENTION DEFICIT AND HYPERACTIVITY DISORDER (AD/HD) *Francisco Barceló[1], Daniel Adrover-Roig[1], Esther Cardo[1,2], José Antonio Periáñez[1], Mateu Servera-Barceló[1]; [1]Institut Universitari d'Investigacions en Ciències de la Salut, Universitat de les Illes Balears, Palma de Mallorca (Spain), [2]Hospital Son Llàtzer, Palma de Mallorca* – We explored the neural bases of attention deficit and hyperactivity disorder (AD/HD) with event-related potentials (ERPs) during performance of a continuous performance task (CPT) (Cohen et al., 1996) that allowed us to isolate attentional control processes during context updating and maintenance operations (Miller & Cohen, 2001). Fifteen healthy children were compared with 15 children diagnosed with AD/HD under two different pharmacological treatments with immediate-release methylphenidate (MPH-ir) and sustained-release methylphenidate (MPH-sr) in a double-blind randomized placebo-controlled crossover study. Compared to control children, AD/HD children under placebo achieved a lower number of correct GO trials, and showed larger rates of omission errors. Under placebo, both P2 amplitudes to GO and NOGO trials, and P3 amplitudes to NOGO trials (peak latency 258 ms at Pz) were significantly reduced as compared to those in control children. Under MPH-ir treatment, AD/HD children improved their accuracy in GO trials, and reduced their anticipation errors compared to the MPH-sr condition. The N1, P2, and P3 ERP components in GO trials were not modulated by methylphenidate. In contrast, a frontally distributed negative brain potential (peak latency 308 ms at Fz; N4) was significantly normalized after administration of MPH-ir as compared to placebo. These results are compatible with the existence of an inhibitory deficit to exogenous contextual information in AD/HD children that can be significantly normalized with MPH-ir treatment.

B 20

DEVELOPMENTAL CHANGE IN SWITCHING BETWEEN COLOR TO SHAPE, AND FROM STOPPING TO GOING *Mariette Huizinga, Maurits W. van der Molen; University of Amsterdam* – This study examined developmental differences in the ability to switch between tasks and to shift between stopping and going. Three age groups (6-7 year-olds, 11-12 year-olds, and 20-21 year olds) performed on a hybrid task, in which participants were required to consider the color or shape of a target stimulus, and to execute a choice response on some trials, but a disjunctive response on others. The paradigm allowed the assessment of the speed of choice repetitions and choice alternations (i.e., switches from color- to shape-responses or vice versa, and shifts from go- to choice-responses or from nogo- to choice-responses) and of disjunctive repetitions (i.e., from go- to go-responses) and disjunctive alternations (i.e., shifts from nogo- to go-responses and from choice- to go-responses). The results showed that the costs involved in switching between choice responses decreased with advancing age into adolescence. Similarly, the costs in shifting from stopping to going decreased with the children's age, but already reached mature levels by late childhood. The results indicate that switching between color and shape responses and shifting between stopping and going are both time-consuming processes that mature at different rates.

B 21

COGNITIVE INFLEXIBILITY IN PARKINSON'S DISEASE REFLECTS STRIATAL OR FRONTAL DYSFUNCTION DEPENDING ON MEDICATION STATUS *Roshan Cools[1], Asako Miyakawa[2], Richard Ivry[2], Mark D'Esposito[2]; [1]Behavioural and Clinical Neuroscience Institute, University of Cambridge, [2]Helen Wills Neuroscience Institute, University of California, Berkeley* – The motor deficits in Parkinson's disease (PD) are generally attributed to dopamine depletion in the striatum. Less clear is whether the cognitive deficits in PD are also related to striatal dysfunction or whether they reflect abnormal dopamine function in frontal cortex. We assessed the performance of mild PD patients on a task requiring two types of flexible control. One level involved lower-order switching between concrete stimuli, an operation associated with the striatum. The other level involved higher-order switching between abstract task rules, an operation associated with PFC. When tested OFF their dopaminergic medication, the PD patients' performance was similar to that observed in patients with focal striatal lesions (Cools et al., 2006): They exhibited an impairment in switching between stimuli, but not task rules. By contrast, when tested ON medication, the patients also exhibited a deficit in switching between abstract rules. Thus, dopaminergic medication induced a frontal-like form of cognitive inflexibility, while having no impact on switching between concrete stimuli. These results provide a new demonstration of dopamine-induced deficits in medicated PD patients, consistent with the idea that abnormal frontal function may result from standard dopamine-replacement therapy.

B 22

MORE FLEXIBLE IN A GOOD MOOD? AN ERP STUDY ON POSITIVE AFFECT AND COGNITIVE CONTROL *Nelleke C. van wouwe[1], Guido P. H. Band[1], K. Richard Ridderinkhof[2,1]; [1]Leiden University, [2]University of Amsterdam* – In order to be able to adapt ourselves to a continuously changing environment we need to maintain currently task relevant information against distracting irrelevant information and to flexibly update new incoming relevant information. Dopamine projections to the PFC are thought to facilitate working memory performance, whereas increased cognitive flexibility and facilitation of set switching is attributed to the dopamine projections into the anterior cingulate. Ashby, Turken and Isen (1999) suggested that dopamine can be temporarily increased by means of a positive affect induction. This study investigated, by means of ERP components, the effect of a positive mood induction (i.e. a short movie clip) on proactive (context maintenance and representation) and reactive control in an AX-Continuous Performance Task. This task was used to test how cue information is applied in making a response decision. The subjects' task was to respond on a target probe given that it was preceded by a specific cue. ERP components (CNV and P3) measured after the cues were not affected by the mood induction, showing that attention and motor preparation to the cue was not modulated by mood. The ERPs measured after the probe showed improved performance and smaller N2 and ERN amplitudes for participants in the positive affect condition, as compared to the neutral affect group, to trials in which the cue creates a response bias. This indicates that a positive mood enhances reactive control while cue processing and preparation remains the same compared to a neutral affect condition.

B 23

ASSOCIATIVE AND NEURAL MECHANISMS MEDIATING THE RESOLUTION OF CONFLICT BETWEEN GOAL-DIRECTED ACTIONS *Sanne de Wit[1], Bernard Balleine[2], Sean Ostlund[2], Mike Aitken[1], Yutaka Kosaki[1], Dana Niry[1], Ravi Wariyar[1], Tony Dickinson[1]; [1]University of Cambridge, [2]University of Los Angeles, California* – The associative structures mediating goal-directed action and habit formation were investigated using congruent and incongruent conditional discriminations. In the congruent discrimination, the stimulus was the same as the outcome in each component, and this discrimination should therefore be easy to solve. In contrast, the stimulus of one component of the incongruent discrimination was the same as the outcome of the other component, thereby causing conflict between the two goal-directed actions. We discovered that rats could solve the incongruent discrimination, but were unable to redirect their performance when one of the two outcomes was devalued (through pairing with LiCl-induced nausea) following training. Therefore, rats appear to resolve the response conflict by inhibiting the two conflicting goal-directed actions thereby allowing habitual control over behaviour. Furthermore, temporarily inactivating the prefrontal cortex (through direct infusion into the brain of the GABA-agonist muscimol) impaired performance on the incongruent discrimination (de Wit et al, 2006, Journal of Neuroscience). This finding is in line with demonstrations that the human prefrontal cortex is involved in response conflict resolution and executive control. In a further study we investigated whether human instrumental behaviour is mediated by the same associative structures. In a modified version of our conflict task human participants also solved the incongruent discrimination by adopting a habitual strategy.

B 24

EXECUTIVE CONTROL IN BILINGUAL LANGUAGE PROCESSING: THE PHENOMENON OF INTERFERENCE *Julia Festman[1], Thomas Münte[1], Antoni Rodriguez-Fornells[2]; [1]Otto-von-Guericke University Magdeburg, [2]University of Barcelona* – Generic „executive function" brain areas (e.g., DLPFC and SMA) are suggested to be involved in resolving conflicts of language processing resulting, for example, from the involuntary influence of a non-target language on target-language production. It has been observed that bilinguals differ in their switch behaviour. Some use one language without overt intrusions ("controllers"), whereas others alternate frequently between both languages („switchers"). We investigate whether a bilingual's ability to prevent interference in language processing is related to her/his capability of controlling performance in general, i.e., the efficient use of executive control. Thirty Russian-German bilinguals were divided into two groups according to their switch behaviour in bilingual screening tasks. We used a series of psychometric tests to assess executive functions. The controller group showed significantly faster performance in the TOH test and the Block design test, and produced more correct items in a Verbal Fluency test and a picture-naming task than the switcher group. A series of brain potential experiments are currently underway to explore the consequences of efficient (controller) or less efficient (switcher) executive control. Specifically, a tacit picture-naming task (Go/noGo) is used to determine group differences during phonological interference. We predict interference effects in the bilinguals relative to a monolingual control group, and more errors and more pronounced interference effects on the N200-component of the ERP in the „switcher" than in the „controller" group. We suggest that expected group differences could be attributed to differences in the efficiency, with which cognitive control functions are applied.

B 25

ENHANCED PUNISHMENT BUT NOT REWARD PREDICTION UNDER TRYPTOPHAN DEPLETION *Oliver Robinson, Roshan Cools, Barbara Sahakian; University of Cambridge, Behavioural and Clinical Neuroscience Institute* – The serotonin (5-HT) system has been implicated in motivational processes. The present study used the acute tryptophan depletion (ATD) procedure to investigate the effect of temporarily lowering 5-HT synthesis on reward and punishment prediction in healthy volunteers. We found that ATD enhanced the ability of healthy subjects to learn to predict punishment in a serial reversal learning paradigm. This enhanced prediction was valence-specific and did not extend to reward-prediction trials. The effect was irrespective of the need to reverse responding and contrasts with that of dopamine-enhancing drugs which selectively impaired reversal learning from punishment (Cools et al. Neuropsychologia 2006). Our data are consistent with previous findings demonstrating that ATD affects learning (Murphy et al; Rogers et al., 1999; Parks et al., 1994); enhances the brain response during errors (Evers et al., 2005; NPP); and enhances processing of negative feedback. The current data extend previous findings by showing that this negative bias improves the prediction of negative but not positive outcomes. Importantly, this effect was driven by diminished prediction under 'normal' balanced tryptophan levels - subjects had greater difficulty with predicting punishment than predicting reward, following the balanced but not the tryptophan depleting drink. This observation highlights the possibility that serotonin may confer a protective resilience against adverse outcomes in healthy individuals.

B 26

DISTINCT REGIONS OF MEDIAL ROSTRAL PREFRONTAL CORTEX SUPPORTING SOCIAL AND NONSOCIAL FUNCTIONS *Sam Gilbert, Iain Williamson, Iroise Dumontheil, Jon Simons, Chris Frith, Paul Burgess; University College, London* – While some recent neuroimaging studies have implicated medial rostral prefrontal cortex (MPFC) in "mentalizing" and self-reflection, others have implicated this region in attention towards perceptual versus self-generated information. In order to reconcile these seemingly-contradictory findings, we used fMRI to investigate MPFC activity related to these two functions in a factorial design. Participants performed two tasks that alternated between phases requiring stimulus-oriented and stimulus-independent attention. In half of the blocks ("mentalizing condition"), participants were instructed that they were performing these tasks in collaboration with an experimenter; in other blocks ("non-mentalizing condition") participants were instructed that the experimenter was not involved. The tasks were matched between these two conditions. Neuroimaging data revealed adjacent but clearly distinct regions of activation within MPFC related to a) mentalizing versus non-mentalizing conditions (relatively caudal/superior) and b) stimulus-oriented versus stimulus-independent attention (relatively rostral/inferior). These results suggest a new axis of functional organization within MPFC.

B 27

FEEDBACK ERN TO IRRELEVANT ACTION CONSEQUENCES *Guido Band[1], Henk van Steenbergen[2], Bernhard Hommel[1], Richard Ridderinkhof[2,3], Michael Falkenstein[4]; [1]Leiden Institute for Brain and Cognition, [2]Leiden University, [3]University of Amsterdam [4]Institut fuer Arbeitsphysiologie, Dortmund* – The feedback ERN (fERN) is a central negative brain potential observed after feedback indicating a response error, as compared to feedback indicating a correct response. The typical interpretation of the fERN is that if performance is evaluated to be incorrect or prone to errors, the cingulate zone calls for investment of control. The current experiment investigated whether the fERN is unique to performance feedback information, or whether it is also observed if subjects hear an unexpected and irrelevant action consequence. Subjects engaged in a probabilistic learning task. Each response was followed by a vowel sound (a, e, o, or i) with or without added noise. The noise element indicated whether the stimulus was categorized correctly or not, with 80% validity. The vowel sound was irrelevant, but specific vowels followed specific responses on 80% of the trials. A fERN occurred after a sound indicating an incorrect response. More important, a smaller negative waveform with the same latency and scalp topography as the fERN occurred after an unexpected vowel

B 28

AFTER THE P300: A LATE ERP INDEX OF STIMULUS EVALUATION FOR COMPLEX CATEGORIZATION RULES *Jonathan Folstein, Cyma Van Petten, MungChen Wong; University of Arizona* – Three experiments examined the effects of novelty and distance from a category boundary on categorization accuracy, RT, and event-related potentials. Stimuli were a large number of individually distinct artificial animals. In two experiments, participants categorized stimuli as Mogs if they shared at least two out of three relevant visual features with the prototype of the Mog category, or as Nibs if they shared at least two features with the Nib prototype. Near Boundary stimuli shared one feature with their prototype and two features with the other prototype. A third response of "Other" was used for stimuli that contained neither Mog nor Nib features, and which had no single prototype; these were comprised of either Common or Novel features. After a training phase, ERPs were recorded while participants categorized Near Boundary, Far Boundary, Common Other, and Novel Other stimuli. Perceptual novelty increased the amplitude of the N2 but not the P300 component of the ERP. Although proximity to the category boundary drastically slowed reaction times, it had no effect on P300 latency. Instead, Near-Boundary stimuli elicited a larger late prefrontal positive component than Far-Boundary. When a simpler rule was implemented, P300 latency tracked RT, and less prefrontal activity was elicited. We suggest that, while P300 latency tracks stimulus evaluation time, application of a complex categorization rule requires a later stage of evaluation involving prefrontal cortex. In very complex rules, computations indexed by the P3 may be terminated early in favor of computations in PFC.

B 29

A LIFE-SPAN VIEW ON REINFORCEMENT LEARNING AND ERROR PROCESSING: EVIDENCE FROM THE ERROR-RELATED NEGATIVITY (ERN) *Ben Eppinger, Jutta Kray, Barbara Mock, Axel Mecklinger; Saarland University* – The aim of this project was to examine age differences in learning-related changes in the response- and feedback ERN across the lifespan. The study was based on the reinforcement learning (RL-) theory (Holroyd & Coles, 2002), which suggests that the ERN is generated when a negative reinforcement-learning signal from the dopamine system is conveyed to the anterior cingulate cortex. We used a probabilistic learning paradigm in which participants had to make a two-choice decision upon presentation of an imperative stimulus and received positive or negative feedback. Feedback was manipulated in three validity conditions (100%, 80%, or 50% validity). ERP-data from younger adults, older adults and children indicated that the response ERN increased with learning in the 100% validity condition. However, contrary to the models' predictions, learning-related changes were much more pronounced in response-locked ERPs for correct trials. A similar pattern was obtained for the feedback-locked ERPs in which learning-related changes were only observed for positive feedback, but not for negative feedback. In contrast to the RL-theory (Holroyd & Coles, 2002), these findings suggest that learning is driven by positive learning signals (when the outcome of actions is better than expected). In the present study we did not find evidence for a reduction of the ERN in children or older adults. However, we found pronounced age differences in the feedback ERN, which was increased for children compared to younger adults but was absent for older adults. This finding suggests an asymmetry in the processing of feedback information across the lifespan.

B 30

EXPLORING THE RELATIONSHIP BETWEEN CONSCIOUSNESS AND COGNITIVE CONTROL *Simon van Gaal[1], Richard Ridderinkhof[1,2], Wery van den Wildenberg[1], Victor Lamme[1,3]; [1]University of Amsterdam, [2]Leiden University, [3]Netherlands Institute for Neuroscience* – Many perceptual and motor processes can occur in the absence of consciousness, as evidenced by recent subliminal priming evidence. However, the question which specific cognitive processes can be triggered by unconscious information and which cannot is subject to a lively debate. It has been suggested that cognitive functions depending on cognitive control mechanisms, such as response inhibition and conflict detection, are specifically associated with consciousness. Here, we put these claims to a direct test. To examine the role of consciousness in response inhibition we manipulated awareness of response-relevant control stimuli in a stop task. By using this experimental setup we were able to demonstrate that response inhibition can be triggered by unconsciously presented stop-signals, whereas strategic trial-to-trial behavioral adjustments are not. In a second experiment, we examined the role of consciousness in the detection of conflicting response tendencies by manipulating awareness of Nogo signals in a Go/Nogo task. Preliminary EEG data shows distinct ERPs for Go and unconscious Nogo trials, which are perceptually equivalent. These data suggests that the brain is able to detect unconscious response conflict. Unconscious response inhibition as well as unconscious conflict detection were highly dependent on practice and task performance. Both studies show that unconscious processes are more flexible than previously supposed, and can incorporate control-initiating stimuli that are presented subliminally. Thus, tasks that are traditionally associated with consciousness and cognitive control can become automatic and applied unconsciously.

B 31

CORRELATIONS BETWEEN BOLD ACTIVATION DURING ATTENTION TASKS AND PERFORMANCE ON EXECUTIVE FUNCTIONING MEASURES *Keith Shafritz[1], Karen Marchione[2], Sally Shaywitz[2], Bennett Shaywitz[2]; [1]Hofstra University, [2]Yale University* – Recent studies and theoretical perspectives have suggested that executive function (EF) and attention are interrelated processes. However, the extent of this relationship and the degree to which the two processes utilize overlapping neural structures remain unclear. Here, we investigated the relation between blood oxygen level dependent (BOLD) activation during selective and divided attention tasks and performance on cognitive tests measuring EF. Thirteen adolescents (ages 12-20) completed four variations of a selective attention task and one divided attention task while undergoing functional magnetic resonance imaging (fMRI). During the tasks, participants made yes/no lexical decisions for words that were presented in either visual, auditory, or both visual and auditory domains. The participants also completed the Tower of Hanoi (TOH) and the Wisconsin Card Sorting Test (WCST) outside the scanner. Correlation maps were created comparing BOLD activation during each task with performance measures obtained from the TOH and WCST. Significant positive correlations between TOH scores and BOLD activation were observed in left dorsolateral prefrontal cortex (DLPFC) during all five task variations. In addition, significant positive correlations between WCST errors and BOLD activation were observed bilaterally in inferior posterior parietal cortex (BA 40) during a complex selective attention task and the divided attention task. These results suggest that the more a person engaged the PFC, the easier the person found the TOH. In contrast, the more a person engaged the parietal cortex, the harder the person found the WCST. Therefore, the DLPFC and parietal cortex might serve complimentary roles during attention and EF processes.

B 32

THE MEASUREMENT OF EXECUTIVE FUNCTION IN A POPULATION-BASED SAMPLE OF TWO-YEAR-OLD CHILDREN *Clancy Blair[1], Mike Willoughby[2], Mark Greenberg[1], Emily Werner[1]; [1]Penn State University, [2]University of North Carolina at Chapel Hill* – Normative data on the development of executive function in early childhood are lacking. Therefore, we measured working memory (a scrambled boxes task assessing number of attempts to retrieve stickers inside 3 boxes), inhibitory control/attention shifting (a reverse categorization task in which children sort big and little blocks into big and little buckets), and delay of gratification (a snack delay task with 10, 20, 30, and 15 second delays) in a sample of 1,088 2-year-old children (M = 2.05, range 1.8 – 2.6) in a population-based longitudinal study of families in primarily low-income, non-urban communities. Preliminary analyses indicated that 28% of children completed the working memory task with the minimum number of attempts, and an additional 26% and 14% required one and two additional attempts. 31% of children waited the full delay before retrieving the snack across delay trials. 10% retrieved the snack immediately. Performance across trials was highly stable, χ2=458.96, p<.0001. For reverse categorization, 481 children successfully completed pretest trials. Of these, 49% of children correctly sorted the first 6 blocks (big blocks into little bucket) but only 15% correctly sorted the second 6 blocks (little blocks into big bucket). Working memory and delay were moderately correlated (r=.08) and all 3 tasks were related to mental development (rs =.14,.12,.16 – for working memory, delay, and reverse categorization). Working memory and delay were also related to characteristics of the home, including income-to-need and parenting behavior, even when controlling for mental development (rs=.10).

B 33

ITEM SPECIFIC ADAPTATION AND THE CONFLICT MONITORING HYPOTHESIS: A COMPUTATIONAL MODEL *Chris Blais, Serje Robidoux, Evan Risko, Derek Besner; University of Waterloo* – Botvinick, Braver, Barch, Carter and Cohen (2001, Psychological Review, 108, 624-656) implemented their conflict monitoring hypothesis of anterior cingulate function in a computational model. We first demonstrate that this computational model fails to simulate Jacoby, Lindsay, and Hessels' (2003) report of an item specific congruency proportion (ISPC) effect in the Stroop task. We then implement a variant of Botvinick et al.'s (2001) model based on the assumption that control must be able to operate at the item level. This model successfully simulates the ISPC effect. In addition, the model provides an alternative to Botvinick et al.'s (2001) explanation of the list level proportion congruent effect in terms of an ISPC effect. Implications of the present modeling effort and new predictions are noted.

B 34

DISSOCIATING THE NEURAL MECHANISMS FOR PROCEDURAL SKILL AND SEQUENCE LEARNING USING FUNCTIONAL NEUROIMAGING *Hillary Schwarb, Eric H. Schumacher; Georgia Institute of Technology* – Despite years of research, considerable disagreement remains regarding the cognitive and neural mechanisms responsible for the acquisition and expression of this procedural knowledge. Neural regions implicated in procedural skill learning include frontal, parietal, and premotor regions (e.g., Schumacher, Hendricks, & D'Esposito, 2005) as well the basil ganglia (e.g., Poldrack & Gabrielli, 2001). These regions as well as regions in the medial temporal lobe have been implicated in sequence learning (e.g., Doyan et al., 1996; Grafton, Hazeltine, & Ivry, 2002; Schenden et al., 2003). The present study investigates the relationship between the mechanisms responsible for the acquisition and expression of these types of procedural knowledge. While measuring brain activity, we manipulated the response-selection difficulty and underlying structure of a perceptual-motor task. Results suggest an interacting effect of these cognitive processes as well as the existence of independent mechanisms to support skill and sequence learning.

B 35

NEURAL AND BEHAVIOURAL DIFFERENCES IN PROSPECTIVE MEMORY ACROSS THE LIFESPAN *J Zöllig[1], M Kliegel[1], M Martin[1], R West[2]; [1]University of Zurich, Switzerland, [2]Iowa State University* – Prospective memory requires the formation and later realization of intentions that must be delayed over minutes, hours, or days. Behavioural studies indicate an impaired efficiency in prospective remembering in children and old adults. However, these two age groups have never been tested in one paradigm. The present study investigates the development of prospective memory across the lifespan and assesses possible age-related differences in neural processing using EEG. The event-related prospective memory task used a retrieve-delay specification in which intention execution had to be additionally postponed after cue detection. This task was embedded in an ongoing activity using the semantic categorization task of West et al. (2003). Three groups were compared: adolescents (11-13), young adults (18-25), and old adults (64-79). Behavioural results revealed the expected inverted U-shaped function with young adults having the best prospective memory performance. Analysis of error data, however, implied that different processes may have contributed to failures of prospective memory in adolescents and old adults. Whereas the poorer performance of old adults seems to be a result of difficulties in encoding of intentions and self-initiated retrieval of prospective cues, adolescents tend to forget the content of the intention. This effect of age on prospective memory performance is supported by age-related differences in ERP-components for intention encoding, cue detection, and post-retrieval monitoring processes. Source localizations of these ERP-data with LORETA revealed different activation patterns for adolescents and old adults. Overall, our findings suggest that adolescents and old adults recruit somewhat different neural generators for prospective remembering.

B 36

THE EFFECTS OF PARKINSON'S DISEASE ON TASK SWITCHING AND STIMULUS SELECTION *Angie Kehagia, Roshan Cools, Trevor Robbins; University of Cambridge, Behavioural and Clinical Neurosciences Institute, Cambridge* – It is widely known that in addition to disabling motor symptoms, Parkinson's disease is associated with a range of cognitive impairments, especially in executive control. Many task switching studies have shown elevated switch costs in PD patients under conditions of high task set interference, for example when switching also necessitates stimulus selection. The purpose of this study was to investigate this interaction between task switching and stimulus selection. To this end, a group of 32 PD patients and 16 age-matched controls performed two variants of the task switching paradigm, differing in the degree to which they required stimulus selection within the display. Severe, but not mild, PD was associated with a switching deficit. Moreover, PD patients were impaired, irrespective of switching, when tasks required concrete stimulus selection, but not when tasks were undertaken with single stimuli, and this was not due to general slowing. These results demonstrate that the ability to switch between task sets is intact early on in the disease and extend recent findings implicating the basal ganglia in basic stimulus selection processes.

B 37

CONTEXT PROCESSING DEFICITS AFFECT PERFORMANCE IN MULTIPLE COGNITIVE DOMAINS IN SCHIZOPHRENIA *Susan M. Ravizza, KC Keur Moua, Debra L. Long, Cameron S. Carter; University of California, Davis* – Schizophrenia is an illness that is marked by chaotic behavior, thoughts, and language. One theory attributes the apparent randomness in schizophrenia patients' behavior to difficulty in maintaining or processing contextual information. However, only a limited number of tasks have been used to test this theory. In two experiments, we examined whether impairments in context processing are related to impairments in cognitive domains including task-switching and language processing. Importantly, the experimental paradigms that we employed did not require patients to overcome a prepotent response, a requirement that is often involved in studies of cognitive disorders in schizophrenia. In general, we found that patients with schizophrenia differed from control participants only when contextual processing demands were high. For example, patients showed greater shift costs than controls in a contextual shifting task, but were equivalent to controls in a perceptual shifting task. We found a similar result in a study investigating the influence of sentence context on performance in a picture recognition task. Pictures were presented that either matched or did not match the implied shape of the object mentioned in the preceding sentence. Controls were faster in the match than the mismatch condition, whereas patients with schizophrenia showed no influence of sentence context. Moreover, they actually outperformed control participants when the picture was related, but not identical, to an object in the sentence. These experiments demonstrate that impairments in the processing of context can have far-reaching effects on many aspects of cognition including language and attention.

B 38

USING MACHINE LEARNING FOR THE PREDICTION OF COGNITIVE STATE: HOW VIRTUAL NAVIGATION ILLUSTRATES FUNDAMENTAL CELLULAR MECHANISMS *Samantha Ellner[1], Michael Kahana[1], Joshua Jacobs[1], Michael Kearns[1], Itzhak Fried[2]; [1]University of Pennsylvania, [2]University of California at Los Angeles* – We analyzed multi-cell neuronal recordings taken from human subjects with intracranial electrodes implanted as part of a surgical treatment for drug-resistant epilepsy. These subjects played a virtual taxi-driver game, Yellow Cab, in which they alternated between the high-level goal states of searching for a randomly placed passenger and delivering that passenger to a specific location within a spatial environment. Our goal was to use these electrical recordings of the subjects' brain activity to predict their instantaneous behavior in the game. To accomplish this, we used Boosting, a multivariate machine-learning algorithm, to predict the subject's goal state, speed, and location from the average neuronal firing rates in a 500-millisecond epoch. This work demonstrates the ability of machine learning algorithms, specifically boosting, to repeatedly and significantly outperform simpler univariate statistical models and baseline (single-cell) classifiers and to illustrate differences in predictability when examining single cells, pairs of cells, or entire brain regions. In particular, prediction confidence and regional specificity were seen to improve the accuracy of the models when determining a subject's cognitive state. We found that neurons in frontal brain regions were especially helpful in predicting the subject's goal state, consistent with recent literature which highlights its importance in path planning. This study discusses the emerging concept of conjunctive coding and the potential advantages of machine-learning algorithms over simple univariate algorithms for the purposes of brain-controlled prosthetic devices.

B 39

COMBINING RT DISTRIBUTION ANALYSIS AND FMRI : PROCESSING DYNAMICS IN THE SIMON TASK *K. Richard Ridderinkhof, Wery van den Wildenberg, Birte Forstmann; Acacia, University of Amsterdam* – fMRI methods may help in understanding processes of response activation and response inhibition in conflict tasks, such as the Simon task. However, data-driven approaches thus far haven't yielded consistent insights into these processes. Here, we use a theory-driven approach that capitalizes on individual differences in the processes of central interest. Based on the so-called activation-suppression model, we computed specific behavioral parameters for each individual, derived from RT-distribution analysis. These parameters correspond closely to the processes of (inappropriate) location-driven response activation and of the subsequent inhibition of this response, respectively, as detailed by the model. In an fMRI study with 24 participants, activation in pre-SMA was found to correlate with the RT-distribution measure of inappropriate response activation, whereas the right IFG was found to correlate with the RT-distribution measure of response inhibition. These results, that are consistent against the backdrop of the larger literature on cognitive control, could have been derived neither from the standard data-driven approach, nor from inspecting overall mean RT only.

Higher Level Cognition: Other

B 40

THE FRACTIONATION OF MENTAL STATE ATTRIBUTIONS IN FOCAL LESION PATIENTS *R. Shayna Rosenbaum[1,2], Donald T. Stuss[2,3], Michael P. Alexander[4,2], Gordon G. Gallup Jr.[5], Susan Gillingham[2]; [1]York University, [2]The Rotman Research Institute, Baycrest, [3]University of Toronto, [4]Harvard University, [5]State University of New York at Albany, New York* – Inferring what people are thinking or feeling appears effortless but may engage separable cognitive and emotional components that rely on distinct neural processes that are differentially vulnerable to insult. Close examination of deficits in patients with lesions to any one of a number of brain structures may help reveal the complexity of social awareness and its relationship to self-awareness. Based on more precise localization techniques than used previously, the present study contrasted the roles of medial and lateral areas of prefrontal cortex in cognitive and affective aspects of self-related inferences and theory of mind. A large group of patients with focal frontal lesions (n=33) and non-frontal lesions (n=15) and healthy control participants (n=14) were tested for mental state attributions when engaged in a game of deception and in viewing videotaped emotional situations. The two tests differed in terms of cognitive vs. affective quality and the ability to represent one's own vs. other people's thoughts and feelings. Analyses based on anatomically predefined groupings showed that patients with superior medial prefrontal damage were most impaired on these tests. More detailed analyses involving architectonic divisions, independent of groupings, revealed that the greatest disruption to inferring deceptive intentions involved right frontal pole (BA 10) and paracingulate (BA 32) lesions, whereas impairment in affective self-referential judgements was related to left anterior cingulate (BA 24) lesions. Our findings point to finer segregation within prefrontal cortex and suggest that current conceptions of 'mentalizing' are in need of corresponding refinement.

B 41

EEG CORRELATES OF SPONTANEOUS AND INTENTIONAL TRAIT INFERENCES *Marijke Van Duynslaeger[1], Frank Van Overwalle[1], Edwin Verstraeten[2]; [1]Vrije Universiteit Brussel, Belgium, [2]University of Swansea, UK* – This study measured event-related potentials during spontaneous and intentional trait inferences. Participants read sentences describing the behavior of a target person from which a strong moral trait could be inferred. The last word of each sentence determined the consistency with the trait induced during an introductory paragraph. In comparison with behaviors that were consistent with the implied trait, a P300 waveform was obtained when the behaviors were evaluative inconsistent with that trait. In addition, when the inconsistency involved another domain of personality (e.g., competence), an additional N400 waveform was observed. This dependency on behavioral consistency indicates that trait inferences were made previously while reading the preceding behaviors. Memory measures taken after the presentation of the stimulus material involved sentence completion, trait- and antonym-cued recall, and supported the occurrence of inferred traits associated with the actor. The increased memory for inconsistent as compared to consistent behaviors during the sentence completion task was significantly correlated with the P300 while making spontaneous inferences, which supports this latter measure as a valid neural correlate of spontaneous, but not intentional trait inferences.

B 42

IMPULSIVITY AND REWARD PREDICTION: A COMBINED ERP/ FMRI INVESTIGATION *Laura Martin[1], Geoffrey Potts[2], Philip Burton[3]; [1]University of Kansas, [2]University of South Florida, [3]Rice University* – Impulsive individuals tend to choose immediate rewards despite long-term negative consequences, similar to patients with medial frontal lesions. The current study employed event-related potentials (ERPs) and functional magnetic imaging (fMRI) to determine whether the neural reward system, particularly its medial frontal projection, was more responsive in impulsive individuals. The current study used a passive reward prediction design in which Stimulus 1 (S1) predicted Stimulus 2 (S2) with 80% accuracy. S1 failed to predict S2 on 20% of the trials thus producing unpredicted reward (better than expected) and predicted reward withheld (worse than expected) conditions, which have been shown to activate the reward system in the monkey. The ERP showed an Outcome x Prediction interaction ($p<.01$) over medial frontal cortex between 200 – 300 ms post-S2, with the most positive response occurring when outcomes were better than expected and the most negative occurring when outcomes were worse than expected. Dipole analyses located this effect to anterior cingulate cortex (ACC). fMRI revealed an Outcome x Prediction interaction similar to the ERP in an ACC region with the largest deactivation when outcomes were worse than expected ($p<.005$). Although neither the ERP component nor the ACC fMRI showed effects of impulsivity, fMRI data from a caudate region showed an Impulsivity x Outcome x Prediction interaction, with a greater response among high impulsive participants when outcomes were better than expected. The results indicate that while both cortical and striatal reward system projections respond to reward prediction, only the striatal response varies with impulsivity.

B 43

THE IMPACT OF PARKINSON'S DISEASE ON PROSODY EXPRESSION: PERCEPTUAL AND ACOUSTIC FINDINGS *Henry S. Cheang, Marc D. Pell; School of Communication Sciences and Disorders, McGill University* – Adults in the late stages of Parkinson's disease (PD) have expressive difficulties to communicate through speech prosody due to marked acoustic alterations in their speech. Comparatively little is known about how speech prosody is affected in early stages of PD and the impact of any acoustic changes on healthy listeners has not been widely investigated. To address these issues, we elicited speech tokens that varied in emotional content, phonemic stress, and contrastive stress from healthy speakers and speakers in the early stages of PD with no relevant cognitive impairments and then evaluated expressive prosody in each group in two ways: each token was analyzed acoustically; and tokens were presented to naïve healthy listeners to determine whether listeners can recognize the intended prosodic meanings. Acoustic analyses revealed significant group-related differences in amplitude, fundamental frequency, and timing across speech token types. As well, naïve listeners had significantly greater difficulty to discern the intended meanings of prosody when produced by speakers with rather than without PD. Additional analyses looked at the relative contributions of acoustic parameters to perceptual errors, revealing that subtle changes in the acoustic patterning of Parkinsonian speech may have promoted difficulties to understand prosody when listening to individuals in the PD group. Coupled with our work demonstrating prosody comprehension deficits in the same PD patients (Pell and Leonard, 2003), we conclude that PD is associated with impairments in the production and comprehension of prosody which are independent of other forms of cognitive decline.

B 44

MULTI-MODAL EFFECTS OF LOCAL CONTEXT ON TARGET DETECTION: EVIDENCE FROM THE P300 *Noa Fogelson[1], Jeffrey Lewis[1], Mark Kishiyama[1], Kilian Koepsell[2], Robert Knight[1]; [1]University of California, Berkeley, The Helen Wills Neuroscience Institute, [2]University of California, Berkeley, Redwood Theoretical Neuroscience Center* – The P300 component of the event-related potential (ERP) has been linked to contextual processing. We used the P300 ERP to investigate how a predicting sequence influenced local context. 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 three-standard predictive sequence. Subjects pressed a button in response to the targets. Peak P300 amplitude and latency at Pz were evaluated for 6 conditions: targets after predictive and non predictive sequences, random preceding standards and the three standards comprising the predicting sequence. Reaction times were significantly faster for predictable targets than for non predictive targets. There was a main effect for peak latency and amplitude across the six conditions in the two modalities. P300 latency was shorter for sequence predicted targets than for targets after non-predictive sequences. Peak amplitudes for targets and for the last, most informative standard of the predictive sequence, were also larger than standards. These findings suggest that more task-informative preceding stimuli shorten P300 latency and increase P300 amplitude, independent of sensory modality. The results indicate that local context has modality independent effects on cognitive processing. Supported by NINDS Grant NS21135

B 45

DIFFERENT SCALES OF CORTICAL INTEGRATION DURING THE PROCESSING OF MUSICAL SYNTAX: FROM EARLY LONG-RANGE ALPHA PHASE SYNCHRONIZATION TO LATE LOCAL GAMMA OSCILLATIONS *Maria Del Carmen Herrojo Ruiz[1], Stephan Koelsch[2], Joydeep Bhattacharya[3]; [1]Institut für Musikphysiologie und Musikermedizin, Hochschule für Musik und Theater, Hannover, Germany, UNED, Madrid,Spain, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [3]Goldsmiths College, University of London, London, UK, Austrian Academy of Sciences, Vienna, Austria* – Although previous studies have demonstrated that brain oscillations and synchronization between multiple brain areas play a crucial role in cognition, little has been done to investigate the temporal dynamics of oscillatory and synchronization properties of brain responses in humans processing music syntactical irregularities. Consequently, the present study investigated the processing of music-syntactical irregularities by recording spontaneous EEG in human subjects while listening to chord sequences ending on either regular or irregular chords. Consistent with traditional event-related-potential analysis, we reproduced the early (~200 ms) right anterior negative component (ERAN), and established that this component was primarily represented by low frequency (<8 Hz) oscillations. Additionally, we found decreased gamma band (45-55 Hz) oscillations at a later stage (~500 ms) of processing, which was interpreted as a signature of harmonic integration after top-down processing. By applying synchronization cluster analysis to reveal the involvement of individual brain regions with a global cluster, we found that irregular chords elicited an early decrease in the alpha band (9-10 Hz) phase synchronization predominantly in right fronto-central brain regions, due to a decrease of long-range phase coupling between these areas and left temporal brain regions, as further elucidated by applying bivariate synchronization analysis. This finding was explained in terms of top-down processes. Taken together, these results support the hypothesis that the processing of music as complex set of perceptive and cognitive operations requires different scales of cortical integration, ranging from long-range alpha synchronization to local fast gamma oscillations.

B 46

FOOD FOR THOUGHT: THE SPATIO-TEMPORAL BRAIN DYNAMICS OF FOOD DISCRIMINATION *Ulrike Toepel[1], Jean-François Knebel[1], Julie Hudry[2], Johannes Le-Coutre[2], Micah M. Murray[1]; [1]Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland, [2]Nestle Research Center, Vers-chez-les-Blanc, Lausanne, Switzerland* – We investigated the spatiotemporal brain mechanisms by which images of foods are discriminated from one another according to their nutritional content. The images were color photographs of common foods that were subdivided into classes according to their caloric (high and low) or fat (high and low) content. All photographs were modified to have the same mean luminance, and classes of stimuli were controlled in terms of their mean power spectra. During the experiment, subjects were given no information about the classes of foods, but rather actively discriminated photographs of foods from photographs of kitchen utensils (non-foods). The nutritional content of the foods was thus completely orthogonal. Electrical neuroimaging analyses were conducted using 160-channel visual evoked potentials (VEPs) to food stimuli. Comparing responses to photographs of different food classes, these analyses tested for modulations in 1) local VEP waveforms, 2) global response strength, and 3) the topography of the electric field at the scalp. In addition, the local auto-regressive average (LAURA) distributed linear inverse solution was applied to periods of observed modulations. Within the initial ~100ms post-stimulus onset, responses to different food classes significantly differed. Responses to high-fat foods were stronger than those to low-fat foods, and responses to high-calorie foods were stronger than those to low-calorie foods. The nutritional content of visually controlled food images is thus rapidly and incidentally assessed. We interpret these results in terms of the brain mechanisms mediating the determination of the nutritional value of seen foods.

B 47

DO MENTAL AND VISUOSPATIAL PERSPECTIVE-TAKING SHARE THE SAME NEURAL CORRELATES? *Nicole David[1], Carolin Aumann[1], Natacha S. Santos[1], Bettina H. Bewernick[1], Simon Eickhoff[2,3], Albert Newen[4], N. Jon Shah[3], Gereon R. Fink[1,3], Kai Vogeley[1,3]; [1]University of Cologne, Germany, [2]C. & O. Vogt Institute for Brain Research, University of Duesseldorf, Germany, [3]Institute of Biophysics and Neurosciences, Research Center Juelich, Germany, [4]University of Tuebingen, Germany* – Being able to take others' perspectives in order to understand and predict their behavior is crucial for social interactions. Different kinds of perspective-taking exist such as mental and visuospatial perspective-taking. Because it is still debated whether they rely on the same functional mechanisms, we investigated neural correlates of mental and visuospatial perspective-taking with fMRI using the same stimulus material. Stimuli depicted a virtual character in a vis-à-vis position expressing a preference towards one of two different objects located on each of his side with a subtle difference in position. Subjects performed a mental preference task (MPT) and visuospatial judgment task (VST), from the subjects' own perspectives (first-person perspective, 1PP) or the perspective of the virtual character (third-person perspective, 3PP). During MPT subjects decided which object they themselves (MPT_1PP) or the virtual character preferred (MPT_3PP). During VST subjects located the elevated object from their own (VST_1PP) or the virtual character's perspective (VST_3PP). We found overlapping activation in bilateral middle/ inferior occipital, superior parietal and middle/ inferior frontal cortices for mental and visuospatial perspective-taking (MPT+VST collapsed across perspectives). Mental compared to visuospatial perspective-taking (MPT>VST) additionally recruited the cerebellum bilaterally, bilateral fusiform, superior/ inferior frontal gyri, and superior/ middle temporal areas including the temporal pole, posterior superior temporal sulcus and temporoparietal junction (particularly for 3PP). Visuospatial compared to mental perspective-taking (VST>MPT) only recruited the anterior cingulate cortex. In conclusion, mental and visuospatial perspective-taking could be dissociated with fMRI, despite using the same stimuli, suggesting differences in their functional basis.

B 48

TEMPORAL DYNAMICS OF AUDITORY DECISION-MAKING: A MAGNETOENCEPHALOGRAPHY STUDY *Jochen Kaiser[1], Therese Lennert[2], Werner Lutzenberger[2]; [1]University of Frankfurt am Main, Germany, [2]University of Tubingen, Germany* – Perceptual decision-making requires the comparison and integration of sensory evidence to generate a behavioral response. We used magnetoencephalography (MEG) to investigate the time course of decision-making during an auditory task that involved forced-choice decisions about whether a pair of syllables S1 and S2 differed either in their sound patterns or their perceived sound source lateralization. Conditions with easy and difficult decisions were created by manipulating the similarity of S1 and S2. Thirteen healthy adults participated in the study. Behavioral data showed main effects of task difficulty both for correct response rates and reaction times. Statistical probability mapping was employed to investigate oscillatory activity in MEG. We observed enhanced gamma-band activity (GBA) over posterior parietal cortex for spatial and over left inferior frontal cortex for pattern changes (at ~120-220 ms after S2 onset). Activations were more pronounced for easy than difficult decisions. GBA over superior prefrontal cortex was more pronounced at ~280-430 ms for easy than difficult decisions regardless of type of change, possibly reflecting decision-relevant networks that integrate information from higher sensory areas representing the perceptual alternatives. During the same latency window, a different frontal and a parietal sensor showed increased GBA for difficult than easy decisions. Sensorimotor beta desynchronization indicating motor preparation processes peaked at ~460 ms for easy and at ~520 ms for difficult decisions, thus reflecting the reaction time difference between both conditions. In summary, the analysis of oscillatory activity in MEG served to elucidate the temporal dynamics of perceptual decision-making in humans.

B 49

SELF-OTHER DISCRIMINATION AND THE MIRROR NEURON SYSTEM: NO INTERACTION IN LEFT PRIMARY MOTOR CORTEX *Marie-Christine Désy, Hugo Théoret; Université de Montréal, Centre de recherche en Neuropsychologie et Cognition and Hopital Sainte-Justine, Montréal* – Recent evidence suggests that the human mirror neuron system (MNS) may be involved in self-other discrimination. Disruption of the inferior parietal lobule with transcranial magnetic stimulation (TMS), a key structure within the MNS, results in impaired self-other discrimination. In primary motor cortex, excitability is increased during presentation of self-images and self-descriptive personality-trait words as well as during observation of finger movements. Here, we ask whether the MNS is preferentially activated by passive observation of hand actions similar to self in terms of sex and skin color. TMS-induced motor evoked potentials (MEP) were recorded from the right first dorsal interosseus (FDI) muscle while participants viewed 4 short videos depicting index finger movement made by female or male participants with black or white skin color. Thirty-two participants took part in the study, which included four groups of 8 subjects (black males, black females, white males, white females). TMS intensity was adjusted to reliably induce MEPs of peak-to-peak amplitude of approximately 1μV. Each video was presented 16 times in randomized order. Results show the absence of significant effects on the size of the TMS-induced MEP as it relates to the similarity with the observed hand on the skin color and sex dimensions. These data show that the left primary motor cortex, which is reliably activated by stimuli related to basic MNS function, does not show a preference for physical characteristics resembling those of the observer. This is in line with previous reports suggesting hemispheric specialization of the right hemisphere in self-awareness.

B 50

HIGHER VISUAL AREAS ENCODE THE SPATIAL ANALYSIS OF PERCEIVED SOCIAL THREAT IN OTHERS *Donna Lloyd[1], India Morrison[2]; [1]The University of Manchester, U.K., [2]Sahlgrenska University Hospital, Sweden* – An fMRI study by Lloyd et al (2006) recently demonstrated a role for posterior parietal cortex (PPC) in visual encoding of potentially threatening or painful objects in the peripersonal space of the observer. The purpose of the current study was to determine whether PPC (via inputs from afferent visual streams) has a more generic ability to spatially differentiate visual events signalling potential threat posed by another person when this person is in peripersonal vs. extrapersonal space. During fMRI we presented 16 female participants with real-life scenes of a male and female actor in which the social context was manipulated to be either threatening (young male wearing a hooded top with the hood covering his face) or non-threatening (hood not covering the face) and the male actor to be in either the peripersonal (i.e., within arms reach) or extrapersonal space (at a distance of over 6m) of the young female. The results reveal a network of cortical areas involved in viewing threatening and non-threatening social interactions, including PPC and sites along the ventral visual stream, cerebellum, ventral and dorsomedial prefrontal lobes (including anterior cingulate cortex; BA32). However, we also show, for the first time, a unique role for higher-order visual areas in left temporal-occipital junction, extrastriate and fusiform cortices in the purely spatial analysis of viewing threatening social encounters. Together these results suggest a putative network of regions involved in the visuo-spatial analysis of social perception and interpersonal behaviour.

Memory: Memory Systems

B 51

ELECTROPHYSIOLOGICAL CORRELATES OF POST-RETRIEVAL PROCESSING ARE NOT SPECIFIC TO MONITORING THE PRODUCTS OF MEMORY RETRIEVAL *Hiroki Hayama, Jeffery D. Johnson, Michael D. Rugg; University of California, Irvine* – Post-retrieval processes are engaged when the outcome of a retrieval attempt must be monitored or evaluated. Previous research employing event-related potentials (ERPs) has implicated a specific ERP modulation - the 'right frontal old/new effect' - as a correlate of post-retrieval processing. In two experiments we examined whether the right frontal effect is specifically associated with episodic memory retrieval. During study, subjects in both experiments were cued to make one of two semantic judgments on serially presented pictures. In experiment 1, one study phase was followed by a source memory task, in which subjects responded 'new' to unstudied pictures, and signaled the semantic judgment made on each studied picture. A separate study phase was followed by a task in which the studied items required, not a source memory judgment, but a judgment about their semantic attributes. Robust right frontal effects were elicited by old items in both tasks, indicating that the effects are not selective for the monitoring of the content of information retrieved from episodic memory. In experiment 2, separate study phases were followed by test phases where semantic judgments were either made on old items (as in experiment 1), or on new items. Right frontal effects were elicited by whichever class of items, old or new, required the semantic judgment. Together, the findings indicate that the right frontal old/new effect is not associated selectively with mnemonic decision-making, and instead reflects processing associated with monitoring or decision making more generally.

B 52

INTACT WORKING MEMORY FOR RELATIONAL INFORMATION IN PATIENTS WITH MEDIAL TEMPORAL LOBE LESIONS *Yael Shrager[1], Larry R. Squire[2,1]; [1]University of California, San Diego, [2]Veterans Affairs Healthcare System, San Diego, California* – The hippocampus and adjacent medial temporal lobe structures (entorhinal, perirhinal, and parahippocampal cortices) are known to support declarative memory. Traditionally, the medial temporal lobe has not been thought to be necessary for working memory. Yet, some recent findings have been interpreted to mean that structures of the medial temporal lobe, including the hippocampus, do support working memory, particularly working memory for relational information (e.g., an object and its location). We tested patients with damage limited to the hippocampus and patients with large lesions of the medial temporal lobe. Participants were tested for their memory of objects (1, 2, 3, 4, or 6) and their locations on a 3 X 3 grid. Memory was tested at two delays (1 and 8 seconds). Patients performed as well as controls at the 1-second delay in all tests (1, 2, 3, 4, and 6 object locations), and they also performed as well as controls at the 8-second delay when asked to remember 1, 2, 3, or 4 object locations. The patients performed more poorly than controls at the 8-second delay when asked to remember 6 object locations. That is, the patients performed poorly when the test was most difficult (high memory load at the longer delay), and when the capacity of working memory was likely exceeded. We interpret this finding as a deficit in long-term memory and propose that the hippocampus and adjacent medial temporal lobe structures are important for declarative memory but not for working memory.

B 53

ENCODING ITEMS AND CONJUNCTIONS: A HIGH-RESOLUTION FMRI STUDY OF MEDIAL TEMPORAL LOBE CONTRIBUTIONS TO FULL AND PARTIAL EVENT ENCODING *Alison R. Preston, Crystal L. Cook, Gwen M. Lawson, Anthony D. Wagner; Stanford University* – Memory for the past yields knowledge that can be used to satisfy current goals. When we interrogate memory, recollection of a specific (criterial) contextual detail may be required to guide present behavior, with recollection of other (non-criterial) information often being insufficient to satisfy the goal. The distinction between criterial and non-criterial recollection may be vital to understanding the contributions of specific medial temporal lobe (MTL) substructures to encoding of item and conjunctive information. The current high-resolution fMRI study used the subsequent memory paradigm to assess how MTL encoding processes support later item recognition and later recognition accompanied by varying levels of contextual recollection. During encoding, participants were scanned while they incidentally encoded visually-presented adjectives 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 post-scan recognition memory test probed for item and conjunctive memory in a three-step procedure: (1) item recognition (old/new), (2) task recollection (scene/person), and (3) detailed recollection (indoor/outdoor or male/female). Encoding activation in MTL subregions was analyzed based on later item recognition and varying levels of context recollection. Preliminary results suggest that MTL cortex and hippocampus demonstrate distinct encoding patterns, with MTL cortex tracking the item dimension regardless of the level of recollected detail, and hippocampal subfields tracking the recollective dimension with greater levels of activation associated with increasing levels of recollected detail. These findings suggest that MTL subregions make distinct contributions to declarative memory.

B 54

DIFFERENTIAL ACTIVATION OF MOTOR BRAIN REGIONS IN PROSPECTIVE MEMORY ENCODING *Anne Eschen[1], Jayne E. Freeman[2], Thomas Dietrich[3], Mike Martin[1], Judi A. Ellis[2], Ernst Martin[3], Matthias Kliegel[1]; [1]Institute of Psychology, University of Zurich, [2]University of Reading, [3]Magnetic Resonance Center, University Children's Hospital Zurich* – Prospective memory research is focused on cognitive processes supporting the realization of actions intended for future enactment. Behavioural findings indicate that these actions are more accessible from memory than actions intended for later observation or verbal report and that their higher accessibility is caused by preparatory motor operations during encoding. Accordingly, in an fMRI study with young participants, it was investigated whether motor brain regions are differentially activated during verbal encoding of actions for later enactment in contrast to that of actions for later verbal report. The encoding of actions for later verbal report was additionally contrasted to that of abstract verbs for later verbal report to examine whether the semantic motor information inherent in action but not in abstract verbs activates different brain regions from those involved in the preparation of actions for later enactment. Differential activation for the verbal encoding of to-be-enacted in comparison to to-be-reported actions was indeed found in brain regions known to be involved in covert motor preparation. There was no overlap between these brain regions and those differentially activated during the verbal encoding of action in contrast to abstract verbs for later verbal report, suggesting the presence of preparatory motor processes is a distinctive characteristic of prospective memory encoding. For the encoding of to-be-enacted actions, differential brain activation was completely left lateralized and participants reported mental simulation of future actions. An ongoing follow-up fMRI study examines two possible causes for this left lateralization, another the influence of mental simulation on differential brain activation.

B 55

USING HIGH-DENSITY EVENT-RELATED POTENTIALS TO UNDERSTAND THE MEMORIAL POWER OF PICTURES AND THE DYNAMICS OF RECOGNITION MEMORY *Brandon A. Ally, Jill D. Waring, Ellen H. Beth, Andrew E. Budson; Boston University, Bedford, MA* – Numerous studies of recognition memory have demonstrated the picture superiority effect. However, there has been limited investigation into how pictures affect the electrophysiological correlates of recognition memory. Our goal was to examine differences in three specific components of the old/new event-related potential (ERP) waveform associated with the processes of familiarity, recollection, and post-retrieval monitoring. Seventeen young adults saw four study-test phases (Word-Picture, Picture-Word, Word-Word, Picture-Picture) with 50 study items and 100 test items (50% old). Both conventional ANOVAs and t-tests, and novel nonparametric analyses were used to analyze the effect of pictures versus words at study and the effect of matched versus nonmatched study and test modalities. Results revealed that when words were studied and when study-test modality was matched, the early frontally based component associated with familiarity was enhanced. When pictures were studied and when study-test modality was matched, the parietally based component associated when recollection was enhanced. Finally, with difficult old/new decisions frontal and parietal regions were simultaneously active during the post-retrieval monitoring interval, supporting the hypothesis that interplay between the two regions is necessary to make many recognition decisions. We suggest that the frontal lobes may utilize the parietal cortex as a sketchpad to match the representation stored in memory with perception or to hold multiple representations for response selection. It is also concluded that the memorial power of pictures stems from enhanced recollection. Based on these findings and a review of the literature, we have developed a novel ERP model of recognition memory.

B 56

BEHAVIOURAL AND ELECTROPHYSIOLOGICAL STUDIES ON THE EFFECT OF AGEING ON SOURCE MEMORY ABILITY. *Páraic Scanlon[1], Paul Dockree[2], Seán Commins[1], Richard Roche[1]; [1]National University of Ireland, Maynooth, [2]Trinity College Institute of Neuroscience* – Two experiments were carried out in order to examine the effect of ageing on source memory capacity in normally functioning humans. Experiment 1 consisted of 3 groups: young adults (18-26 years), middle-aged adults (40-50 years) and older adults (65-75 years). Each group completed the Opposition Task (Jennings & Jacoby, 1997) in which a study- and test-list of words are presented to each participant, who must decide if words presented in the test-list were present in the study list. Words are presented at 3 different lag lengths; 0, 4 and 16. Older adults found it more difficult to differentiate between words from the study list and words that were presented earlier in the test list, particularly for lag 4 and lag 16 words.

Experiment 2 was an ERP-based study involving 2 groups (n=10); younger adults (18-26) and older adults (65-75). A modified Opposition task was used in this study, in which lag length was increased for the young adult group in order to achieve maximum difficulty in the task, to determine if similarities occurred between the ERP data of the more difficult task and the data of the older adults' simpler task. We also examined electrophysiological changes that occurred over differing lag lengths and neural generators of the ERP waveforms in both young and older adult performance using BESA© software, revealing cortical dipole sources for the scalp recorded componentry.

B 57

DYNAMIC CORRELATIONS OF PREFRONTAL CORTEX NEURONS REPRESENTING FUTURE AND PREVIOUS GOALS *Satoshi Tsujimoto, Aldo Genovesio, Steven Wise; NIMH* – We recorded the activity of cells in the prefrontal cortex as monkeys chose one of three spatial goals (Genovesio et al., J. Neurosci. 26: 7281, 2006). The monkeys based their decision on symbols that instructed them either to reject or to repeat their most recent, previous goal as the next fixation point. We found that separate populations of cells encoded future versus previous goals. Here, we investigated dynamic cross-correlations between pairs of simultaneously recorded neurons from these populations. The database included 34 future-future (F-F) pairs, 41 previous-future (P-F) pairs, and 23 previous-previous (P-P) pairs. We found that previous-goal cells tended to correlate with future-goal cells (P-F correlations), but not with other previous-goal cells (P-P correlations). Future-goal cells, however, not only tended to correlate with previous-goal cells (as mentioned above), but also did so with other future-goal cells (F-F correlations). Specifically, 17% of P-F pairs and 24% of F-F pairs, but no P-P pairs satisfied our criterion for correlation (r>0.15). This finding suggests that previous-goal representations might rely less on cell-to-cell correlations than do representations of future goals. We also studied the temporal profile of dynamic correlations. P-F and F-F correlations both increased as a goal could be chosen and remained relatively stable as that goal was remembered and later fixated. P-F correlations increased further after fixation. These results provide insight into the mechanisms of goal selection and output monitoring: F-F and P-F correlations could contribute to goal selection, and P-F correlations could, in addition, be especially important in output monitoring.

B 58

UNCERTAINTY DURING FEAR CONDITIONING: OBSERVATIONS OF BOLD ACTIVITY AND IMPLICATIONS FOR ANXIETY DISORDERS *Seth Shipman[1], Matthew Johnson[1,2], Michal Assaf[1], Clayton Maxwell[1], Becket Greten-Harrison[1], Kira Bailey[1], Robert Astur[1,2]; [1]Olin Neuropsychiatry Research Center, [2]Yale University* – Uncertainty is pervasive in the natural world. It is, therefore, imperative that we understand the ramifications of uncertainty on neural systems. There have been some inroads into this study, particularly with the discovery of the partial reinforcement extinction effect, which has its roots in the uncertainty of reward or punishment presentation (Leonard, 1975). Additionally, recent evidence about dread indicates that a proportion of humans would prefer a more severe adverse event immediately rather than a less severe adverse event at some time later, indicating the effect of uncertainty in the timing of adverse event presentation (Berns et al., 2006). Clinically, uncertainty is of crucial relevance to the treatment of anxiety disorders as unpredictability and lack of control have been proposed as key escalating factors in both panic disorder (Bouton et al., 2001) and PTSD (Foa et al., 1992). We have addressed the issue of uncertainty during fear learning directly, testing 20 participants on a fear conditioning paradigm during fMRI. We focused on BOLD signal changes, particularly within the amygdala, and changes in galvanic skin response during an experiment that exposed healthy adults to shocks that were preceded by either certain or ambiguous markers of whether a shock would follow. Important differences are evident as a function of the predictability of the shock. Specifically, the BOLD signal response elicited by the uncertain predictor of a shock appears more resistant to extinction than that elicited by the certain predictor, possibly mirroring the maladaptive response that characterizes some anxiety disorders.

B 59

COCAINE-INDUCED PLACE PREFERENCES WITHIN A VIRTUAL ENVIRONMENT *Robert Astur[1,2], Seth Shipman[1], Shepard Siegel[3], Albert Rizzo[4], Robert Malison[5]; [1]Hartford Hospital/Institute of Living, [2]Yale University, [3]McMaster University, [4]University of Southern California [5]Yale University School of Medicine* – The context and environment where drugs are used can induce cravings and precede relapse in substance abusers. This contextual influence often is independent of the specific drug paraphernalia These learned associations are problematic for the treatment for drug addiction because it is challenging for users to avoid places, people, and objects associated with substance use prior to recovery. This Pavlovian conditioning has been experimentally demonstrated in nonhumans in a paradigm known as conditioned place preference (CPP), in which an animal is conditioned to prefer a specific environment through repeated pairings of a rewarding substance to that environment. We have created a virtual reality analogue of the CPP paradigm to explore the contributions of contextual conditioning to substance abuse in humans. In this study, five non-treatment seeking cocaine abusers have been given repeated pairings of cocaine 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 the influence of cocaine. Following the pairings, participants spent an increased percentage of time in the cocaine-paired environment as well as rated the cocaine paired room as ~42% more preferable than the placebo paired room. Subjective ratings of drug effects and mood were also collected throughout the experiment. This work is the first report of an experimentally induced CPP in humans, and this paradigm could be used to test the efficacy of treatments aimed at reducing the effect of conditioned place preferences on substance abuse in humans.

B 60

NEURAL SUBSTRATES UNDERLYING HUMAN DELAY AND TRACE EYEBLINK CONDITIONING *Dominic Cheng[1], John Disterhoft[2], John Power[3], Deborah Ellis[1], John Desmond[1]; [1]Johns Hopkins University School of Medicine, [2]Northwestern University Feinberg School of Medicine, [3]Queensland Brain Institute* – Eyeblink classical conditioning has been widely used as a model system to study the neurobiological mechanisms of learning and memory. In delay conditioning, the conditioned stimulus (CS) and unconditioned stimulus (US) coterminate while in trace conditioning, a period of time (called the trace interval) passes between offset of the CS and delivery of the US. Considerable evidence from laboratory animal and human lesion studies suggests the hippocampus plays a critical role during trace conditioning, while the cerebellum is critical during both delay and trace conditioning. However, human studies often compare performance of delay and trace eyeblink conditioning in a between-subjects design. The current study used fMRI and healthy human volunteers to investigate the neural substrates underlying delay and trace eyeblink conditioning in a within-subjects design. Delay (850 ms) and trace (250 ms, 500 ms trace interval) CSs were 1200 Hz tones and white noise delivered binaurally (95 dB) and the US was a 100 ms corneal airpuff (4 psi). Behavioral eyeblink data indicate that subjects learned the CS-US association for both delay and trace conditioning trials. Imaging data showed that common cerebellar regions were recruited during both delay and trace conditioning. Furthermore, increased hippocampal activity during trace conditioning was detected supporting the idea that this region is critically important for this type of learning.

Perceptual Processes: Auditory Processing

B 61

NEURAL RESPONSES TO MAJOR/MINOR CHORD CHANGES IN MUSICAL PHRASES: AN EEG STUDY *Tamar Baer[1,2], Karen Froud[3,2]; [1]Barnard College, [2]Columbia University, [3]Teachers College* – The goal of this experiment was to investigate how the brain recognizes a shift from a major to a minor chord of music or vice versa. Past research has been conducted focusing on the Event Related Potential (ERP) component elicited when a dissonant chord is played at the end of a familiar tune. Violations of terminal note expectations of musical pieces have been found to elicit late positive components, between 300 and 800 milliseconds (ms) post stimulus presentation. In addition, dissonant terminal notes have been associated with shifts in P3 amplitude, and with elicitation of a negative component between 200 and 600 ms. Past findings however, have not indicated if a shift from a major chord to a minor chord or vice versa (by raising/lowering the third scale of the given chord by a semi-tone) has the same effect as a dissonant terminal note. In this experiment, 4 types of unfamiliar musical pieces were played for subjects: a piece in an all major chord, an all minor piece, and pieces which shifted from major to minor or from minor to major. Our results indicated an earlier and greater negative amplitude post chord shift, compared with the non-shift condition. There was also a negative complex between 200 and 500 ms post chord shift. This negative complex was followed in some subjects by a late positive component (LPC), which could be interpreted as indexing additional attentional processing and/or cognitive restructuring effects.

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HIPPOCAMPAL RECRUITMENT IN IMPLICIT LEARNING: NEUROIMAGING EVIDENCE FROM A VISUAL SEARCH TASK *Ruskin Hunt, Kathleen Thomas; Institute of Child Development, University of Minnesota* – Neuropsychological evidence suggests a functional dissociation between brain systems recruited for explicit versus implicit memory and learning, with structures in the medial temporal lobe (MTL) needed for explicit but not implicit function. Contrary to this model, successful performance on the contextual cueing task (CCT), an implicit learning task, is thought to require the integrity of MTL. We investigated this in healthy adults (N=8) using a CCT modified for fMRI. Our CCT was a visual search task in which a target was embedded among distractor stimuli and participants indicated target orientation via button press. Stimulus displays were of three types: Fixed, Novel, or Baseline. Fixed displays contained fixed locations for both target and distractors. With repeated exposure, reaction times (RT's) to Fixed displays improved without overt awareness. Novel displays contained fixed locations for targets across presentations, but randomly located distractors. RT's to Novel displays improved slower than RT's to Fixed displays. Baseline displays contained random locations for both targets and distractors. Furthermore, Baseline distractors differed in appearance from targets, requiring less effortful search. RT's to Baseline displays were faster than RT's to other displays. Consistent with patient data, significant hippocampal activation was found for Familiar displays (Familiar > Baseline), but not for Novel displays (Novel vs. Baseline). Significant activation was also found in bilateral medial prefrontal, posterior parahippocampal, and fusiform gyri for both Familiar and Novel displays (Familiar/Novel > Baseline), but with greater activation for Novel displays. Results are discussed in terms of visual search and the dissociative model above.

B 63

PERCEPTUAL PROCESSING IN RECOGNITION MEMORY: AN ERP STUDY *Erika Nyhus, Tim Curran; University of Colorado, Boulder* – The perceptual match between study and test has been found to contribute to recognition memory under the right conditions. Event-related brain potentials (ERPs) recorded from the human scalp during recognition memory experiments have revealed differences between old (studied) and new (not-studied) items that are thought to reflect the activity of memory-related brain processes. The present experiment examined how orienting task and distinctiveness contribute to the perceptual match effect in recognition memory and which ERP components index these effects. Distinctiveness modulated the perceptual match effect by acting on familiarity and recollection processes, as indexed by the FN400 and parietal old/new effects. The present results indicate that perceptual information can aid recognition memory by acting on familiarity and recollection processes.

B 64

IS MEDIAL PREFRONTAL CORTEX CRITICAL IN MONITORING LEARNING AND MEMORY? *Mandana Modirrousta, Lesley K. Fellows; Montreal Neurological Institute, McGill University, Montreal, Quebec, Canada* – The frontal lobes in general and the ventromedial frontal region in particular have been implicated in the monitoring of memory processes (so-called 'meta-memory'). Previous neuroimaging studies have implicated medial prefrontal cortex specifically in prospective feeling-of-knowing judgments, and at least one prior lesion study found that frontal damage affected prospective, but not retrospective memory monitoring. Here we evaluated 3 aspects of meta-memory in a group of patients with damage involving medial prefrontal cortex, compared to 12 age- and education-matched control subjects. Overall, both recall and recognition memories of face-name pairs were impaired in all 3 patients. The effects of medial prefrontal damage on meta-memory depended on the specific form of monitoring: Patients were more optimistic about their future ability to remember, judged immediately after initial learning, than controls. Prospective feeling-of-knowing judgments prior to recognition testing were also less accurate in the patient group (mean gamma = 0.06, SD = 0.28 for patients and mean gamma = 0.52, SD = 0.34 for controls). However, the accuracy of confidence ratings after recall (retrospective meta-memory) was comparable across the two groups. Interestingly, even restricted damage to a region within left anterior cingulate cortex was associated with this pattern of performance. Medial prefrontal cortex appears to play a critical role in prospective but not retrospective monitoring of memory performance, arguing that these two meta-memory processes are supported by at least partially distinct neural substrates.

B 65

SUPPORT FOR AN INHIBITORY MODEL OF WORD RETRIEVAL *Kathryn H. Caddick[1], Lauren R. Moo[2], Robert S. Ross[1], Scott D. Slotnick[1]; [1]Boston College, [2]MGH* – Word retrieval has been described as a competitive process involving either selection from multiple activated alternatives or an inhibitory process where a word is activated with related alternatives suppressed. We aimed to distinguish between these models using fMRI during an anagram solving paradigm. Participants were first presented with a distractor word that was read aloud followed by a 5-letter to-be-solved anagram. Distractor types were defined relative to orthographic overlap with the subsequent anagram solution and included related words with one letter different (e.g., "gripe" for the anagram of "price") and unrelated words which served as controls (related non-words were also included). We reasoned that the competition model would predict greater activity in language processing regions associated with the related distractor condition versus the control condition (due to co-activation of the distractor word and anagram solution). Conversely, the inhibition model would predict less activity in language processing regions for this contrast (due to suppression of the anagram solution). Behavioral results revealed a slower anagram solution reaction-time in the related distractor conditions. In support of the inhibitory model, fMRI results showed significantly less activity in language processing regions for the related distractor word condition versus the control condition. Furthermore, activity in prefrontal cortex was of opposite sign (i.e., increased activity for this contrast) indicating this region may mediate inhibition of related word representations. A similar pattern of results was observed for related non-word distractors relative to controls, suggesting these effects operate at the orthographic-phonological level.

B 66

MODULATION OF THE NEURAL CORRELATES OF EPISODIC ENCODING BY STUDY-TEST OVERLAP *Heekyeong Park, Michael Rugg; University of California, Irvine* – Successful memory depends both on study processing and the nature of the retrieval cue. Findings from studies that have manipulated the relation between study and retrieval processing have motivated the proposal that the greater the degree of study-test overlap, the greater the likelihood of successful retrieval (the transfer appropriate processing (TAP) principle). Here, we investigated whether the neural correlates of episodic encoding differ according to degree of match between study material and the cues employed in the subsequent memory test. Subjects were scanned while they made incidental indoor/outdoor judgments on a visually presented list of words and pictures. On a later memory test, half of the studied items were probed with a matching cue (word-word, picture-picture) and half with a non-matching cue (word-picture, picture-word). Each test item was subjected to a Remember/Know/New judgment. To identify encoding-related activity potentially associated with TAP, activity elicited at encoding for later recollected words or pictures probed with matching cues was contrasted with activity for recollected items probed with mismatching cues, and the outcome inclusively masked with regions selectively activated by the relevant study material (pictures > words and vice-versa). This procedure identified two regions, in right occipital and parietal cortex, where activity was greater during picture encoding than word encoding, and for later recollected pictures probed with matching vs. non-matching cues. These findings suggest that, at least in the case of pictures, matching cues are more likely than non-matching cues to recapitulate study processing, consistent with one of the tenets of TAP.

B 67

COLOR AND SPATIAL SOURCE MEMORY ACTIVATE UNIQUE SUB-REGIONS OF THE MEDIAL TEMPORAL LOBE *Robert S. Ross, Scott D. Slotnick; Boston College* – Hippocampal and parahippocampal activation has previously been reported during source memory retrieval. However, to our knowledge, no study has directly examined whether different source memory judgments are associated with unique sub-regions of the medial temporal lobe (MTL). In this study, participants were shown monochromatic line drawings of objects in two different source conditions. In one condition, participants were shown objects on the left or right side of the screen. In a second condition, participants were shown objects with green or red backgrounds. At test, words were presented at the center of the screen and participants were asked to indicate if the word represented a previously viewed (old) object or was new and, if it was old, the context in which it appeared (left or right for half the trials, green or red for the other half). Preliminary analysis revealed that color source memory, as measured by color-old-hit-hit vs. color-old-hit-miss (i.e., correct item + source vs. correct item), activated the hippocampus and parahippocampal cortex while spatial source memory activated the hippocampus. When color source memory was directly compared to spatial source memory, using the comparison color-old-hit-hit vs. spatial-old-hit-hit and vice versa, differential activation was seen in all regions of the MTL including the hippocampus, entorhinal, perirhinal, and parahippocampal cortices. No differences in MTL activation were found when item memory activations were compared using the comparison color-old-hit-miss vs. spatial old-hit-miss or the reverse contrast. These results suggest that different source memory judgments may rely on unique sub-regions of the medial temporal lobe.

B 68

EPISODIC ENCODING ACTIVATION OF THE LEFT POSTERIOR PARIETAL CORTEX *Pamela Perschler[1], Reza Habib[1], Endel Tulving[2]; [1]Southern Illinois University, [2]Rotman Research Institute of Baycrest Centre* – In a recent review, Wagner et al. (2005) highlight the important role that the posterior parietal cortex (PPC) serves during pisodic memory retrieval. They note that the PPC is active 1) during old-new comparisons, 2) during false alarm - correct rejection comparisons (i.e. perceived recognition), and 3) when retrieval is accompanied by recollective experience (i.e. remember responses in a remember/know task). Here we report positron emission tomography (PET) data on the role of the PPC during episodic memory encoding. Subjects were scanned while looking at novel and two kinds of familiar pictures, and were later given an incidental recognition test. Novel pictures had never been seen before, whereas familiar pictures had been shown to subjects either immediately prior to the start of scanning (recent familiar) or the day before the scanning session (distant familiar). Overall, activity in the left inferior parietal lobule (IPL, BA 40) was greater during encoding of familiar rather than novel pictures. One possible interpretetaion of these results is that encoding of familiar pictures involves retrieval of previously stored information about these pictures. Additionally, further specificity of the involvement of the IPL was observed: in the anterior portion, activity was greater for recent familiar rather than distant familiar pictures, whereas in the posterior portion it was greater for distant familiar rather than recent familiar pictures. These results complement the observations made by Wagner et al(2005).

B 69

BIOLOGICALLY PLAUSIBLE MODEL OF REWARD-MEDIATED LEARNING *Brian J. Spiering, Robin W. Scaife, F. Gregory Ashby; UC Santa Barbara* – Ashby, Ennis, and Spiering (2006, submitted) proposed a model of reward-mediated learning that assumes synapses between cortex and the striatum are strengthened if three conditions are met: 1) strong presynaptic activation, 2) postsynaptic activation exceeds the NMDA threshold, and 3) dopamine levels are above baseline. If one or more of these conditions is missing then the synapse is weakened. This model also specifies the exact amount of dopamine released on every trial in response to the feedback signal (which determines the amount of strengthening and weakening that occurs). This new model is compared to standard neural network learning algorithms. For example, the ability of the reward-mediated learning model to mimic gradient descent is explored. In addition, it is shown that the known properties of dopamine release imbue this model with natural simulated annealing and cooling properties. These features allow the model to escape local minima. The model accounts for behavioral data in which humans can escape from a local minimum in a categorization task. During the categorization task, participants were first trained on an information-integration category structure. Later they learned a new category structure in which the previously learned strategy is now a local minimum. Some participants were able to escape the local minimum and learn a new global minimum strategy. The neurobiological mechanisms of the strategy shift are explored.

B 70

CONTRIBUTIONS OF RECOLLECTION AND FAMILIARITY TO SOURCE MEMORY FOR INTRAITEM AND EXTRAITEM SOURCE INFORMATION: TESTING A HYPOTHESIS GENERATED FROM IMAGING DATA *Rachel A. Diana, Andrew P. Yonelinas, Rick James Addante, Robert S. Blumenfeld, Charan Ranganath; University of California, Davis* – Recognition memory can be supported by the assessment of the familiarity of an item, and by the recollection of contextual information associated with the item. In general, neuroimaging studies have shown that familiarity-based recognition is associated with activity in the perirhinal cortex, whereas performance on source memory tasks—traditionally thought to rely on contextual recollection—is associated with activity in the parahippocampal cortex (Eichenbaum, Yonelinas, & Ranganath, in press). However, one recent study found that activity in perirhinal cortex was associated with successful source memory (Staresina & Davachi, 2006). In that study, participants encoded each item in a manner such that source and item information might have been integrated as a single unit ("unitized"). Here, we tested the hypothesis that source information that is incorporated into an item representation (intraitem source) can be accessed using familiarity processes, whereas source information that is not incorporated into an item representation (extraitem source) requires the use of recollection processes. Analyses of receiver operating characteristics (ROCs) of source memory data revealed that familiarity made a significantly larger contribution to the intraitem source task, as compared to the extraitem source task. These results suggest that familiarity can support source memory if source and item information are integrated during encoding. Under these circumstances, perirhinal activity may be expected to contribute to source recognition.

B 71

EYE MOVEMENT AND SPATIOTEMPORAL BRAIN DYNAMICS UNDERLYING PROCESSING OF RELATIONS AMONG OBJECTS. *Jennifer Ryan[1,2], Anthony Herdman[3], Lily Riggs[1,2], Sandra Moses[1]; [1]Rotman Research Institute, [2]University of Toronto, [3]Simon Fraser University* – The spatiotemporal dynamics underlying the processing of relations among objects were outlined using recordings of eye movements and magnetoencephalography (MEG). Subjects were presented with an initial scene of three abstract objects overlaid on a real-world background context. Following a delay of two seconds, a repeated or manipulated version of the original scene was presented. The manipulation involved moving one of the three objects to a new location. Eye movement data from 16 subjects revealed increased viewing of the new location of the moved object for manipulated compared to repeated or original scenes. MEG single trial data from 15 subjects were averaged with respect to stimulus onset. Viewing of either the repeated or manipulated picture, relative to the initial presentation, resulted in activation of the medial occipital gyrus, superior temporal gyrus, cuneus, inferior and medial frontal cortices within 150 ms and responses were observed in parahippocampal gyrus approximately 300 ms post-onset. Comparisons of the repeated and manipulated scenes revealed increased activity for the repeated picture within inferior frontal cortex and increased activity for the manipulated scene in medial occipital, temporal gyri and superior temporal gyrus within 200 ms post-onset. These findings suggest early processing and detection of relational changes that may contribute to subsequent changes in eye movement behavior.

B 72

DISSOCIATIONS BETWEEN ITEM-SPECIFIC AND RELATIONAL ENCODING *Robert Blumenfeld, Colleen Parks, Andrew Yonelinas, Charan Ranganath; UC Davis* – Results from recent neuroimaging studies have supported the idea that different prefrontal regions support processing of information about specific items and processing of relationships between different items. These findings beg the question of whether item and relational processing can be dissociated behaviorally. Previous studies on this topic have yielded mixed results, and it is unclear whether the differences between item-specific and relational encoding processes are just quantitative rather than qualitative. In the present study, we sought to dissociate the behavioral effects of item-specific and relational encoding processes by using mathematical modeling of data from parallel measures of item and inter-item memory. In experiment 1, participants encoded word pairs using either an item-based (separation-imagery) or relational (interactive-imagery) strategy, and were subsequently given either a 6-point confidence item recognition test or a 6-point confidence associative recognition test. Consistent with the notion that encoding of item and relational information produce qualitative differences in long-term memory, separation and interactive imagery produced equivalent item recognition, yet interactive imagery led to far greater associative recognition. In experiment 2, participants encoded word pairs using either an item-based (large-small separation-imagery) or relational (interactive-imagery) strategy. After encoding, participants were tested for recognition of specific item details (via left-hand vs. right-hand side of screen recognition), or for inter-item memory (via associative recognition). Results showed that separation-imagery led to better memory for item details, yet interactive-imagery led to better inter-item recognition. This double-dissociation suggests that item-specific and relational encoding make qualitatively different contributions to LTM formation.

B 73

SENTENCE NOVELTY INDUCES INCREASED HIPPOCAMPAL-PREFRONTAL FUNCTIONAL CONNECTIVITY *Jordan Poppenk[1], Stefan Köhler[2], Morris Moscovitch[1], Anthony McIntosh[1]; [1]University of Toronto, [2]University of Western Ontario* – The hippocampus is known to be important for encoding novelty. To determine whether network interactions involving the hippocampus characterize various kinds of novelty processing, an fMRI novelty-processing study was reanalyzed using multivariate statistics. During scanning, participants encountered sentences that were familiar, contained novel syntax, contained a novel semantic detail, or described an entirely novel episode. Subsequent recognition memory was superior for the conditions containing semantic novelty (i.e., detail change and entirely new sentences) than for syntactic novelty, which was near chance levels. A partial least squares (PLS) analysis of the functional data with a seed planted in the left hippocampus revealed two significant latent variables (LVs), the second of which represented stable novelty-dependent relationships between the hippocampus and other regions. Salient voxels from LV2 were filtered for reliability, and regions of interest (ROIs) were selected from surviving voxel clusters in PFC and the temporal lobe. These included clusters in bilateral dorsolateral prefrontal cortex (DLPFC) and the left superior temporal gyrus (L-STG). For each novelty condition, the mean regional BOLD response for the left hippocampus and selected ROIs was then entered into a correlational analysis. Correlations involving the left hippocampus were relatively weak in familiar and syntactic novelty conditions but were mostly negative for semantic novelty conditions. Because network correlations were generally strongest under conditions where encoding was most effective, these results suggest that synchronization of the hippocampal network underlies the effective encoding of novelty.

B 74

INTERACTION BETWEEN SUBSEQUENT MEMORY AND SERIAL POSITION OF WORDLIST ENCODING USING MEG *Sverker Sikström[1], Xing Tian[2], David Huber[3], Petter Kallioinen[1], Andrew Smart[4], Eddy Davelaar[5], Kristoffer Åberg[6]; [1]Lund University Cognitive Science, [2]University of Maryland, [3]University Californa San Diego, [4]New York University, [5]School of Psychology Birkbeck College, [6]Laboratory of Psychophysics Lausanne* – The subsequent memory effect (SME) is the empirical finding that the pattern of neural activity during encoding is different for items that later are recalled compared to non-recalled items. The primacy effect is the behavioral finding that the first few items in a list are better recalled than items later in the list. However, few studies have investigated how the SME effect interacts with serial position. We let participants study short word list and measured the magnetic encephalogram (MEG) during conditions to actively encode the presented words followed by a free recall test, or to passively read the words without intention to encode. The behavioral data showed a primacy effect. The Evoked Magnetic Field (EMF) for subsequently recalled words increased as a function of serial position, whereas both non-recalled words and words studied under passive reading conditions did not change across position. In particular the subsequent memory effect in EMF were absent during the primacy effect, but became increasingly stronger across serial position. We further analyzed the SME effect in the theta, alpha, and gamma bands. The spatial locations of these findings were investigated by using a minimal norm technique. The interaction effect between serial position and SME for recalled words, and the absence of this effect for passive reading, indicates that instructions to encode play an important role in changes of neural activity across serial position.

B 75

COMMON AND DIFFERENTIAL BRAIN REGIONS ASSOCIATED WITH RETRIEVING SPATIAL AND NON-SPATIAL INFORMATION FROM EPISODIC AND SEMANTIC MEMORY *Chun-Yu Lin, Katie Ketcham, Lee Ryan, Lynn Nadel; University of Arizona* – The present study examined the brain regions involved in the retrieval of spatial and non-spatial information from episodic or semantic memory using event-related fMRI. In the study phase, participants viewed six object arrays (each had pictures of objects in four quadrants), and were instructed to remember the objects, their locations, and the details of their appearance. At test, participants were presented with verbal names of two objects at a time during scanning and made relational judgments on questions from the following conditions: EPISODIC SPATIAL, EPISODIC NON-SPATIAL, SEMANTIC SPATIAL, SEMANTIC NON-SPATIAL, and CONTROL. Objects in the semantic conditions were either from the study phase or new. Results indicated similar brain activation patterns across all the memory conditions. However, the various conditions yielded differential activations in terms of magnitude, cluster size, and location in specific sub-regions. For example, posterior medial temporal lobe (MTL) was more active for episodic and spatial conditions than semantic and non-spatial conditions, while anterior MTL showed the opposite pattern. Precuneus and lateral parietal regions also showed differential activations that might be related to "perceived familiarity" and spatial processing, respectively. For instance, even when using the same semantic questions that did not require episodic retrieval (e.g. which object is normally softer), precuneus was more active when the objects in the questions had been studied in the study phase than when they were new, perhaps reflecting involuntary feelings of familiarity. Interactions between conditions and the implications of the results will be discussed.

B 76

DISSOCIATING FAMILIARITY DERIVED FROM CONTEXT AND ITEM REPETITION: AN ERP STUDY *Shih-kuen Cheng[1], YuHan Chen[1], Daisy L. Hung[2], Ovid J.L. Tzeng[3]; [1]National Central University, Taiwan, [2]National Yang-Ming University, Taiwan, [3]Academia Sinica, Taiwan* – This study examined the ERP correlates of familiarity in recognition for episodes sharing semantically related components. At study, subjects were presented with lists of word pairs formed by pairing one of two associated words with different associates of an unstudied theme word (e.g., time-religion, watch-temple etc. in one list; demand-bed, supply-rest etc. in another list). At test, subjects discriminated 'Old pairs' (e.g. time-religion) from 'Intra-list Rearranged pairs' (e.g., time- temple), 'Inter-list Rearranged pairs' (e.g., time-rest), 'Old-New pairs' (e.g. time-bulb), and 'New-New pairs' (e.g., wine-painting). The false alarm rate for Intra pairs was lower than the hit rate but was significantly higher than the false alarm rates for the other test pairs. The ERPs elicited by hits to Old pairs and false alarms to Intra pairs were indistinguishable and were more positive-going than those associated with other response categories in the time window of 300-500 ms after stimulus onset, during which the familiarity-related ERP old/new effect has been identified in previous studies. However, this positive-going effect showed different topographies when the ERPs associated with hits were compared with correct rejections to Inter pairs and correct rejections to New-New pairs. We therefore conclude that the contribution of context repetition and item repetition to familiarity can be dissociated.

B 77

COMMON SYSTEMS FOR THE COMPREHENSION AND PRODUCTION OF NARRATIVE SPEECH *Richard Wise[1], Jane Warren[1], Sophie Scott[2]; [1]Imperial College London, Hammersmith Hospital, London, United Kingdom, [2]Institute of Cognitive Neuroscience, University College London, United Kingdom* – Humans devote much time to the exchange of personal memories within the context of shared general semantic knowledge. Our hypothesis was that functional imaging in normal subjects would demonstrate that everyday speech comprehension and production converge principally on high order heteromodal and amodal cortical areas that have been implicated in declarative memory functions. Activity independent of speech phase was most evident in left and right anterolateral temporal cortices. Lesser, but significant, effects were observed in posterior cortex, just ventral to the angular gyri. The left and right hippocampus and adjacent inferior temporal cortex demonstrated significant activity during speech comprehension, compatible with a role in mnemonic encoding of narrative information, but no activity was evident during the overt memory retrieval associated with speech production. Further, the response profiles of activity indicated that the inferomedial temporal lobes contribute to the perceptual processing of sequences of complex auditory stimuli, over and above their role in mnemonic encoding. In contrast, the retrosplenial and parahippocampal areas, which are closely associated anatomically with the hippocampus, were equally active during speech comprehension and production. The results of this study indicate why a severe and persistent inability both to understand and produce meaningful speech in the absence of a linguistic impairment is usually only observed after bilateral, and particularly anterior, destruction of the temporal lobes; and emphasizes the potential importance of retrosplenial cortex, an area known to be affected early in the course of Alzheimer's disease, in the processing of declarative memories during communication.

Memory: Working Memory

B 78

DIFFERENCES IN PATTERNS OF CEREBRAL ACTIVATION ON FMRI ON WORKING MEMORY TASKS IN INDIVIDUALS WITH MULTIPLE SCLEROSIS VERSUS HEALTHY INDIVIDUALS *Nancy Chiaravalloti[1,2], Glenn Wylie[1,2], Amanda O'Brien[1,2], Helen Genova[2], Julie Balzano[1], John DeLuca[1,2]; [1]Kessler Medical Rehabilitation Research and Education Corporation, [2]UMDNJ - New Jersey Medical School* – Working memory (WM) allows for the storage and manipulation of information. Although WM impairments have been consistently demonstrated in Multiple Sclerosis (MS), the neurological correlates of these impairments are poorly understood. The current study was designed to examine where the source of the WM deficit in MS lies: maintenance or manipulation. Participants consisted of 28 individuals with clinically definite MS and 10 healthy individuals (HC). fMRI was performed on a 3 Tesla scanner to assess brain activation during three versions of the n-back task: 0-, 1-, and 2- back. The 1- and 2- back tasks examined the maintenance and manipulation of information in working memory, respectively. The 0-back was the control task. Significant differences in patterns of activation were noted between the MS and HC groups on the 1-back task. The MS group showed more diffuse patterns of activation in bilateral frontal and parietal regions as compared with HCs. In addition, the MS group showed more activation in the anterior cingulate while performing the 1-back task. In contrast, patterns of cerebral activation on the 2-back task was similar for the two groups. Individuals with MS appear to require significantly more resources to complete a relatively simple task requiring the maintenance of information (1-back). In contrast, no additional cerebral resources appear to be required, above that which is required by healthy control subjects, to successfully complete a task requiring the manipulation of information (2-back).

B 79

RECRUITMENT OF INTUITIVE VS. ANALYTIC THINKING STRATEGIES AFFECTS THE ROLE OF MEMORY IN THE GAMBLING TASK *Marta Gozzi, Paolo Cherubini, Costanza Papagno, Emanuela Bricolo; University of Milano-Bicocca* – Previous literature reports apparently inconsistent results concerning the role of memory on performance in the Iowa Gambling Task. Inconsistencies might depend on the different demands of the various versions of the gambling task (GT) that have been used (Dunn, Dalgleish, & Lawrence, 2006). In this study we capitalize on the distinction between intuitive thinking strategies and analytic thinking strategies (e.g., Kahneman, 2003) to illustrate that, whilst the standard versions of the gambling task can be successfully acquired by using intuitive thinking strategies, the complex versions of it involve analytic thinking. In Experiments 1a-b we used a complex version of the GT, comparing participants with and without a concurrent memory load. Participants in both conditions recruited intuitive strategies, and accordingly performed badly. In Experiment 2 we simplified the task, even though it still could be successfully acquired only by using analytic thinking. Participants in the memory load condition recruited intuitive thinking strategies, and performed badly; participants in the condition without memory load managed to recruit analytic thinking strategies, and successfully acquired the task. In addition to standard performance measures on the GT, we also used the participant's subjective expected utility, showing that it sometimes differs from standard measures in some important regards. Finally, in Experiments 1a and 2 we compared performances of participants trained in economic decision making with those of untrained participants. The two groups did not differ reliably.

B 80

THE INFLUENCE OF WORKING MEMORY LOAD ON FACE PROCESSING: AN EVENT-RELATED POTENTIAL STUDY OF THE P300, N170, AND N250R. *Helen M. Morgan, Christoph Klein, Stephan G. Boehm, Kimron L. Shapiro, David E. J. Linden; School of Psychology, University of Wales, Bangor* – This study used event-related potential (ERP) methodology to examine cortical activity associated with visual working memory (WM) for faces. There were two main goals. First, to confirm previous findings of P300 modulation by WM load in a new procedure. Second, to examine whether the face-related N170 and N250r components are influenced by WM load. One, two, three, or four faces (WM loads 1-4) were simultaneously presented for memory encoding. After a one second delay, a target face appeared and participants had to judge whether this face was part of the previous face array. P300 amplitude decreased as WM load increased, and this P300 suppression was observed at both encoding and retrieval. WM load was also found to modulate face-related ERP components. The amplitude of the N170 elicited by the target face was reduced for higher loads. In addition, an increase in negativity over inferior temporal areas (N250r) was observed for target faces that were present in the encoding array relative to target faces that were absent from the encoding array, and this N250r also showed a reverse load effect. These findings confirm previous work showing that working memory load influences late cognitive components such as the P300. Furthermore, these results suggest that WM load affects early visual components such as the N170 and N250r. The processing capacity of visual areas at retrieval may thus contribute to the limited number of faces that can be stored in WM.

B 81

EVALUATING THE ROLE OF PREFRONTAL AND PARIETAL CORTICES IN MEMORY-GUIDED RESPONSE WITH REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION *Massihullah Hamidi, Giulio Tononi, Bradley R. Postle; University of Wisconsin-Madison* – Patients with frontal lobe damage are relatively unimpaired on simple tasks of working memory, such as forward digit span. Similarly, we have previously found that delay-period repetitive transcranial magnetic stimulation (rTMS) to the dorsolateral prefrontal cortex (dlPFC) does not affect recognition of locations or of letters. However, with tasks involving memory-guided decision-making, the patients' performance suffers. Specifically, patients performed poorly on tasks requiring a response dependant on the relationship of the probe with the items in working memory, but not when performing tasks requiring immediate serial recall. In this study, we predict that recognition will be differentially sensitive to rTMS of the dlPFC, but not superior parietal lobule, in making two types of responses in a spatial working memory task. Subjects were presented four identical circles in four quadrants on the screen, followed by a three-second delay period. Memory-guided decision-making was tested with a memory probe that required subjects to compare the locations of the remembered items to that of a probe stimulus and make a match/non-match decision. In the direct recall task, one quadrant of the screen was highlighted and subjects were required to move the cursor to the remembered location of the target in that quadrant. rTMS (10 Hz, 3 s, 110% motor threshold) was coincident with the onset of the probe/response cue of each task. Preliminary results indicate differential sensitivity of dlPFC to response-locked rTMS, consistent with the idea that dlPFC plays a more important role in memory-guided action than in storage processes in working memory.

B 82

BINDING AND MEMORY: DOES THE HIPPOCAMPUS INTEGRATE BRAIN REGIONS? *Roy P.C. Kessels[1,2], Carinne Piekema[3,4], Karl Magnus Petersson[3], Guillén Fernández[3,2]; [1]Nijmegen Institute for Cognition and Information, Radboud University Nijmegen, The Netherlands, [2]Radboud University Nijmegen Medical Centre, The Netherlands, [3]F.C. Donders Centre for Cognitive Neuroimaging, Nijmegen, The Netherlands, [4]Helmholtz Instituut, Utrecht University, The Netherlands* – Recent studies have shown medial temporal-lobe (MTL) involvement in working-memory tasks, possibly related to the formation of associations within memory (i.e., binding). Previously, we showed hippocampal involvement during the maintenance of associations of objects with their spatial location, but not in the maintenance of a single item or an object-color association. While this may be explained by the spatial component of the stimuli, an alternative explanation is that the hippocampus is involved in binding information processed in any two spatially segregated brain areas. In an fMRI study (Siemens 1.5T system, TR=2.3s, TE=30ms, 33 axial slices, slice thickness=3.5mm), 8 subjects performed a 3-item delayed-match-to-sample task using a factorial design with factors Association (single vs. multiple) and Feature Type (spatial vs. color vs. spatial distribution) (34 trials per condition). Each of the 3 items was composed of a face and a house (that are processed in distinct brain areas) which were presented in one of eight colors (random) and one of eight locations (random). A cue at the start of each trial indicated which feature or combination of features of the stimulus set had to be maintained. Results indicate that maintenance of single items and associations with color did not activate the MTL. When associations between houses and faces had to be maintained, the MTL, specifically the hippocampus, was more active than when an association with a spatial location had to be maintained. This suggests that the hippocampus indeed is implicated in the binding of information from spatially segregated brain regions.

B 83

IS THE PARIETAL LOBE CRITICAL FOR VISUAL WORKING MEMORY? EVIDENCE FROM PATIENTS WITH UNILATERAL AND BILATERAL PARIETAL LESIONS. *Marian Berryhill, Ingrid Olson; University of Pennsylvania* – Recent neuroimaging studies report parietal activity during visual short-term or working memory (VWM) tasks (Todd & Marois, 2004; Xu & Chun, 2006), suggesting posterior parietal involvement in visuospatial working memory. Yet there is little evidence from other sources to indicate any role for the parietal lobe in memory. In the present study, we sought to evaluate the presence of a causal link between parietal function and VWM performance by testing patients with various types of parietal lobe damage: unilateral left, unilateral right, or bilateral parietal lesions. Their performance was compared to that of age and education matched controls. We tested a set of related hypotheses. First, we hypothesized that right parietal damage would cause impaired VWM for tasks and stimuli that had a strong spatial component. Second, we hypothesized that left parietal lobe damage would cause impaired VWM for manipulable objects such as tools. VWM for four novel shapes, colors, and tools, over a 1 second delay was tested. Two tasks were used: a sequential task in which spatial processing was irrelevant, and a simultaneous task in which spatial processing was essential. The results reveal a pattern of preserved and impaired VWM, depending on task and stimuli. However, there was no association between overall loss of VWM and parietal damage, suggesting that the parietal lobe does not have a general role in VWM.

B 84

SPATIAL WORKING MEMORY AND ATTENTIONAL SELECTION SHARE COMMON NEURAL SUBSTRATES *Jutta S. Mayer[1], Fabian Fußer[1], Robert A. Bittner[1], Danko Nikolić[2,1], Corinna Haenschel[2,1], David E. J. Linden[3]; [1]Johann Wolfgang Goethe University, Frankfurt, [2]Max Planck Institute for Brain Research, Frankfurt, [3]University of Wales, Bangor* – Selective attention and visual working memory (WM) are fundamental cognitive mechanisms both operating at the interface between perception and action. Selective attention has been implicated as a limiting factor for the storage capacity of WM. Behavioral evidence indicates interference between visual attention and visuospatial WM. In this study we used functional magnetic resonance imaging (fMRI) to test the hypothesis that spatial WM and selective attention share common neural substrates. We designed a paradigm that separated attention and WM encoding in time and allowed for an orthogonal manipulation of the two. Subjects performed a task that combined attention-demanding visual search and delayed discrimination for spatial locations. Attention was manipulated by the difficulty of the search, and WM load was varied parametrically (1, 3 and 5 locations). We report fMRI data of 20 subjects (3 Tesla Trio, Siemens, Erlangen; 17 slices; TR = 1 s; TE = 30 ms) that were analyzed within the General Linear Model using a random effects whole brain analysis. Pure effects of WM load and attentional demand were found bilaterally in the prefrontal cortex for WM and the visual cortex for attention. Conversely, distributed visual, parietal and precentral areas showed overlapping activation for the two task manipulations and were reduced in their memory load response under the condition with high attentional demand. These findings demonstrate that the processes underlying attentional selection and spatial WM draw largely upon the same limited neural resources and may define the neural locus of a processing bottleneck of spatial WM and attention.

B 85

ENHANCED VISUAL WORKING MEMORY FOR ANGRY FACES: AN FMRI STUDY *Margaret Jackson, Claudia Wolf, Stephen Johnston, David Linden; University of Wales Bangor* – Emotional expression modulates visual working memory (WM) for face identities: WM is significantly enhanced for angry faces compared to happy and neutral faces (Jackson et al., 2006). In the current study, we aimed to determine the neural correlates of this angry face advantage using fMRI. Between one and four angry, happy, and neutral faces were presented in a single probe visual WM task. An event-related design was adopted in which emotion and load conditions were pseudo-randomised. Thirty-five subjects responded 'yes' or 'no' to whether a single probe face matched the identity of one of the faces presented 1000 ms earlier in a memory display. Emotional expression remained constant within any one trial and was not task relevant. Behavioural data showed significantly enhanced visual WM for angry compared to happy faces, and a trend towards an angry vs. neutral face advantage. Functional data revealed significantly higher angry vs. happy and neutral face-related activity in right hippocampus, middle temporal gyrus, dorsolateral prefrontal cortex, and globus pallidus. Activity in these regions did not interact with load. Generalised increases in brain activity during emotional vs. neutral face trials were found in cingulate cortex, and left hippocampus, parahippocampal gyrus, and dorsolateral prefrontal cortex. These findings suggest that a mainly right hemispheric network for emotion processing becomes activated when angry faces are to be remembered. This network may serve the function of enhancing processing capacity for threatening stimuli that are of particular evolutionary relevance.

B 86

MEDIAL TEMPORAL LOBE ACTIVITY PREDICTS ACCURACY ON AN ALLOCENTRIC SPATIAL WORKING MEMORY TASK *Deborah Hannula, Charan Ranganath; University of California, Davis* – Results from recent investigations have implicated medial temporal lobe (MTL) structures in retaining information over the course of short delays, but when and how these regions might support accurate performance remains unclear. Here, we used event-related FMRI to investigate the role of MTL structures in the encoding, maintenance, and retrieval of spatial relationships among objects in a visual scene. On every trial, four objects were presented, each in one of nine possible spatial locations of a three-dimensional grid. Participants were instructed to mentally rotate the grid during the delay in anticipation of a test stimulus, which was a rendering of the grid that was rotated 90 degrees from the original viewpoint. Participants were to indicate whether: (A) the object-location bindings in the grid were intact (match), (B) one of the objects occupied a new, previously unfilled, location (mismatch-location), or (C) two of the objects had swapped positions (mismatch-swap). Activation in anterior and posterior left hippocampus during the encoding phase of each trial was predictive of response accuracy. Additionally, activation in the left anterior parahippocampal gyrus (likely corresponding to perirhinal cortex) was correlated with individual differences in behavioral performance during the delay; this result suggests that good, but not poor performers exhibit additional MTL recruitment during the maintenance phase of this task. Finally, activity in the right anterior hippocampus distinguished between correctly identified match and mismatch probes. These results are consistent with the idea that MTL structures contribute to the retention of relational information even across short delays.

B 87

MEMORY-DEPENDENT INHIBITION OF VISUAL DISCRIMINATION SHOWS A MEXICAN-HAT DISTRIBUTION *Carsten Finke[1], Florian Ostendorf[1], Peter Martus[2], Mischa Braun[1], Christoph J. Ploner[1]; [1]Neurology, Charité Berlin, [2]Institute of Biometry and Clinical Epidemiology, Charité Berlin* – Recent evidence suggests that maintenance of spatial items in working memory not necessarily facilitates behavioural responses to stimuli presented at remembered locations. Surprisingly, both in monkeys and humans, accurate memory of a spatial stimulus in a memory-guided saccade task leads to sustained and spatially selective inhibition of manual responses to visual stimuli presented during the memory delay (Ostendorf et al. 2004, Krishna et al. 2006). In extension of previous theories on inhibition of return, these results suggest that top-down modulation of visual processing during working memory tasks may be the net effect of two simultaneously acting complementary mechanisms. Their relative strength at each time-point during the memory delay may determine whether a behavioural response is facilitated or inhibited. To investigate this issue we employed a memory-guided saccade paradigm (6-s delay) with a visual discrimination task, performed either 1,500, 2,500, or 3,500 ms after presentation of the memory cue. In additional analyses of the dataset from our first report (Ostendorf et al. 2004), reaction times to discrimination stimuli were analysed as a function of memory-guided saccade amplitude. By fitting polynomial approximations to our data, we show that memory-dependent inhibition of visual discrimination significantly differs from a gradient distribution. Similar to recent studies on the spatial distribution of attention, and in direct support of a memory-dependent push-pull modulation of visual processing, our data show the existence of a central inhibitory peak surrounded by an excitatory annulus, forming a transient inverted "mexican hat" profile that gradually diminishes as the memory delay proceeds.

B 88

EXPLORING THE INNER SPEECH PROCESS IN VERBAL WORKING MEMORY *Corrine Durisko, Julie Fiez; University of Pittsburgh* – Verbal working memory (VWM) is the ability to dynamically preserve and manipulate verbal information for brief periods of time. VWM is maintained through a silent "inner speech" process. It is well established in the behavioral and neuroimaging literature that VWM can be disrupted by the simultaneous performance of simple speech tasks. Our primary goal in these experiments is to test whether VWM and overt concurrent articulation have overlapping regions of activation in speech processing associated areas, and to determine whether such regions are active during simple tapping tasks. Due to concerns about overt movement artifacts, we also explore covert versions the tasks. Experiment 1 examines the effects of overt and covert concurrent articulation and finger tapping on VWM. We find that concurrent articulation tasks are the most detrimental to subjects' recall ability. These effects could be attributed to dual-task interference effects at the level of inner speech in VWM, thus, indicating a shared set of regions for speech and VWM. Also, the effect sizes differ between overt and covert versions of our tasks, raising questions about the common assumption of shared substrates. Experiment 2 examines whether there are shared neural regions between simple speech tasks and VWM and to further explores differences between overt and covert tasks. The results from this experiment provide evidence implicating the left cerebellum and left superior temporal gyrus as the shared locus of activation. We also found evidence in support of distinct sets of regions for overt versus covert versions of the tasks.

B 89

FEEDFORWARD MODULATIONS OF PERCEPTUAL ACTIVITY ARE CRUCIAL FOR SUCCESSFUL WORKING MEMORY MAINTENANCE: AN ERP INVESTIGATION *Kartik Sreenivasan, Danielle Spiegel, Amishi Jha; University of Pennsylvania* – Recent imaging studies have demonstrated enhanced activity in domain-specific perceptual regions during working memory (WM) maintenance (e.g. Druzgal and D'Esposito, 2003; Ranganath et al., 2004). Furthermore, our lab has recently demonstrated that WM maintenance-related enhancement of perceptual activity occurs at early feedforward levels of processing (Sreenivasan et al., submitted), which is consistent with evidence suggesting that WM maintenance is achieved via the recruitment of selective attention (see Awh et al., 2006 for a review). However, the relationship between feedforward enhancement of perceptual processing and WM performance remains unclear. We sought to explore this relationship by comparing maintenance-related perceptual activity on correct and incorrect trials. Our prediction was that if the enhancement of perceptual processing is crucial for WM success, delay-period perceptual activity should be greater for correct relative to incorrect trials. Subjects performed a delayed-recognition task for faces as event-related potentials (ERPs) were recorded from 64 channels. During the delay period, task-irrelevant visual noise probes were presented sequentially. We used the face-sensitive N170 ERP component elicited by the probes as an index of delay-period perceptual activity associated with face-processing, and found that N170 amplitude to probes was greater for correct relative to incorrect trials. This effect was robust for trials in which the test item and memory item were identical ($p < 0.01$), but not for trials in which the test and memory item were not identical ($p > 0.1$). These results suggest that, at least for match trials, successful WM maintenance requires the enhancement of feedforward perceptual activity.

B 90

THE NEURAL CORRELATES OF RETRIEVAL PROCESS IN CORRECT DETECTION BASED ON VISUOSPATIAL WORKING MEMORY: AN EVENT-RELATED FMRI STUDY *Yei-Yu Yeh[1], Bo-Cheng Kuo[1], Ho-Ling Liu[2], Jyh-Horng Chen[1]; [1]National Taiwan University, Taipei, Taiwan, [2]Chang Gung University and Chang Gung Medical Center, Taoyuan, Taiwan* – Spatial cueing instigates both top-down control and stimulus-driven attention. Manipulating the cue onset time to affect the effectiveness of top-down control and the demand on retrieving detailed information in a change detection paradigm, we examined the neural correlates in the contrast between correct detection and correct rejection. Under effective top-down control, fronto-parietal activation including the left inferior parietal lobule subserved easy decision that did not require retrieval of detailed information. When the decision required retrieval of detailed information, activation in the left inferior frontal gyrus and activation in the occipital and temporal regions increased. When top-down control was ineffective, easy decision increased activation only in the right inferior frontal gyrus and difficult decision enhanced activation in an extensive fronto-parietal network including the bilateral inferior parietal lobule, the right front-eye-field, the right anterior cingulate and the bilateral middle frontal gyrus. The findings suggest that the left inferior frontal gyrus associating with episodic retrieval is also involved in the retrieval process of visuospatial working memory when a detailed episode is retrieved for correct decision. When multiple elements compete in processing and memory retrieval, activation in the parietal regions increases because the demand on selection is high. The region related to post-retrieval monitoring also increases activation when selection is difficult under ineffective top-down control. Attention plays an important role in affecting the neural correlates of retrieval process in visuospatial working memory.

B 91

OBJECT OR SPACE, VISUAL OR VISUOSPATIAL? CONTRASTING VISUAL AND SPATIAL WORKING MEMORY *Boris Suchan, Kathrin Hey, Odo Köster, Irene Daum; Institut of Cognitive Neuroscience* – Results from neuroimaging studies on working memory suggest a dissociation between visuospatial and visual subcomponents. This dissociation is based on results from separate studies on visual and spatial working memory. The current experiment combined visual and visuospatial items in a 2x2 experimental design by using a special designed 2-back task. This combination included "pure" visual and visuospatial 2-back tasks as well as 2back tasks that included the possibility of having a one back item from the second, non matching modality (e.g. strings of non-matching 1-back item: spatial, object, spatial or object, spatial, object). This task allowed looking for additional interference effects of one modality onto the other. Main effects yielded activation of the dorsal stream for visuospatial working memory performance in contrast to ventral stream activation including the hippocampus for visual working memory. The interaction term yielded evidence for activation in the right dorsolateral prefrontal cortex in combination with middle occipital gyrus activation for contrasts with visuospatial one-back items (spatial, spatial, spatial and visual, spatial, visual). Results confirm the dissociation between visuospatial and visual working memory networks. Additionally, results yield evidence for exclusive, rehearsal related right sided lateral prefrontal cortex activation for visuospatial items suggesting different ways of processing for visual and visuospatial working memory contents.

B 92

EFFECTS OF NICOTINE ON BRAIN FUNCTION DURING OCULOMOTOR DELAYED RESPONSE TASK PERFORMANCE IN HEALTHY HUMANS *Dhanesh Patel, Ulrich Ettinger, Tanja Michel, Mma Nwaigwe, Ojuolape Oniwinde, App Anilkumar, Steven C. R. Williams, Veena Kumari; Centre for Neuroimaging Sciences, Institute of Psychiatry* – Nicotine is known to improve cognitive function in healthy humans; however, the neural correlates mediating these improvements remain unclear. The present study employed the oculomotor delayed response (ODR) task, a measure of spatial working memory, and investigated the effects of acute administration of nicotine on brain function using functional magnetic resonance imaging (fMRI). Eleven neurologically and psychiatrically healthy, right-handed, male non-smokers took part in a double-blind, placebo-controlled, randomised design. Participants underwent fMRI at 1.5T during performance of the ODR task before and after subcutaneous administration of nicotine (12μg/kg bodyweight) or an identical amount of placebo (saline). Assessments took place one week apart, with time of day kept constant for each subject. Activation at baseline showed a neural network underlying the working memory task which consisted of bilateral medial frontal eye fields, left lateral frontal eye field, supplementary eye field, bilateral anterior and posterior intraparietal sulcus, left putamen, and left posterior cerebellum. Nicotine enhanced brain activation in posterior regions but decreased activation in frontal cortex. Reductions in activation due to repeated exposure were seen in frontal and parietal cortex, putamen, and cerebellum. These findings suggest that the influence of nicotine on spatial working memory in humans is mediated by differential effects on anterior and posterior brain activation levels. Implications of the present study concern the development of cholinergic-based cognitive enhancers for neuropsychiatric disorders with known cognitive dysfunction, such as schizophrenia and Alzheimer's disease.

B 93

EARLY VISUAL COMPONENT OF ERP REFLECTED THE MENTAL IMAGERY GENERATION AND INSPECTION *Keiko Yamazaki, Jun'ichi Katayama; Hokkaido University* – We examined the brain activity related to the mental imagery generation and inspection using ERP. In two experiments, participants visualized an uppercase letter on a 5x5 grids corresponding to a cue lowercase letter and decided whether an X probe mark fell on the visualized letter. The half of trials were "early trials", in which the probes placed on, or near, the segment drawn early in the order if they would be drawn on paper, and the other half were "late trials". In long SOA between cue and probe, participants needed only inspection of once created image, while they were required to generate and inspect image in short SOA condition (Exp. 1). The earliest ERP effect of probe position was on the negative component over the occipital electrodes around 200 ms (N200), which was larger in the late trials than in the early trials without the effect of SOA. This result suggests that N200 reflects inspection process, which is required in both SOA conditions. To examine whether the N200 reflect generation process in the short SOA, we analyzed ERP elicited by simple and complex trials, defined by the complexity of visualized letter (Exp. 2). Main effects of probe position and complexity on N200 amplitude were significant. Taken together, these results indicate that the N200 amplitude reflects both imagery generation and inspection processes. We concluded that both processes are involved in visual areas activated in early latency range.

B 94

NEURAL SUBSTRATES ASSOCIATED WITH THE REPRESENTATIONS OTHER THAN PHONOLOGY IN VERBAL SHORT-TERM MEMORY *Hsiyin Chen[1], Denise H. Wu[1], Daisy L. Hung[2], Ovid J.L. Tzeng[3]; [1]Institute of Cognitive Neuroscience, National Central University, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taiwan, [3]Institute of Linguistics, Academia Sinica, Taiwan* – Phonology has been assumed to play a dominant role in verbal shot-term memory (VSTM), but recent neuropsychological and neuroimaging research has indicated the importance of semantic and orthographic factors as well. In the current fMRI study, we employed homophonic Chinese characters to examine the neural substrates underlying the representations other than phonology in VSTM. Specifically, participants were instructed to retain a short list of Chinese characters and performed probed recall based on phonology or meaning of the list items. When the task instruction encouraged semantic retention, the list items also shared the same sound which rendered the phonological information insufficient to reach a correct response. When comparing the brain activation between the retention and resting periods, a network subserving VSTM including bilateral middle frontal gyrus, left precentral gyrus, and left superior parietal lobule was identified. Within this network, the left middle frontal gyrus (LMFG) and superior parietal lobule (LSPL) were preferentially associated with retaining homophonic than non-homophonic Chinese characters. In contrast, no regions within the VSTM network demonstrated the opposite pattern. Our results are compatible with previous findings in showing the involvement of LMFG and LSPL in reading Chinese. The homologous region of LSPL in the right hemisphere has also been suggested to play a role in orthographic processing of VSTM. Our data highlight the semantic and orthographic contribution to VSTM. More importantly, the close correspondence between the neural substrates underlying reading and VSTM suggests an intimate relation between long- and short-term linguistic representations.

B 95

ORBITOFRONTAL CORTEX MEDIATES THE INTERACTION OF EMOTION AND COGNITION DURING VERBAL WORKING MEMORY *Christian Fiebach[1,2], Isabelle Bareither[2], Mark D'Esposito[2]; University of Heidelberg, [2]Helen Wills Neuroscience Institute, University of California, Berkeley* – While the influence of emotions on long-term memory is investigated extensively, little is known about the interaction of affective processing and working memory. We explored how affective valence in to-be-maintained words influences performance and brain activation patterns elicited during working memory encoding and retention (8 sec). Specifically, we used fMRI to examine how affective valence (neutral, positive, negative) modulates the utilization of cognitive resources in case of increased working memory load. Behavioral results show an interaction of memory load and valence. Accuracy under low memory load is improved for affective relative to neutral words, while only negative valence improves performance under high memory load. The effect of affective valence on working memory-related brain activation is greatest during stimulus encoding. During encoding, fMRI demonstrates a dissociation between lateral orbitofrontal and ventromedial prefrontal cortex for negative vs. positive words. During working memory retention, left dorsolateral prefrontal cortex is more strongly activated for higher memory loads. Activity in this region is modulated by the affective valence of the maintained words. Analyses of functional connectivity using the method of beta series correlation (Rissman et al., 2004) demonstrate an increased coupling of valence-sensitive orbitofrontal regions with lateral prefrontal cortex for negative as compared to positive valence, during encoding. This difference in functional connectivities may be the basis of the observed valence by working memory load interaction. These results suggest that positive and negative affect differentially influence working memory, and specify the neural mechanisms underlying this emotion-by-cognition interaction.

B 96

DIFFERENTIAL EFFECTS OF HIGH LOAD AND HIGH ITEM-SIMILARITY ON SHORT-TERM RECOGNITION: A COMBINED ERP AND FMRI STUDY *Christoph Bledowski[1], Benny Rahm[2,3], Katharina Spira[1], Juliane Simon[1], Jochen Kaiser[1]; [1]Institute of Medical Psychology, Johann-Wolfgang-Goethe University, Frankfurt am Main, Germany, [2]University of Freiburg, Germany, [3]University of Basel, Switzerland* – In recognition, a higher memory load is often thought to increase the number of comparisons to be made, whereas greater target-probe similarity requires participants to match items more precisely. Up to now, there is no evidence whether these two manipulations tap similar or different resources. We integrated both as factors in our design to explicitly test for main and interaction effects in the recognition phase of a delayed-match-to-sample-task. Either 1 or 3 colours had to be encoded and maintained for a short delay of 1.7 seconds. In the recognition phase, a single probe was presented which matched, was similar or was dissimilar to the learned colour(s). Behavioral results showed that both high load and high similarity increase recognition difficulty. Moreover, we observed an interaction of load and similarity. While load had no effect on dissimilar recognition, accuracy and response times were increased both for similar lures and matches under high load. Accordingly, fMRI revealed significant load and similarity main effects in the ventral and dorsal lateral prefrontal cortex (PFC) and medial frontal areas, whereas posterior parietal cortex responded selectively to the load manipulation. Moreover, ventrolateral PFC showed an interaction effect with similar lures leading to stronger activation than for matches only under low load. Modelling the ERP-source activity of this region revealed that this interaction was evident at late time points (400-800ms). We propose that ventrolateral PFC reflects control processes of selecting targets among competing items.

B 97

AGE DIFFERENCES IN DLPFC RECRUITMENT DURING VERBAL WORKING MEMORY MAINTENANCE DEPEND ON MEMORY LOAD *Katherine Cappell[1], Leon Gmeindl[2], Patricia Reuter-Lorenz[1]; [1]University of Michigan, [2]Johns Hopkins University* – Both age-related under-activation and over-activation of dorsolateral prefrontal cortex (DLPFC) have been reported across multiple task domains, including working memory (WM). We recently proposed the Compensation Related Utilization of Neural Circuits Hypothesis (CRUNCH) to explain this phenomenon. According to CRUNCH, more neural resources are used by older brains to accomplish computational goals completed with fewer resources by younger brains. Therefore, seniors are more likely than young adults to experience resource limitations at lower levels of task demand. An adequate test of CRUNCH requires varying task demand in a single group of young adults and seniors. Using event-related fMRI, we scanned young adults and seniors while they performed a verbal WM task in which memory load was manipulated (4, 5, or 7 letters). Our fMRI design allowed us to separate encoding-, maintenance-, and retrieval-related neural activity. Here we report results for the maintenance interval. In accordance with CRUNCH, we predicted that relative to young adults seniors would over-activate DLPFC at the low memory load and under-activate at the high load. We examined the effects of load and age on neural activity in left and right Brodmann's area (BA) 46. In left BA 46, neural activity was age-equivalent. However, consistent with our predictions, in right BA 46, we observed age-related over-activation at the two lower loads, and under-activation at the high load. Thus, like seniors, young adults display bilateral activation with increasing task demand. However, seniors recruit additional circuits, and therefore appear to reach a resource ceiling, at lower levels of load.

B 98

THE EFFECTS OF EFFORT AND INCENTIVE ON HUMAN CORTICAL AND SUBCORTICAL BRAIN ACTIVITY *Clayton Curtis[1], Mauricio Delgado[2], David Valenzuela[1]; [1]New York University, [2]Rutgers University* – Although neural activity correlates with the expectation of reward in a variety of cortical and subcortical areas, such observations do not necessarily implicate these areas in the direct modulation of behavior based on reward. For instance, increased activity could simply reflect the greater effort that one is willing to exert in order to obtain the greater reward. Here, using event-related fMRI, we image the human brain performing a spatial delayed-response task, while we independently manipulate both reward incentive and effort. To manipulate incentive, we told subjects at the beginning of each trial how much money (5¢ vs. $5) could be gained or lost depending on their performance on that trial. At the same time, to manipulate effort, we told subjects how difficult the current trial was going to be (easy vs. hard). We controlled difficulty by adjusting the precision necessary to discriminate the spatial memoranda from a probe stimulus presented after the delay. A psychophysical staircase procedure was used to dynamically adjust difficulty to arrive at 85% and 60% accuracy for the easy and hard conditions, respectively, for each subject. Behaviorally, reaction time, pupil size, and subjective ratings indicate that our manipulations of incentive and effort were successful. Neurally, classic oculomotor cortical areas showed strong effects of effort independent of the magnitude of incentive. Moreover, both the striatum and prefrontal cortex showed strong effects of reward incentive independent of effort level. These results suggest that effort and incentive may depend on distinct cortical and subcortical structures whose interaction promotes the attainment of desired goals. Supported by: Seaver Foundation & NIH R01 EY016407

B 99

SPATIAL REMAPPING OF MULTIPLE OBJECT LOCATIONS IN TRANSSACCADIC MEMORY *Paul Bays, Masud Husain; Institute of Cognitive Neuroscience, University College London, UK* – In the absence of visual landmarks, object displacements that occur during a saccade go largely undetected. However, displacements of the saccade target can be detected with high precision if it is blanked for a short period following saccade onset. Thus retinal location of the saccade target can be remapped in memory to account for the change in eye position. In this study we test whether such remapping is limited to the saccade target or can also occur for other objects in the visual scene. Subjects made a saccade to a target object embedded in an array of coloured objects. The display was blanked at saccade onset, and then one object re-appeared in a shifted position. The accuracy with which subjects could detect the direction of displacement decreased with increasing number of objects in the display, consistent with a limited capacity object memory. However, memory capacity was no lower than in a control condition without an intervening saccade, indicating that remapping occurs for all objects held in visual short-term memory. Nonetheless, the saccade target appears to have a privileged status, as detection of saccade target displacements was unaffected by the number of other objects in the display. The same effect was observed for an object that attracted covert attention by flashing immediately prior to the blanking period, suggesting that independent memory for the saccade target may result solely from the allocation of attention to it prior to the saccade.

B 100

MODULATION OF OSCILLATORY GAMMA AND ALPHA ACTIVITY DURING WORKING MEMORY TASKS ENGAGING THE DORSAL AND VENTRAL STREAM *Daniel Jokisch, Ole Jensen; F.C. Donders Centre for Cognitive Neuroimaging* – Experimental work in both animals and humans has focused on the role of oscillatory brain activity during working memory maintenance. Gamma band activity (30-100 Hz) has been hypothesized to reflect either the maintenance of neuronal representations or demands in attention. With respect to posterior alpha activity, it is under debate if it reflects functional inhibition or actual maintenance of working memory. The aim of the present study was to further elucidate the role of oscillatory brain activity in humans during working memory operations. We recorded brain activity using magnetoencephalography (MEG) from subjects performing a delayed-matching-to-sample task. Subjects were instructed to remember either the identity or the spatial orientation of shortly presented faces thus engaging either the ventral or the dorsal visual stream. Time-frequency spectral analysis revealed significantly stronger alpha power over parieto-occipital sensors during retention of face identity (ventral stream) compared to the retention of face orientation (dorsal stream). By contrast, successful retention of face orientation was associated with a significant increase in gamma power over dorsal areas relative to the face identity condition. In several subjects the alpha and gamma power were anti-correlated on a trial-by-trial basis. We propose that gamma activity reflects the actual neuronal maintenance of visual representations whereas the alpha increase results in functional inhibition due to a top-down drive serving to allocate resources to actual working memory areas by reducing the influence of interfering visual input.

Linguistic Processes: Lexicon

B 101

SOUNDS AND MEANING: AN FMRI STUDY OF PHONOLOGICAL AND SEMANTIC PROCESSING OF SPOKEN AND WRITTEN WORDS *Matt H. Davis[1], Jack Rogers[1], Ferath Kherif[2], Ian Nimmo-Smith[1], Matthew Brett[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK, [2]Functional Imaging Laboratory, University College, London, UK* – Recent evidence suggests functional and anatomical distinctions between frontal and temporal lobe networks involved in semantic and phonological components of visual word recognition (Jobard, 2003, NeuroImage). In this work we use fMRI to compare neural separation for phonological and semantic processing of spoken words with that previously observed for written words. In four 5 minute runs, 20 participants were scanned using a 3T Bruker scanner while performing semantic (living/non-living) or phonological decisions (1/2-syllables) on written or spoken words. We used a fast sparse imaging design for runs using auditory stimuli (TR=2.5s, TA=1.1s) and continuous acquisition for visual runs (TR=TA=1.1s) with 20 second blocks of test trials alternating with rest and with non-language baseline tasks matched for stimulus/response characteristics. In line with previous observations for visual stimuli, we observed a network of inferior frontal, posterior middle temporal and anterior fusiform activity when participants made semantic decisions to spoken words. In contrast, phonological decision making evoked more distinct temporal lobe activity for spoken and written input, with overlapping activity only in inferior frontal and premotor regions. Consistent with these functional imaging observations, a second scanning phase during which some stimuli were repeated from the initial phase showed significant cross-modal behavioural priming for semantic decisions but not for phonological decisions. Univariate and multivariate analysis of fMRI data collected during this second phase will be used to assess neural correlates of cross-modal and cross-task transfer of repetition priming.

B 102

PREVERBAL EFFECTS OF OBJECT MANIPULATION ON 11-13 MONTHS AGED CHILDREN *Maurizio Gentilucci, Arianna Bello, Paola Pettenati, Silvia Stefanini, Paolo Bernardis; Dipartimento di Neuroscienze, Parma, Italy* – The execution of transitive actions, such as grasping and bringing-to-the-mouth affects mouth kinematics and voice spectra of syllables pronounced simultaneously with the action (Gentilucci et al. 2001, 2004). Consequently, it has been proposed that a dual motor command to the hand and mouth transfer features of the action to the mouth articulation postures in order to be used for verbal communication. The aim of the present experiment was to determine whether this dual command system is present in children. Eight 11-13 months children experiencing the preverbal phase participated in the experiment. The stimuli were colored wooden objects, which were either small (2.5 cm size) or large (4.5 cm size) geometrical and meaningful solids. They were presented and, when requested, given to the child who manipulated them, occasionally vocalizing. The child's behavior was recorded by a video camera and successively analyzed. The periods of vocalization while manipulating and simultaneously fixating the object were selected for voice spectra analysis: mean values of the formant 1, formant 2, pitch and voice intensity were taken into account. In the ANOVA formant 1 was significantly affected by the size of the manipulated object. Specifically, it was higher when manipulating the large than the small object. The type of object did not induce any effect. Summing up, aspects of the object manipulation were transferred into mouth articulation postures. The data of the present experiment support the notion that a strict relationship exists between early speech development in children and several aspects of manual activity.

B 103

CROSSLINGUISTIC SEMANTIC AND TRANSLATION PRIMING IN NORMAL BILINGUAL INDIVIDUALS AND BILINGUAL APHASIA *Swathi Kiran, Keith Lebel; University of Texas at Austin* – The present study examined lexical representation in early Spanish-English bilinguals using an unmasked semantic and translation priming paradigm. Stimuli included cross-language semantically related pairs (SR, e.g., screw - clavo), cross-language semantically unrelated pairs (SU, e.g., screw - lagarto), translation pairs (TR, e.g., screw - tornillo), translation unrelated (TU, e.g., screw - jabón), unrelated fillers (UF, e.g., steak - lluvia), and word-nonword pairs (NW, e.g., drawer - loleno). Within each of the above conditions, there were equal numbers of word pairs in each direction (English-Spanish and Spanish-English). In experiment 1, 24 normal participants were divided into two groups based on performance (more-balanced bilinguals, MB and less-balanced bilinguals, LB) on the experimental task. In experiment 2, four patients with bilingual aphasia (BA) performed the same experiment. Results from both experiments revealed that all groups were more accurate for English targets (S-E direction) than Spanish targets (S-E direction). In experiment 1, semantic priming was observed from English to Spanish in both the LB and MB groups although the effect was greater for the LB group. Further, only the LB group showed priming from Spanish – English. For both normal groups, there was no difference between translation and semantic priming effects. In experiment 2, patients with bilingual aphasia demonstrated different patterns of activation with no clear trends. Two participants demonstrated greater priming from Spanish to English whereas two participants demonstrated the opposite effect. The results are discussed within the context of normal bilingual models of conceptual memory and processing impairments in patients with aphasia.

B 104

BILINGUAL CONTROL IN LANGUAGE PRODUCTION: AN EVENT-RELATED BRAIN POTENTIAL STUDY *Ingrid K. Christoffels[1,2], Christine Firk[2], Niels O. Schiller[3,2]; [1]Leiden Institute for Brain and Cognition & Cognitive Psychology Unit, Leiden University, The Netherlands, [2]Maastricht University, The Netherlands, [3]Brain and Cognition & Cognitive Psychology Unit, Leiden University* – Using event-related brain potentials (ERPs) and naming latencies, this study addressed how bilingual speakers control their languages. We assessed sustained language control as evidenced by mixed language context effects and top-down trial-by-trial control induced by switching between languages. Unbalanced German (L1) – Dutch (L2) speakers named pictures either in their L1 or in their L2 (blocked language conditions), or switched between their first and second language unpredictably (mixed language condition). Furthermore, form similarity between translation equivalents (cognate status) was manipulated to assess phonological activation of the non-response language.We found that cognates were responded to faster than non-cognates for L1 and L2 and cognate status influenced the ERPs. Language switching resulted in equal switch costs for both languages and was associated with a modulation in the ERP waveforms (time windows 275-375 ms and 375-475 ms). The effect of mixed language context was evident (blocked versus non-switch trials). Both the RT and the ERP data indicated a profound impact on L1 production but less clearly on L2 production. L1 latencies were slowed down, and the cognate facilitation effect for L1 is larger in the mixed compared to the blocked language context. Also, modulation of ERP components occurred mainly in the L1. Our data indicate that when speaking only in the L2 or in a mixed language context, both languages were relatively active. However, modulation of the relative activation of the languages appeared to take place mainly by adapting accessibility of the L1 rather than in both the L1 and L2.

B 105

BANKS, ORGANS AND EVEN CHICKENS: THE ROLE OF THE LEFT INFERIOR FRONTAL GYRUS IN RESOLVING LEXICAL SEMANTIC AMBIGUITY *Marina Bedny[1,2], Megan McGill[2], Sharon Thompson-Schill[2]; [1]Harvard Medical School, [2]University of Pennsylvania* – Although we perceive words as having a single meaning, most word forms have multiple interpretations. For example, "organ" can refer to a musical instrument or a body part, and "chicken" can refer to a food or a bird. During comprehension we rapidly settle on a particular meaning of a word based on the context. What neural systems support the meaning selection process? Prior neuroimaging and neuropsychological evidence suggest that the left inferior frontal gyrus (LIFG) resolves competition during language processing. We therefore hypothesized that the LIFG resolves meaning competition during word comprehension. According to his hypothesis, activation of the LIFG during word comprehension should increase when words are ambiguous. To test this hypothesis we performed an event-related fMRI study in which participants made relatedness judgments to word pairs. Pairs varied in the degree of lexical ambiguity and the amount of novel semantic information. Results showed that the LIFG is more active when ambiguity is high, irrespective of the amount of novel semantic information. This response profile of the LIFG differed from that of other regions such as the posterior superior temporal gyrus (STG), which did not respond to semantic competition, but did respond to increases in the amount of novel semantic information. These data demonstrate that the LIFG and the STG play distinct roles in word comprehension: the LIFG resolves competition, while the STG retrieves word meanings. These findings are consistent with the broader framework of the LIFG serving as a cognitive control mechanism during language processing.

B 106

AN ERP STUDY FOR INVESTIGATING THE SEMANTIC COMBINABILITY EFFECT AND PHONETIC CONSISTENCY EFFECT IN READING CHINESE. *Chun-Hsien Hsu[1], Jie-Li Tsai[1], Chia-Ying Lee[1,2], Daisy L. Hung[1], Ovid J.L. Tzeng[1,2]; [1]National Yang-Ming University, Taiwan, [2]The Institute of Linguistics, Academia Sinica, Taiwan* – The majority of Chinese characters are phonograms, which usually contain a phonetic radical on the right and a semantic radical on the left. According to the split-fovea theory, the semantic and phonetic radicals of a central fixated phonogram may be initially projected to and processed in right and left hemispheres, respectively. Recently, a repetitive transcranial magnetic stimulation (rTMS) study by Hsiao et al. (2006) showed that rTMS over the left occipital cortex impaired the facilitation of semantic radicals with large combinability, whereas right occipital rTMS did not. Their results suggested that for a character with a large combinability semantic radical, the reliance is more skewed to the information on the right of the character. The presented event-related potential (ERPs) study aimed to examine this hypothesis by manipulating character consistency and semantic combinability in a homophone judgment task. Character consistency was defined as whether a group of characters containing the same phonetic radical have same pronunciation. Semantic combinability was defined as the number of characters sharing the same semantic radical. If the hypothesis is true, the consistency effect shall be more salient in reading characters with high semantic combinability. The results showed significant semantic combinability effect and consistency effect on P200. Meanwhile, there was a significant consistency-by-semantic combinability interaction in N400. High consistency characters revealed greater negative of N400 than low consistency characters for reading characters with high semantic combinability, but not for those with low semantic combinability. These findings support the split-fovea theory for lexical processing.

B 107

THE COMBINABILITY EFFECT OF SEMANTIC RADICAL IN READING CHINESE CHARACTERS *Ying-Ying Cheng[1], Chia-Ying Lee[1,2], Jie-Li Tsai[2], Daisy L. Hung[2], Ovid J.L. Tzeng; [1]The Institute of Linguistics, Academia Sinica, Taiwan, [2]National Yang-Ming University, Taiwan* – More than 80% of Chinese characters were phonetic compounds which are usually made of a semantic radical and a phonetic radical. Previous study has used the semantic combinability to reflect the tendency of a semantic radical to enter into few or many combinations to form phonetic compounds and reported that lexical decision time for characters with large semantic combinability were faster than those with small semantic combinability (Feldman and Siok, 1997). A series of experiments were aimed to further examine this effect by manipulating both character frequency and semantic combinability in the character decision task. In experiment 1, when psedocharacters were used for no trials, the inhibitory combinability effect was found in reading low frequency characters. In experiment 2, when non-characters were used for no trials, the facilitative combinability effect was found in reading high frequency characters. A follow-up ERP study showed a significant frequency-by-combinability interaction on P200 and N400. Characters with high semantic combinability revealed less positive P200 and greater negativity of N400 than those with low semantic combinability. This pattern could be found in reading low frequency characters, but not for high frequency characters. These evidences supported the two-stage framework of lexical processing. In the early stage, characters with high semantic combinability would lead to greater activation at orthographic processing that facilitated response latencies and reflected on P200. For the later stage, radicals with higher semantic combinability might activate more candidates that share the same radical and thus induced a greater semantic competition that reflected on N400.

B 108

DISSOCIATION IN THE NEURAL NETWORK AND TIME COURSE UNDERLYING AFFECTIVE AND CONCEPTUAL SEMANTICS OF DUAL-MEANING WORDS *Hongyan Liu[1], Danling Peng[1], Zhiguo Hu[1], Yanhui Yang[2]; [1]Beijing Normal University, China, [2]Xuanwu Hospital, Beijing, China* – Word contains both affective and conceptual information. However, the processing mechanism of affective semantics and the corresponding difference with conceptual semantics have been largely ignored by current language researches. Adopting two types of priming paradigms (Conceptual and affective priming) with various SOAs (50ms and 300ms), we investigated dissociation mechanism of affective and conceptual semantics using fMRI. Ten subjects were scanned twice while they performed a lexical decision task to dual-meaning Chinese word (e.g. "Pharaoh" has meaning of both "emperor" and "cruelty"). Results showed that: (1) Under both SOA conditions, conceptual semantics processing exhibited a neural network with brain areas engaging in traditional semantic and preattentional / attentional processing, involving bilateral ACC, left MGF, right SGT, left cerebellum, right precuneus, right lingual et al., while affective semantics processing exhibited a neural network with brain areas responsible for emotional and attetnional / strategy processing, involving right MGF, left MGT, bilateral IGP, right PCC, bilateral caudate, left angular et al.; (2) Comparing activation under two SOAs, conceptual semantic processing received higher response amplifies in frontal and temporal areas at long SOA condition than short one, while affective semantic processing gained highest activation in many cortex (e.g. PFC) and sub-cortex areas (e.g. amygdala) at short SOA condition; (3) From short SOA to long SOA, conceptual semantic processing represented a brain lateralization trend from left to bilateral, while affective semantic processing was from right to bilateral. These findings identify different neural mechanisms and time patterns underlying conceptual and affective semantics.

B 109

A 4T ERF MRI STUDY OF ORTHOGRAPHIC EFFECTS ON PICTURE NAMING IN CHINESE *Brendan Weekes[1], Greig de Zubicaray[2], Sam Hutton[1], Katie McMahon[2], Deming Wang[2], Qifang Zhang[1]; [1]University of Sussex, [2]University of Queensland* – A phonological relationship between a context word (cap) and the name of a target picture (cat) facilitates picture naming in the picture-word interference task in alphabetic languages such as English and Dutch. In non-alphabetic languages such as Chinese the relative contribution of orthographic and phonological information to the facilitation effect can be examined. We report results from an event related fMRI experiment investigating the influence of orthography and phonology on name retrieval in five native Chinese speakers. The task was picture naming and all participants were trained to criterion prior to data collection (no errors were made). The study was performed on a 4T Bruker Medspec system. For the functional MRI studies a sparse temporal acquisition was used to acquire 80 T2*-weighted GE EPI volumes (36 slices, 3mm x 0.6 mm gap, and in-plane resolution of 3.6mm) with TR/TE of 3000/30 ms. Functional MRI data were pre-processed and analysed in SPM99. Activation from the group random effects analysis is reported, thresholded at $p<.005$ (uncorrected) with a cluster size minimum of 5 contiguous activated voxels. Activation during phonological processing was observed in multiple left hemisphere sites including temporal, lingual, insula, post-central, supramarginal frontal inferior orbital and supplementary motor areas. Activation during orthographic processing was observed in left hemisphere sites including middle and superior temporal lobe, angular gyrus, thalamus, lingual, and supramarginal gyrus. We conclude that phonological effects without a confounding of orthography are genuine and orthography has a unique effect on picture naming in Chinese.

B 110

NEURAL PATHWAYS UNDERLYING THE EMOTIONAL MODULATION OF WORD PROCESSING *Zhiguo Hu[1], Danling Peng[2], Hongyan Liu[2], Yanhui Yang[3]; [1]Shantou University Medical College, Shantou, P.R. China, [2]Beijing Normal University, Beijing, P.R. China, [3]Xuanwu Hospital, Beijing, P.R. China* – The influence of emotion has been ignored in word processing until now. Using fMRI, we explored the neural pathways underlying the emotional modulation of word processing at different attentional levels. Eleven healthy subjects were scanned during a lexical decision task involving neutral and negative words. Half of the words were masked with random dot noise (i.e., noisy condition), the others were not (i.e., clear condition). To test the prior hypothesis, we created several regions of interest (ROIs) including visual cortex (i.e., fusiform gyrus (FG), inferior/middle occipital gyrus (IOG/MOG)), amygdala and anterior cingulate cortex (ACC). Furthermore, we performed psychophysiological interaction (PPI) analysis to examine the functional connectivity between brain regions. We obtained three main results: (1) All the ROIs were involved in the processing of negative words contrary to neutral ones. (2) For clear condition, PPI analysis revealed a covariation between amygdala and visual cortex (left FG/MOG). And for noisy condition, bilateral FG/IOG, right MOG, and ACC were modulated by amygdala. (3) Further PPI analysis indicated amygdala and visual cortex were also modulated by ACC in reverse. Our results suggested that there are three ways underlying the emotional modulation of word processing: (1) Emotional information directly modulates the activity in visual cortex. (2) Visual cortex activity is modulated and enhanced by amygdala, which facilitate ongoing word processing.（3）Amygdala could modulate activity within visual cortex via its projections to ACC which controls the allocation of attentional resources and affect word processing indirectly.

B 111

ERP EVIDENCE FOR EARLY EFFECTS OF NEIGHBORHOOD DENSITY IN WORD RECOGNITION *Vanessa Taler, Natalie Phillips; Concordia University* – Orthographic neighborhood density (ND) may be defined as the number of words in the lexicon that differ from a given word by one letter (e.g., “badge” has two neighbors, “budge” and “barge”). ND has been shown to play an important role in lexical access, albeit with differing effects in different tasks: high ND lexical items engender shorter response times in lexical decision tasks but longer fixations in reading tasks. The present study aimed to shed light on these conflicting results utilizing event-related brain potentials (ERPs). Healthy young adult participants (n=28) read sentences terminating in a high or low ND word, which was either congruent or incongruent with the sentence context. Sentences were presented one word at a time and EEG epochs were time-locked to the sentence-final word. High ND stimuli elicited a significantly more positive waveform than low ND stimuli between 150 and 300 ms post-stimulus onset. We suggest that this early positivity to high ND stimuli reflects greater initial global activation in the lexical system due to initial activation of orthographic neighbors. Stimuli seen in incongruent sentence contexts elicited a more negative-going waveform between 300 and 600 ms post-stimulus onset than those seen in congruent contexts, a prototypical N400 effect. Surprisingly, no effect of ND was seen in the N400 window. The fact that the ND effect occurred early and did not interact with congruency effects suggests that activation of orthographic neighbors in a reading task proceeds automatically and independently of context.

B 112

PRIMING OF THE AUDITORY M350 RESPONSE: A SINGLE-TRIAL ANALYSIS APPROACH *Lauryn Zipse[1], Kevin Kearns[2], Alec Marantz[3,4]; [1]MIT HST Speech, Hearing, Bioscience & Technology, [2]MGH Institute of Health Professions, [3]New York University, [4]MIT KIT MEG Laboratory* – Magnetoencephalography (MEG) was used to track cortical activity while normally speaking subjects listened to auditory word stimuli presented in a priming paradigm. Target words were presented in the context of semantically related pairs (e.g., bread-cake), identity pairs (e.g., cake-cake), and control pairs (e.g., leg-cake) during a lexical decision task. Data were analyzed with a single-trial analysis procedure, in which an idealized m350 activation pattern was created for each subject, and the presence and strength of this activation pattern was measured following presentation of each target word. The m350 activation was then compared among the various target word conditions. Subjects showed attenuated m350 activation in both primed conditions, compared to the control condition. These findings are consistent with the hypothesis that the m350 response reflects spreading activation among lexical entries (Pylkkänen, Stringfellow, and Marantz, 2002). Pilot data from subjects with aphasia are also presented. The single-trial analysis method used in this study can be applied to explore differences between individual trials, and offers increased statistical power for single-subject studies. It may therefore prove useful for studying patients with language disorders such as aphasia, and for evaluating cognitive models of aphasic processing deficits.

B 113

THE TEMPORAL DYNAMICS OF CONSISTENCY EFFECT IN READING CHINESE: AN EVENT-RELATED POTENTIALS STUDY *Wen-Hsuan Chan[1], Chia-Ying Lee[1], Jie-Li Tsai[2], Chun-Hsien Hsu[2], Daisy L. Hung[2], Ovid J. L. Tzeng[1]; [1]The Institute of Linguistics, Academia Sinica, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taiwan* – This event-related potentials (ERPs) study aimed to explore the temporal dynamic of the consistency effect in lexical processing for reading Chinese phonograms. Given consistency effect was mainly observed in reading low frequency characters, high and low consistency characters within low frequency characters were used in the homophone judgment task. The data showed that the low consistency characters elicited greater N170 in temporal-occipital region and greater P200 in frontal region than high consistency characters, while high consistency character showed greater negativity of N400 than low consistency characters. These findings suggested that the low consistency phonetic characters which were associated with a large number of phonological candidates produced the greater activation for the initial analysis of orthography and phonology representations and showed greater positivity of P200. The greater N400 activation for high consistency characters suggested that a specific phonological representation had been selected in the earlier stage. Given that the phonetic combinability was matched between high and low consistency conditions, there were more homophones within a selected phonological subgroup for high consistency characters than low consistency characters. Thus, the high consistency characters involved the greater lateral inhibition to identify the correct lexical item in the later stage and showed greater N400. These results support that Chinese phonetic radical is a functional sublexical unit for Chinese character recognition and the consistency of orthography-to-phonology mappings affects both early and late stages of lexical processing.

B 114

THE NEURAL BASIS OF FREQUENCY EFFECTS FOR INFLECTED AND UNINFLECTED VERBS: AN EVENT-RELATED FMRI STUDY *Jennifer Vannest[1], Elissa L. Newport[2], Daphne Bavelier[2]; [1]Cincinnati Children's Hospital Medical Center, [2]University of Rochester* – It is well-established that a word’s frequency of occurrence affects how quickly it is accessed. This frequency effect has been exploited to investigate the role of morphological structure in processing complex words, making use of the distinction between frequency of the word’s own surface form (e.g., “walk”) and its base frequency (total frequency of all words containing the base morpheme “walk”.) Inflected words (like “walked”) consistently show effects of base frequency in behavioral studies, whereby frequency of the base predicts reaction time better than frequency of the surface form. Unexpectedly, recent studies have discovered effects of base frequency in uninflected words, suggesting that even for words without complex structure, processing is influenced by the word's entire morphological family. fMRI studies of frequency reveal increased activation in language-processing regions for low frequency words. We used event-related fMRI to examine contrasts in base and surface frequency in complex and uninflected verbs. Fifteen participants made lexical decisions to visually presented verbs; BOLD response was measured in several regions of interest. Variation due simply to response time was removed from the data using regression analysis. Results revealed that left inferior frontal regions responded to base and surface frequency for both verb types. Subcortical areas were sensitive to surface frequency only when surface frequency was high. Only visual processing areas showed increases in activation specific to complex words. These similar patterns of frequency effects for uninflected and inflected words support the hypothesis that morphological family relationships influence access of all words, even uninflected ones.

B 115

CROSS-LANGUAGE INTERFERENCE IN A BILINGUAL STROOP TASK *Emily M. Stanley[1], Delia Kothmann[1], Nicole Y. Y. Wicha[2,1]; [1]University of Texas Health Science Center at San Antonio, [2]University of Texas at San Antonio* – Bilinguals experience cross-language interference when inhibiting one language while using the other (e.g., Sumiya & Healy, 2004), and exhibit increased brain activity related to inhibitory control even when switching between languages is task irrelevant – e.g., scanning for Spanish words in a mixed language list (Rodriguez-Fornells, et al, 2002; Crinion et al, 2006). The goals of this experiment were to test the timing of lexical interference in the first and second languages of fluent bilinguals, and to determine if language switching can affect processing when it is not relevant to the task. Voice-onset times and accuracy were recorded during a bilingual Stroop task in which Spanish-English bilinguals named the ink color for color words. Words were presented in English or Spanish, or both (mixed block), and naming was performed in English or Spanish on alternate blocks. We observe a classic Stroop effect, with greater interference in the form of slower RTs and increased errors for color incongruent than congruent items. This effect was larger when the naming language was the same as the written words than when they differed, and relative proficiency in the response language modulated overall response time. There was no difference in the pattern of effects between mixed and single-language blocks. We compare these findings with preliminary data from a parallel event-related potentials study to observe subtle differences in brain response during bilingual interference with and without language switching. These findings help elucidate the nature of bilingual lexical access and cross-language interference.

B 116

ACTION-OBJECT PROCESSING IN CHINESE APHASIA ACROSS THREE TASKS: A CROSS-LINGUISTIC AND CROSS-MODAL ANALYSIS *Ching-ching Lu[1], Analia Arevalo[2], Bao-Yi Hu[1], Elizabeth Bates[3], Nina Dronkers[2,4]; [1]National Hsinchu University of Education, Hsinchu City, Taiwan, Graduate Institute of Taiwan, Languages and Language Education, Hsinchu City, Taiwan, [2]VA Northern California Health Care System, Martinez, CA, [3]University of California, San Diego, CA, [4]University of California, Davis, CA, USA* – The current study is part of a cross-linguistic investigation comparing action and object processing across different tasks and modalities in both healthy and aphasic participants. As in a previous English-language version of this experiment (Arévalo et al., 2006), words and pictures representing actions and objects were tested in 25 Mandarin Chinese aphasic patients. The set of 120 stimuli (normed with healthy native Chinese speakers) was presented to each patient across three word production tasks: picture-naming (PN), single word reading (WR) and word repetition (WRP). Results revealed striking similarities between the Chinese- and English-speaking participants in terms of task difficulty, lexical category effects, and even motor imagery characteristics. We discuss theories of cross-linguistic differences, noun-verb processing and classic theories of aphasia classification.

B 117

ON THE ROLE OF STANDARDS IN STUDYING LANGUAGE-SPECIFIC MMN EFFECTS *Carsten Eulitz[1], Jonas Obleser[2], Aditi Lahiri[1]; [1]University of Konstanz, [2]University College London, Institute of Cognitive Neuroscience* – Most studies on language-specific MMN effects highlight the importance of the deviant. Consequently the experimental designs are optimized for studying the effects of deviants. The control for the effects of standards is, however, often reduced to a minimum or even neglected. Here we present a study where language specific and non-specific speech sounds were used as both standards and deviants to study the role of the standard in activating language specific memory traces in more detail. The control for the language-specificity of effects was achieved by using a cross-linguistic experimental setup. We studied the MMN in groups of English and German subjects using the high vowels /i/, /y/ and /u/ as standards as well as deviants. For the English subjects, the rounded, high, front vowel (/y/) is not a part of their phonemic inventory and was experienced (offline) as a rather strange sound. Nevertheless, the MMN to /y/ as a deviant was similar to those of the German subjects. However, a marked difference in MMN amplitude between English and German subjects was seen when /y/ was used as the standard. This pattern of results is compatible with the idea that abstract phonological information is activated in the course of repeated presentations of the standard, whereas the phonetic information extracted from the deviant is rather mapped onto the closest-matching category of the corresponding first language.

B 118

TO WATCH, TO SEE, AND TO DIFFER: AN EVENT-RELATED POTENTIAL STUDY OF CONCRETENESS EFFECTS AS A FUNCTION OF WORD CLASS AND LEXICAL AMBIGUITY *Chia-lin Lee[1], Kara Federmeier[2]; [1]University of Illinois, Urbana-Champaign, [2]The Beckman Institute for Advanced Science and Technology, University of Illinois, Urbana-Champaign* – Event-related potentials were used to assess the generalizability of concreteness effects on word processing across word classes and different types of lexical ambiguity. Four types of words were embedded in minimal phrases and tested in a semantic relatedness judgment task: word class unambiguous nouns (e.g., sofa), word class unambiguous verbs (e.g., eat), word class ambiguous items (e.g., vote), and word class ambiguous items with meaning disparity across their noun and verb senses (e.g., duck). Each word type was subdivided into high and low concreteness sets, based on concreteness norming that took word class into consideration. Our results replicate prior work showing an enhanced N400 response over central/posterior electrode sites and a sustained frontal negativity to concrete as compared with abstract words. The effect of concreteness on the N400 appeared for all conditions, whereas the frontal effect was present for all word types except for the syntactically and semantically ambiguous items when these were used as verbs. These data thus show that concreteness effects previously documented for nouns can be generalized to verbs; however, concreteness effects are modulated by both word class and ambiguity. The dissociable ERP indices of concreteness revealed by these data further suggest that the central/posterior and the sustained frontal effects may derive from different sources and that concreteness may thus impact multiple aspects of neurocognitive processing – e.g., the richness of associated semantic information as well as the possibility/efficacy of imagery processes elicited by these words – which is coherent with proposals in earlier ERP studies.

B 119

INVESTIGATING THE INFLUENCE OF PHYSICAL FEATURES ON VISUAL WORD RECOGNITION: AN EVENT-RELATED POTENTIAL STUDY *Krysta Chauncey[1], Jonathan Grainger[2], Phillip Holcomb[1]; [1]Tufts University, [2]CNRS, Université de Provence* – Previous event-related potential (ERP) studies have suggested that some of the earliest processes involved in visual word recognition are influenced by the physical features of words. However, it is as yet unclear exactly which features are important and when they come into play. In this study, native English speakers were exposed to word pairs in which primes were masked (duration 50ms), and ERPs were recorded to subsequent target words. There were eight trial types resulting from the crossing of three factors: target size (same as the prime or larger), target font (same as the prime or different) and target repetition (the same word as the prime, or a different word). All three variables modulated the early P/N150 component. Targets that were larger, in a different font or were a different word than the preceding prime all generated smaller posterior positivities and anterior negativities, than targets that were the same size, in the same font or were the same word as their primes. However, only the repetition factor had a notable influence on the amplitude of the later N250 and N400 components, with different target words producing larger negativities than repeated targets. Interestingly, while the font manipulation did not influence the amplitude of the N250 or N400, the peak latency of both components were significantly later when the target font differed from the prime font. The data will be discussed in terms of current models of visual word recognition.

B 120

ELECTROPHYSIOLOGICAL CORRELATES OF BILINGUAL WORD PRODUCTION *Maya Misra[1], Taomei Guo[2], Susan Bobb[1], Judith Kroll[1]; [1]The Pennsylvania State University, [2]Beijing Normal University, China* – Previous research has shown that both of a bilingual's languages may be active during comprehension and production, suggesting that elegant control mechanisms must allow for the selection of the intended form and/or inhibition of the unintended form. The current experiments evaluated the time-course of lexical activation and the interaction of a bilingual's languages during speech production using event-related potentials (ERPs). In two experiments Chinese-English bilinguals named pictures while 32 channels of ERPs were recorded. Participants named in Chinese or English, depending on the picture's background color. Pictures were named at either short (250 ms) or long (1000 ms) delays, with ERPs evaluated only at long delays to minimize artifact. In Experiment 1 (mixed naming) pictures to be named in Chinese and English alternated in a predictable fashion. In Experiment 2 (blocked naming) participants named the pictures in one language in the first block and then named them in the other language in the second block. The effects of switching from one language to another were evaluated for each experiment, and mixed naming was compared to blocked naming between experiments. Results suggest that there is a processing cost associated with forcing both languages to be active, reflected in effects on both the P200 and N400 for mixed naming. However, in contrast to expectations based on the behavioral literature, where costs to the first language are typically greater, processing costs were similar for both languages in most conditions. Implications of these results for models of bilingual production will be discussed.

B 121

EVENT-RELATED POTENTIALS TO SEGMENTAL AND SYLLABIC RETRIEVAL IN A PICTURE NAMING TASK IN YOUNG AND OLD ADULTS *Yael Neumann[1], Valerie Shafer[1], Hilary Gomes[2,1]; [1]CUNY, [2]City College* – A common complaint among healthy older adults is the increased frequency of word-finding problems. Research points to breakdowns in phonological processing. The aims of this study were 1) to investigate the effects of age on specific phonological substages of processing, namely, sound segments and syllables and 2) to establish baseline norms of behavioral (reaction time) and ERP responses (both early sensory and attentional components, e.g. visual evoked potentials (VEPs), and later cognitive components, e.g. N200), across the normal adult lifespan on a word retrieval task. Two groups of 16 younger (21-40 years) and 16 older (65-85 years) adults performed two experimental implicit naming tasks. They were asked to either push a button (GO) or withhold a button press (NOGO) based on the final phoneme of the picture name, and then in a separate task based on the syllabic length of the target word. Examination of the grand mean difference waves at frontal electrode site FP1, where the N200 is largest, showed latency differences across the groups and across the tasks. Results reveal that older adults seem to retrieve both types of phonological information at a later time than do younger adults. Additionally, retrieval of syllabic information occurs earlier than that of segment information in both groups. In sum, this study reveals how phonological processing of segments vs. syllables contributes to the naming problems of older adults. Clinical implications for improved methods of assessment and treatment of naming problems in both non-clinical and, by extension, clinical populations, can be derived.

B 122

THE VISION-BASED AND MANIPULATION-BASED SIGNS PROCESSING IN TAIWAN SIGN LANGUAGE: AN ERP STUDY *Yi-Shiuan Chiu[1,2], Wen-Jui Kuo[2,3], Daisy L. Hung[2,3,4], Ovid J.- L. Tzeng[2,3,5]; [1]Fu Jen Catholic University, Taipei, Taiwan, [2]National Yang-Ming University, Taipei, Taiwan, [3]Institute of Neuroscience, School of Life Sciences, National Yang-Ming University, Taipei, Taiwan, [4]Institute of Cognitive Neuroscience, College of Science, National C, [5]Institute of Linguistics, Academia Sinica, Taipei, Taiwan* – This study examined the representation of iconicity of Taiwan Sign Language (TSL) by the event-related potential (ERP) technique. Iconicity reflects how the form of a sign resembles the referent's meaning. The concrete nouns of TSL were categorized into vision-based and manipulation-based signs. The vision-based signs represent the features of shapes or contours of target objects, such as the TSL sign DOG representing the ears of a dog. The manipulation-based signs represent the way to manipulate or interact with the object, such as the TSL sign HORSE representing the way of horse riding. We investigated the role of sign familiarity and the representation of iconicity (vision-based, manipulation-based) among the deaf signers and hearing non-signers by picture signing and naming tasks. During the interval of 225-250 ms after stimulus onset, familiarity effects were showed in both signers and non-signers. Between 600-650 ms, only signers showed familiarity effects. These results revealed that the mechanism of familiarity might be independent of language modality at early pre-lexical level, but it might be influenced by language modality after accessing the lexicon. The effects of iconicity representation were showed between 220-250 ms and 600-650 ms only among signers, suggesting that the way to represent the concept in each language would construct the representation of the concept in the lexical processing. Interestingly, between 450-500 ms the iconicity effects were only found among non-signers, suggesting the activation of significant related properties of the concept. These results revealed that our lexicons are constructed both by linguistic knowledge and perceptual experience.

B 123

EARLY COMPONENTS OF WORD READING: A HIGH-DENSITY ERP STUDY OF LEXICAL ACCESS *Xin Zheng, Sidney Segalowitz; Brock University* – Word reading has been shown to depend on both automatic and contextually sensitive processes. We examined these processes using high-density ERPs in a word recognition study. Participants (n = 16) performed a standard lexical decision task in which rapidly presented real words were distinguished from pseudo-words and a lexical semantic version in which words were selected from one category (e.g., animals) and at the end of the block participants were asked to indicate the category by selecting a word that fits the category (e.g., zebra). The same words were used in both task conditions which were counterbalanced across subjects, but were dispersed across the blocks in the lexical decision task so no category was dominant in any single block. There were 5 blocks in each task. Results: (1) The earliest word-pseudoword (orthographic) differentiation occurred within 100 ms after stimulus onset and could be localized to bilateral posterior regions followed by a right posterior hemisphere component at 150 ms - much earlier than the word-pseudoword differentiation usually reported (e.g., N400). (2) Processes of word recognition were also influenced by context. We found that the real words were processed differently depending on task: The semantic instructions produced early components of greater amplitude 100 to 150 ms post-onset, topographically localized to the left frontal region. Conclusions: Taken together, these data suggest that lexical access initially occurs within 100 ms bilaterally and then differentiates into simultaneous but separate semantic and orthographic processes that can be tracked with EEG.

Linguistic Processes: Semantics

B 124

LATERALIZED SEMANTIC PRIMING AND RELATIONSHIP WITH THOUGHT DISORDER *Erica Neill[1], Simon Collinson[2], Marjorie Collins[3], Nicholas Voudouri; [1]Latrobe University, [2]Mental Health Research Institute of Victoria, [3]Murdoch University* – The semantic priming paradigm can be used to explore language deficits in individuals with thought disorder. Research suggests that thought disorder may reflect a difficulty in inhibition or an increase in spreading activation in one or both of the hemispheres in response to language based information. Currently, little research has been done in this area and the research that is available is methodologically flawed. For the current study a lateralised version of a semantic priming task was employed to examine the role of each hemisphere in processing language, and also to examine how the two hemispheres synchronize information. As in the standard semantic priming task reaction times to related and unrelated word pairs were contrasted. Novelly to this experiment word pairs were presented solely to the left (LL) or right (RR) visual field, or across visual fields; left-right (LR) or right-left (RL). Participants included 21 healthy controls and 42 participants with a diagnosis of schizophrenia (21 with thought disorder, 21 without). Repeated measure ANOVA's were used to compare stimulus type (related vs. unrelated), visual field (LL, RR, LR, RL), and group. Preliminary analyses suggest that there are significant differences in priming across visual fields between healthy controls and individuals with schizophrenia. There were no significant differences between the two psychiatric groups. This data suggests that participants with schizophrenia have difficulty when performing a task where the two hemispheres must synchronize information. However, this pattern this does not seem to be causal for thought disorder.

B 125

EFFECTS OF SENTENCE CONTEXT IN NON-NATIVE NATURAL SPEECH COMPREHENSION *Ian FitzPatrick, Peter Indefrey; Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, F.C. Donders Centre for Cognitive Neuroimaging, Nijmegen, The Netherlands* – Electrophysiological studies consistently find N400 effects of semantic incongruity in non-native written language comprehension. Typically these N400 effects are later than N400 effects in native comprehension, suggesting that semantic processing in one's second language (L2) may be delayed compared to one's first language (L1). In this study we were firstly interested in replicating the semantic incongruity effect using natural auditory speech, which poses strong demands on the speed of processing. Secondly, we wished to investigate whether a possible delay in semantic processing might be due to bilinguals accessing lexical items from both their L1 and L2 (a more extensive lexical search). We recorded EEG from 30 Dutch-English bilinguals who listened to English sentences in which the sentence-final word was: (1) semantically fitting, (2) semantically incongruent, (3) initially congruent: semantically incongruent, but sharing initial phonemes with the most probable sentence completion within the L2, (4) semantically incongruent, but sharing initial phonemes with the L1 translation equivalent of the most probable sentence completion. We found an N400 effect in each of the semantically incongruent conditions. This N400 effect was significantly delayed to L2 words that were initially congruent with the sentence context. We found no effect of initial overlap with L1 translation equivalents. Taken together these findings firstly demonstrate that non-native listeners are sensitive to semantic incongruity in natural speech, secondly indicate that semantic integration in non-native listening can start on the basis of word initial phonemes, and finally suggest that during L2 sentence processing listeners do not access the L1 lexicon.

B 126

NEURAL CORRELATES OF LEARNING JAPANESE WORDS WITH AND WITHOUT ICONIC HAND GESTURES *Spencer Kelly, Megan Esch, Tara McDevitt; Colgate University* – Hand gestures are a natural part of spoken language. Behavioral research has demonstrated that iconic gestures influence language comprehension (Goldin-Meadow, 2003), and electrophysiological research has shown that these gestures affect speech during semantic stages of processing (Kelly, Kravitz & Hopkins, 2004). These results suggest that hand gestures may be an effective tool in teaching people new words in a foreign language. The present study investigated whether: 1) gestures increase memory for newly learned Japanese verbs, and 2) there are identifiable electrophysiological correlates of such learning. Twenty English-speaking adults watched three 15-minute training videos presenting ten Japanese verbs. The instructor on the video produced half of the words with speech alone and half with a congruent iconic gesture. Following training, ERPs measured the auditory processing of the ten trained words and five new Japanese words. Behavioral results demonstrated that participants learned words in the Speech + Gesture condition better than the Speech Alone condition. Electrophysiological results revealed P300 and P600 differences between trained and untrained words, and P600 differences between words in the Speech Alone versus Speech + Gesture conditions. The behavioral results suggest that hand gestures do play a role in foreign language learning, and the ERP data suggest that gestures may enhance that learning by strengthening the imageability of semantic memory traces. Together, the results reinforce the claim that gesture and speech form an integrated system of meaning during language processing (McNeill, 1992).

B 127

ON SENSE AND REFERENCE: FMRI EVIDENCE FOR DISTINCT NEURAL MECHANISMS SUPPORTING SEMANTIC AND REFERENTIAL ASPECTS OF LANGUAGE COMPREHENSION *Mante Nieuwland[1], Karl Magnus Petersson[2,3], Jos van Berkum[1,2]; [1]University of Amsterdam, the Netherlands, [2]F. C. Donders Centre for Cognitive Neuroimaging, Radboud University Nijmegen, the Netherlands, [3]Karolinska Institutet, Stockholm, Sweden, University of Algarve, Faro, Portugal* – In an event-related fMRI study, we investigated to what extent semantic and referential aspects of language comprehension recruit common or distinct neural ensembles. We compared BOLD responses to sentences containing semantically anomalous or coherent words, and to sentences containing referentially ambiguous pronouns (e.g., "Ronald told Frank that he…"), referentially failing pronouns (e.g., "Rose told Emily that he…") or coherent pronouns. Semantic anomaly elicited activation increases in lateral prefrontal brain regions associated with semantic processing. Referential failure elicited activation increases in brain regions associated with morphosyntactic processing, and additional activations associated with elaborative inferencing if readers took failing pronouns to refer to unmentioned entities. Referential ambiguity selectively recruited medial prefrontal regions, suggesting that readers engaged in problem-solving to select a unique referent from the discourse model. Furthermore, our results showed that semantic anomaly and referential ambiguity recruit overlapping neural ensembles in opposite directions, possibly reflecting the dynamic recruitment of semantic and episodic processing to resolve semantically or referentially problematic situations. These findings suggest that neurocognitive accounts of language comprehension will have to address not just how we parse a sentence and combine individual word meanings, but also how we determine who's who and what's what during sentence and discourse comprehension.

B 128

THE NEURAL-CORRELATES OF THE CONCRETENESS EFFECT IN CHINESE NOUNS AND VERBS *Brenda H.-Y. Yu[1], Denise H. Wu[1], Chia-Ying Lee[2], Ovid J.-L. Tzeng[2], Daisy L. Hung[3]; [1]Institute of Cognitive*

Neuroscience, National Central University, Taiwan, [2]Institute of Linguistics, Academia Sinica, Taiwan, [3]Institute of Neuroscience, National Yang-Ming University, Taiwan – Previous ERP studies have demonstrated the semantic difference between nouns and verbs reflected in P200 and N400.To investigate whether such difference can be solely accounted for by the concreteness effect in a language with relatively ambiguous word class, we employed Chinese disyllabic words while manipulating their word class and concreteness independently. In three experiments, the participants were instructed to perform lexical decision (Experiment 1), semantic relatedness judgment (Experiment 2), and concreteness rating (Experiment 3) while ERP recording was simultaneously applied. The difference between word classes was detected in P200 in Experiment 2 and 3, which was independent of concreteness of the stimuli. In contrast, the concreteness effect was consistently observed, with a more robust influence in nouns than verbs, in all three experiments in N400. More importantly, the amplitude of N400 also reflected the interaction between word class and concreteness in Experiment 2 and 3, which indicated that verbs did not show a concreteness effect in N400 in semantic tasks. In summary, our findings suggest that P200 is an early index of noun-verb difference independent of concreteness, which is revealed in tasks that are more semantically driven. The interaction between word class and concreteness that was expressed in N400 across three tasks further supports the difference between nouns and verbs along the concreteness dimension. Overall, the current findings demonstrate that the word class difference at the semantic level cannot be fully explained by concreteness difference between nouns and verbs.

B 129

HEMISPHERIC SENSITIVITIES TO LEXICAL AND SENTENTIAL CONSTRAINTS *Zohar Eviatar, Orna Peleg; Haifa University* – Previous studies suggest that ambiguity resolution is governed by lexical (frequency) and contextual factors. However, the relative contribution of these factors to hemispheric processes is still under investigation. We examined the extent to which each hemisphere uses frequency and sentential context to guide the resolution process of polarized homographs. Participants read either unbiased sentences, or sentences biased toward the dominant or the subordinate meaning of their final homograph, and performed a lexical decision task on lateralized targets presented 250 ms after the onset of the final ambiguous prime. Hemisphere asymmetry was found in the absence of biasing context, where dominant meanings were exclusively activated in the LH, while both dominant and subordinate meanings were activated in the RH. These results converge with the "fine/coarse coding model", suggesting that the LH activates small and precise semantic fields, while the RH diffusely activates large semantic fields. Hemisphere symmetry was found in the presence of a biasing context, where dominant meanings were exclusively activated in dominant-biasing contexts, while both dominant and subordinate meanings were activated in subordinate-biasing contexts. Contrary to the claim that the RH primarily processes word-level meaning, these results indicate that both hemispheres are sensitive to both lexical and sentential information.

B 130

REAL-WORLD INTERFERENCE IN DETECTING VIOLATIONS OF COUNTERFACTUAL AND NEGATED WORLDS *Heather J. Ferguson, Anthony J. Sanford, Hartmut Leuthold; University of Glasgow, UK* – Counterfactual reasoning is valid reasoning arising from premises that are true in a hypothetical model, but false in actuality. Negated statements cancel real-world expectations, but do not create an alternative model. The present study examined in separate ERP experiments whether and to which extent real-world knowledge interferes with our understanding of counterfactual and negated worlds. Context provided by a first sentence was counterfactual-world (CW- "If cats were vegetarians…"), negated-world (NW- "If cats were not carnivores…") or real-world (RW- "If cats were hungry…"). The second sentence was visually presented word-by-word. The noun in this sentence was manipulated to create RW anomalous continuations ("Families could feed their cat a bowl of carrots"), where events included a violation of RW knowledge, and continuations congruent with RW knowledge ("…fish"). Note that RW violations are congruent in a CW or NW context, and vice-versa. Experiment 1 revealed a centroparietal N400 for RW anomalous compared to congruent continuations following a RW context. However, the opposite N400 pattern was present following the CW context, indicating that here RW violations are processed as acceptable and RW congruent items as anomalous. In Experiment 2 the N400 to RW anomalous rather than congruent continuations demonstrates that a NW context does not 'neutralise' RW anomalies. Further analysis suggests subtly different location and timing for processing CW, NW and RW information. In conclusion, the fact that local-semantic RW anomalies are overruled by the CW but not the NW context suggests that semantic analysis is context-dependent when an alternative model is immediately available.

B 131

CROSS-MODAL IDENTIFICATION OF SEMANTIC CATEGORIES IN WORDS AND PICTURES FROM FMRI BRAIN ACTIVATION *Svetlana Shinkareva, Vicente Malave, Robert Mason, Tom Mitchell, Marcel Just; Carnegie Mellon University* – Machine learning methods were applied to brain imaging (fMRI) data to identify the cognitive states associated with each 4 s viewing of words (5 tools and 5 dwellings) and, separately, ten line drawings of the objects depicted by the words. These methods were able to (1) identify with high accuracy the category of the word the participant was viewing, based on that participant's characteristic neural activation patterns; (2) identify with even higher accuracy the category of the object the participant was viewing, based on that participant's characteristic neural activation patterns; and (3) identify, for the first time, with reasonable accuracy, the category of the object the participant was viewing, based only on that participant's characteristic neural activation patterns during word viewing, and vice versa. The locations of the voxels that were important for category identification were similar across participants, and distributed throughout the cortex where various object properties might be neurally represented. These findings indicate the presence of stable, distributed, and identifiable amodal neural states corresponding to object concepts.

B 132

DISSOCIATIONS IN THE REPRESENTATION OF SPATIAL RELATIONSHIPS *Prin Amorapanth, Page Widick, Anjan Chatterjee; University of Pennsylvania* – Recent work from Kemmerer and Tranel suggests that neural systems important for mediating the categorical spatial relationships lexicalized by locative prepositions localize to areas in left inferior prefrontal and parietal cortices. Conversely, work from Kosslyn and others suggests that coordinate spatial processing of the type needed for fine-grained representations localizes to right parietal cortex. To examine this issue further, we developed a battery aimed at testing comprehension of both categorical and coordinate spatial relations with a series of matching and naming tests involving words, sentences, and pictures. We tested the hypothesis that knowledge of spatial relationships fractionates into different patterns by examining the performance of 34 subjects with left and right hemisphere damage (LHD, RHD). Behaviorally, groups displayed a double dissociation of categorical and coordinate tasks in the expected directions. On categorical tasks, individual LHD patients demonstrated double dissociations of language-to-picture matching and picture-to-picture matching. Permutation mapping analysis suggests that damage to middle/superior temporal cortex is likely to produce a behavioral deficit on language related tasks, and that further damage to the parietal cortex is likely to impair generalization of categorical spatial relationships. While the RHD group performed relatively well on categorical tasks, a similar pattern of damage accounts for the impairments they did exhibit. In addition to confirming the idea that categorical spatial relations lateralize to the left hemisphere and vice versa for coordinate spatial relations, these results also suggest that verbal and non-verbal knowledge of categorical locative relations may have distinct neural and functional instantiations.

B 133

ERP EVIDENCE PROVIDES A LINK BETWEEN HARMONY AND SEMANTICS *Nikolaus Steinbeis, Stefan Koelsch; Max-Planck Institute for Human Cognitive and Brain Sciences* – The present study sought to investigate the functional role of the N500, an event-related potential (ERP) elicited in response to violations of harmonic expectancy. Its close resemblance to the N400 has suggested the possibility of reflecting similar cognitive mechanisms (i.e. semantic processing). The question addressed by the present study was whether the N500 is a mechanism dedicated to either syntax or semantics or reflects more general demands placed on working memory. To test this we used sentences which were either correct or contained a syntactic or a semantic violation at the end. Twenty-six non-musical subjects were visually presented with language material, while simultaneously listening to chord sequences ending either on a harmonically expected or unexpected chord. Sentences and harmonic sequences each contained five items (words and chords respectively), which were presented in synchrony, but of which only the last item was analysed. Assuming that cognitive processes of similar function recruit the same neural resources regardless of modality, we were interested in how the language violations affect the N500. It was found that the N500 was reduced only when presented concurrently with a semantic violation, but not with a syntactic violation. This suggests that the N500 may in fact reflect some type of semantic processing established by harmonic chord sequences. As well as providing evidence in favour of musicological notions on the potential semantic impact of tension-resolution patterns, this study may also end a long empirical quest for attempting to find a musical match to the language-related ERP for semantic processing.

B 134

SENSITIVITY OF SECOND LANGUAGE USERS TO SUBTLE ASPECTS OF WORD MEANING *Dorothee Chwilla[1], Noriko Hoshino[2], Judith Kroll[2]; [1]NICI Radboud University of Nijmegen, [2]Pennsylvania State University* – Do second language (L2) users have access to the full range of meanings available to native speakers? Psycholinguistic studies yield controversial results. Some studies suggest that access to L2 semantics is limited by age of acquisition and proficiency, while other studies suggest that accessing L2 semantics occurs early in acquisition. One semantic factor explored in monolingual studies is the number of meanings (NOM). Azuma and Van Orden (1997) reported an interaction of NOM with relatedness in lexical decision for native English speakers. Performance was faster for words with many than few meanings, but only for words low in relatedness. We find that proficient Dutch-English bilinguals show the same interaction in English as their L2. A second factor that affects semantic ambiguity is word regularity. Rodd (2004) demonstrated a relation between the number of senses of meaning and word regularity in a word naming task in English: a semantic ambiguity effect only occurred for irregular words. Critically, we replicated the interaction for monolingual English speakers and extended it to proficient Dutch-English bilingual speakers. Currently, we are testing whether this pattern generalizes to language comprehension. ERPs are recorded to the Rodd materials consisting of irregular versus regular words with few or many senses. The main question is whether an interaction of consistency and number of senses is obtained for N400. The implications of the behavioral and ERP results for the sensitivity of L2 speakers and readers to nuances of word meaning are discussed.

B 135

HOW MUCH GESTURE DO YOU NEED ?: EXPLORING TEMPORAL ASPECTS OF ICONIC GESTURE COMPREHENSION. *Thomas C. Gunter[1], Henning Holle[1], Christian Obermeier[2]; [1]Max Planck Institute for Human and Cognitive Brain Sciences, Leipzig, Germany, [2]Catholic University Eichstätt – Ingolstadt, Germany* – A steadily increasing number of studies have shown that iconic gestures have an effect in speech comprehension. While such experiments indicate that a listener can extract additional meaning from iconic gestures, it is still unclear how much of a gesture is needed before it becomes meaningful. A gesture can usually be divided into three consecutive time phases: preparation, stroke and retraction. Most researches consider the stroke as the essential part of a gesture phrase, because it has been theorized as the segment in which the meaning is expressed. In this experiment, we explored how much of an iconic gesture is needed to successfully disambiguate a homonym. A gating paradigm was used to determine the earliest point at which gesture information reliably contributed to the selection of one of the two meanings of a homonym. For 60 out of 96 gestures, the information in the preparation phase already sufficed for a successful disambiguation. We extended this finding using an ERP experiment. Participants were presented with short video clips of an actress uttering sentences ('She was impressed by the BALL, because the TOY/DANCE ...'). The ambiguous noun was accompanied by a dynamic gesture that was presented up to its disambiguation point. Then the visual stream stopped whereas the acoustic stream continued. ERPs elicited by the target words (i.e. TOY/DANCE) showed N400 effects, which indicated that the shortened gestures had disambiguating properties. Thus, listeners seem to be able to extract a substantial amount of information already during the preparation phase of a gesture.

B 136

DEFINITE DESCRIPTIONS AND PROPER NAMES REVEAL DISTINCT DEMANDS DURING REFERENTIAL PROCESSING: EVIDENCE FROM ERPS *Petra Burkhardt[1], Dietmar Roehm[2]; [1]University of Marburg, Germany, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – Referential processing (when an expression refers to a discourse entity) is influenced by syntactic, semantic, and discourse-based factors. We examined whether the type of expression (proper name vs. definite description – e.g. Jeff/the speaker) impacts referential processing in distinct ways. In a reading experiment conducted in German, we assessed the processing of these two referential-types following three context manipulations: [A] no mention of critical entity (e.g. Peter sent Sarah a letter), [B] introduction as a salient entity (Peter visited Jeff in Seattle), [C] introduction as part of a conjoined clause, making the entity less salient (Peter visited Jeff and Ron). ERPs were measured to the onset of the critical entity in a subsequent sentence (He said that Jeff/the speaker…). Statistical analyses revealed an interaction of referential-type by context between 350-450ms post-onset, with a two-way distinction for definite descriptions ([A] showing the most enhanced N400 while [B&C] patterned alike) and a three-way distinction for names (with an N400-modulation [A>C>B]). In addition, new entities [A's] elicited a pronounced P600 (between 600-850ms) over previously introduced entities [B&C], irrespective of referential-type. These results first support previous findings that report an N400-P600-pattern for the integration of given and new information. Second they indicate that definite descriptions and proper names are subject to distinct processing demands. This can be attributed to discrete degrees of semantic strength that differentially impact integration (definite descriptions carrying more lexico-semantic information than names). The data therefore provide new evidence that referential-type is one of the factors that affects referential processing.

B 137

THE INFLUENCE OF DISCOURSE FOCUS ON ANAPHOR RESOLUTION: A SIMULTANEOUS SELF-PACED READING AND ERP INVESTIGATION *Tali Ditman, Phil Holcomb, Gina Kuperberg; Tufts University* – The ability to link multiple references to the same character or object -- i.e., resolve anaphors -- is essential for successful discourse comprehension. One factor that influences the ease of anaphor resolution is whether the referenced character/object is in a reader's focus of attention. Past studies have provided evidence that repeated noun-phrase (NP) anaphors are more difficult to resolve when they refer to characters/objects that are in focus of attention compared with when they refer to characters/objects outside of focus of attention (e.g., Almor, 1999). However, the reason for this differential preference is under debate. The present study investigated the influence of focus of attention on repeated NP anaphor resolution using a novel methodology: simultaneous self-paced reading and event-related brain potential (ERP) techniques. Two-sentence scenarios were constructed. The first sentence introduced two NPs in one of two clefted-sentence constructions ("It was the bird that ate the fruit", "What the bird ate was the fruit"). The second sentence introduced a repeated NP anaphor that referred to either the first (bird) or second NP (fruit) in the previous sentence. It-clefts put the first NP in the focus of attention whereas what-clefts focus the second NP. Reading time differences replicated previous findings of longer reading times when repeated NP anaphors referred to in-focus characters/objects following it-clefts (Almor, 1999). In addition, ERP results demonstrated a larger left anterior negativity for repeated NP anaphors that referred to characters/objects that were in focus of attention, providing evidence for a working memory load explanation.

B 138

MODALITY-SPECIFIC BRAIN ACTIVATION REFLECTS LEXICO-SEMANTIC PROCESSES IN VISUAL WORD RECOGNITION: A PARAMETRIC FMRI STUDY *Olaf Hauk[1], Matthew H Davis[1], Ferath Kherif[2], Friedemann Pulvermuller[1]; [1]MRC Cognition and Brain Sciences Unit, [2]UCL Wellcome Trust Functional Imaging Laboratory* – A great advance in cognitive neuroscience was the discovery of different patterns of brain activation for words with different semantic associations. However, existing data have not fully decided whether these “category-specific” activations reflect processes involved in accessing the semantic representation of the stimuli, or some secondary process not mandatory for word or object recognition (e.g., deliberate mental imagery). In our fMRI study, we addressed this issue by investigating the impact of the lexical variable “word frequency”, on neural responses to two different semantic word categories: action words and visual words. We first replicated previous fMRI results showing that action-relatedness modulates neural responses in action-related areas in middle temporal and left precentral gyrus, while imageability modulates object processing areas in bilateral fusiform gyrus. Crucially, activation modulated by lexical frequency in left fusiform gyrus was specific for visually-related words, and in left middle temporal gyrus frequency effects emerged only for action words. These category-specific effects of lexical frequency on neural activity is explained by lexico-semantic processes central to word recognition, but not by secondary, post-access phenomena such as imagery. Our data are consistent with accounts postulating lexico-semantic information processing and storage in distributed, modality-specific neuronal ensembles, which ground language and concepts in perception-action systems of the human brain.

B 139

EARLY AND LATE BRAIN REFLECTIONS OF WHAT MAKES SENSE: ATTENTION EFFECTS IN A NEURONAL MODEL OF THE LANGUAGE CORTEX *Max Garagnani, Friedemann Pulvermuller; Medical Research Council, Cognition & Brain Sciences Unit* – Meaningful material and senseless unknown stimuli lead to different patterns of brain activation. The major neurophysiological response indexing “sense” has been the N400, a late event-related brain response (elicited under conditions where subjects are attending to the input) larger for senseless materials (e.g., meaningless pseudowords) than for matched meaningful words. Recently, early MEG and EEG differences have also been recorded – for example, in the Mismatch Negativity (MMN, latency 100-250ms). The MMN is elicited even when subjects are distracted and is larger for words than for pseudowords, thus exhibiting the reverse pattern seen for the N400. We present a neuroanatomically-grounded neural-network model of the left-perisylvian language cortex that offers a unifying explanatory account for these seemingly contradictory observations. The network was trained using biologically-plausible Hebbian learning mechanisms and then stimulated with “words” and “pseudowords” while varying the global excitation (internal noise) starting level and feedback inhibition. We found that low excitation and weak feedback inhibition produced late activation differences, with a stronger response to pseudowords than to words (mirroring the N400 pattern). In contrast, high starting levels of excitation or strong feedback inhibition lead to early activation differences, with a stronger response to words (paralleling the MMN data). In light of these results, we interpret global excitation and feedback inhibition as possible brain correlates of attention. Accordingly, our model predicts that this cognitive process modulates latency and “polarity” of event-related brain responses to linguistic stimuli. Recent experimental evidence (see poster by Shtyrov, Kujala and Pulvermüller, submitted to CNS2007) confirms this prediction.

B 140

COMPENSATORY REGIONS FOR PICTURE NAMING IN ALZHEIMER DISEASE DEMONSTRATED WITH FMRI AND RTMS *Howard Chertkow[1], Anh Duong[1], Dion Fung[1], Tomas Paus[2]; [1]McGill University, [2]University of Nottingham* – The posterior left temporal lobe (PLTL) regions normally most involved in semantic processing and picture naming, are also regions strongly affected by cortical pathology in Alzheimer Disease (AD). Previous PET and fMRI studies have shown a change in blood flow during cognitive processing in AD. While AD produces impaired naming (anomia), there may be other brain regions involved in a compensatory fashion. We have demonstrated in 8 young normals using fMRI and rTMS that there is increased cbf in PLTL during picture naming, and blocking this region (but not inferior left parietal) slows picture naming. In 13 mild AD individuals, stimulating inferior left parietal, but not PLTL region, improves picture naming. This implies that compensatory networks in AD are involving the inferior left parietal region, and are amenable to stimulation using rTMS.

B 141

VERB ASSOCIATIVE KNOWLEDGE IN FRONTOTEMPORAL DEMENTIA AND ALZHEIMER’S DISEASE *Luisa Vesely[1], Catherine Price[2], Peachie Moore[1], Katy Cross[1], Shaleigh Kwok[1], Murray Grossman[1]; [1]Hospital of the University of Pennsylvania, [2]University of Florida* – Previous research demonstrated verb comprehension deficits in both frontotemporal dementia (FTD) and Alzheimer’s disease (AD) on measures of naming and word-picture matching. In this study, we examined verb associative knowledge in FTD and AD using a novel measure of associative knowledge, the Verb Similarity Test (VST). We compared 17 AD and 30 FTD with 14 healthy matched-adults. The FTD patients were subdivided into progressive non-fluent aphasia (PNFA; n=9), semantic dementia (SD; n=11), and social/dysexecutive (EXEC; n=10). Verb associative knowledge was assessed using a 48-item VST, while a 52 item Pyramids and Palm Trees (PPT) Test assessed noun associative knowledge. VST and PPT stimuli were matched for frequency, familiarity, and concreteness. During both tasks, participants were presented with a target word and instructed to indicate, from two choices, the word most similar in meaning to the target. Both FTD and AD showed significant impairment on VST (FTD: $p<0.001$; AD: $p<0.02$) and PPT (FTD: $p<0.001$; AD: $p<0.002$) compared to controls. Controls and AD performed with 94% and 85% accuracy, respectively, on both VST and PPT. Unlike controls and AD, FTD were significantly less accurate with verbs (77%) than nouns (85%), $p<0.01$. Analysis of individual FTD subgroups revealed worse performance with verbs than nouns in PNFA ($p<0.02$) and EXEC ($p<0.04$), but not SD. This study shows relative verb comprehension difficulty in FTD and emphasizes a deficit in verb associative knowledge. This was most evident in PNFA and EXEC, FTD subgroups with frontal disease. This implicates frontal brain regions in verb associative knowledge.

B 142

NEURAL CORRELATES OF SEMANTIC ORGANIZATION: RELIANCE ON DIAGNOSTIC VS. CHARACTERISTIC FEATURES *Jonathan Peelle, Vanessa Troiani, Peachie Moore, Murray Grossman; University of Pennsylvania* – To investigate the organization of semantic memory we used BOLD fMRI to measure neural processing of two types of nouns: nominal kinds and complex nouns. Nominal kinds are nouns that possess a diagnostic feature (e.g., an UNCLE is the "brother of a parent"). These are distinguished from complex nouns, which may have high-contribution features, but do not possess a diagnostic feature (e.g., "red" is a feature of most APPLES, but some apples are green). We hypothesize that processing of nominal kinds depends in part on rule-based categorization (the diagnostic value of the presence of a specific feature), while complex nouns depend more on similarity-based categorization (the probabilistic weighting of several contributing features). Features were presented visually one at a time to a group of 26 healthy young adults, who then decided whether these features accurately described a target noun. Half of the participants were given rule-based instructions and half similarity-based instructions. Differences in neural processing were observed for feature processing for complex nouns and nominal kinds. Relative to nominal kinds, complex nouns produced more superior temporal activation bilaterally, as well as increased activity in the inferior frontal lobe. By comparison, nominal kinds resulted in more medial parietal processing compared to complex nouns. Sensitivity to violations of object descriptions was modulated by the class of feature that was violated, and the rule- or similarity-based instruction condition that was administered. These results suggest that semantic processing is modulated by task requirements and the qualitative nature of the concept being considered.

B 143

THE CONSTRUCTION OF MEANING: NEUROLOGICAL REFLECTS OF PHRASE–LEVEL SYNTAX AND SEMANTICS IN NATIVE AND NON–NATIVE ENGLISH SPEAKERS *Robin J. Schafer, Jennifer Roth, Todd Constable; Yale University* – We investigated the processing of simple phrases by native and non–native English speakers (N=30, 16 native speakers). Phrases provide a constrained environment where semantics and syntax can be directly compared. Stimuli include 32 abstract and 32 concrete count and mass nouns, presented with a pair of adjectives (e.g. plans: fragrant or frequent) or a pair of quantifiers (e.g. knowledge: fewer or less) depending upon condition. Subjects completed a phrase by choosing an adjective or quantifier. Quantifier choice is driven solely by syntax, adjective choice by semantics. Mean task accuracy was above 88% and did not differ significantly across conditions and subject groups. fMRI whole–brain images were collected on a 1.5T Siemens Sonata with gradient echo planar imaging (64x64 matrix, TE=45ms, a=80, TR=1500ms). Individual data underwent voxel-wise regression on each task prior to random effects analysis. Data were corrected for multiple comparisons by spatial extent of contiguous supra–thresholded voxels to maintain a $p<.01$. Thus far results for native speakers show significant bilateral, left dominant activation in both conditions. BA 47 and 44 show a greater extent of activation in the semantic condition. This activation, particularly in absence of superior and middle temporal activations, may be attributed to the compositional nature of the task. In addition, a greater extent of activation in the fusiform gyrus is observed in the syntactic condition, suggesting that fusiform gyrus takes a larger role in unification than its label as the "word form area" would suggest.

B 144

SEMANTIC ACTIVATION IN THE POSTERIOR MIDDLE TEMPORAL GYRUS: AN ERP/FMRI CO-REGISTRATION STUDY *Aminda O'Hare[1], Joseph Dien[1], Cary Savage[2]; [1]University of Kansas, [2]University of Kansas Medical Center* – The posterior middle temporal gyrus (pMTG) is an area that has frequently been found to activate in brain imaging studies. In particular, studies involving aspects of semantic processing seem to elicit pMTG activation the most consistently, yet the cognitive processes underlying activation in this area are still unclear. Participants for this 3T fMRI study (n=13) were presented with a series of sentences that had either congruent or incongruent endings. A significant activation in the pMTG [-42 -54 8] was found to be stronger for congruent endings and correlated with meaningfulness ratings. Both the location and condition effects of this result seem to correspond to the N330 ERP result of a previous study by Dien, Frishkoff, Cerbone, and Tucker (2003); thus it may be possible to use this component to investigate the function of the pMTG and its mental chronometry. Additionally, a significant main effect was found for congruency in the posterior cingulate [-18 -31 50]. The posterior cingulate is an area that has been found to activate in a myriad of imaging studies, including semantic language studies (O'Hare, Dien, Waterson & Savage, submitted). We suggest that this activity represents a general aspect of expectancy.

B 145

PERCEPTION OF PANTOMIME, AMERICAN SIGN LANGUAGE VERBS, AND NONSENSE SIGNS BY DEAF SIGNERS AND HEARING NON-SIGNERS *Karen Emmorey[1], Jiang Xu[2], Patrick Gannon[3], Susan Goldin-Meadow[4], Allen Braun[2]; [1]San Diego State University, [2]NIDCD/NIH, [3]Mount Sinai School of Medicine, [4]University of Chicago* – Using BOLD fMRI, we examined the neural systems that underlie the perception of meaningful, non-linguistic gestures (pantomimes), meaningful linguistic gestures (ASL verbs for signers), and non-meaningful gestures (nonsense signs). Fourteen hearing non-signers and 14 deaf signers passively viewed blocked video clips of pantomimes (e.g., peeling a banana), ASL action verbs that do not involve tools and do not exhibit sensory-motor iconicity (e.g., TO-DANCE), and meaningless non-signs (phonologically legal, but non-occurring ASL forms). In contrast to visual fixation, pantomimes strongly activated fronto-parietal regions (the "mirror neuron" system) for hearing non-signers, whereas activation for deaf signers was primarily observed in bilateral middle temporal regions. For deaf signers, activation in left inferior frontal and middle temporal regions was observed for both ASL verbs and nonsense signs, with greater activation in these regions for nonsense signs. For hearing non-signers, both ASL verbs and nonsense signs activated left fronto-parietal regions, in addition to bilateral posterior temporal regions. For signers, the contrast between pantomimes and ASL verbs revealed stronger activation in inferior temporal (IT) cortex for the object-based pantomimes. For non-signers, this contrast also revealed greater activation in left IT and in the intra-parietal sulcus for pantomimes. Overall, the results indicate that when observing pantomimes and sign gestures, parietal cortices were extensively activated for hearing non-signers, but not for deaf signers. Deaf signers may not automatically engage the mirror neuron system when perceiving pantomimes due to their expertise and experience comprehending human gesture. Research in part supported by NIH DC00201.

B 146

ELECTROPHYSIOLOGICAL CORRELATES OF IDIOM PROCESSING *Debra Titone[1], Sabrina Wiebe[1], Marie-Eve Rivard[2], Karsten Steinhauer[2]; [1]McGill University, [2]School for Communication Sciences & Disorders, McGill University* – Few studies have examined idiom processing electrophysiologically, though many studies have made use of idioms as a means of manipulating contextual constraint. As well, idioms presented in previous studies have not systematically manipulated characteristics of idioms shown to be important in the psycholinguistic literature (syntactic complexity, length, Cloze probability). Thus, it is unclear whether event related potentials (ERPs), such as N400, are elicited by idioms because of their high Cloze probability, or because of a unique process specific to idiom comprehension. In this study, 23 participants read 120 "verb-the-noun" idioms (She kicked the bucket), 120 literal sentences matched to the idioms on Cloze probability, length, and frequency of the sentence-final word (She wore the skirt), and 120 anomalous sentences matched on length and frequency of the sentence-final word (He read the fun). High Cloze idioms elicited a more positive-going N400 than matched literal sentences. This idiom-related enhancement of N400 amplitude occurred over frontal sensors in the first half of the experiment, and over central/posterior sensors in both the first and second halves of the experiment. In contrast, low Cloze idioms did not differ in N400 amplitude from matched literal sentences. These results are consistent with the view that early retrieval of idiomatic meanings, which likely occurs prior to the sentence-final word for high Cloze idioms, reduces N400 amplitude observed at the sentence-final word. Follow-up experiments are underway to determine whether these results are due to the requirement of an overt semantic judgment during comprehension.

B 147

LATE POSITIVITY OR LATE POSITIVITIES? A COMPARISON OF P600 EFFECTS ELICITED BY MORPHOSYNTACTIC AND SEMANTIC-PRAGMATIC ANOMALIES *Stefanie Regel, Thomas C. Gunter, Angela D. Friederici; Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – Event-related brain potential (ERP) studies have shown distinct ERP components reliably related to semantic anomalies (N400) and to syntactic anomalies (P600). Recent ERP studies have challenged these well-defined components in which P600 effects were triggered by semantic reversal or thematic anomalies (Van Herten et al. 2005, Hoeks et al. 2004). ERP correlates to the processing of verbal irony are in accordance with these current findings. Sentences like "That's really rich" achieved an ironic meaning when they were embedded in negative contexts thereby contradicting its literal meaning (i.e. receiving a very small dish). Compared to their literal sentence meaning, ironic sentences evoked a posterior positivity between 500-900 ms in the absence of syntactic difficulties. Thus, it may reflect semantic-pragmatic processes necessary for the comprehension of irony, i.e. derivation of an appropriate message-level representation. In the present ERP study we investigated in how far the irony-related positivity can be dissociated from the syntax-related positivity. Discourses ending in an ironic or non-ironic target sentence were presented visually. The target sentence final word was also manipulated morphosyntactically having either a correct or an incorrect morphosyntactic word ending, e.g. "rich/richs". Between 500-900 ms, ERPs on the sentence final word revealed two distinct late positivities differing in their morphology. Ironic discourses evoked an anteriorly distributed positivity, whereas morphosyntactic violations elicited a broadly distributed positivity. These findings support a dissociation of both late positivites being independently involved in the processing of grammatical and semantic information.

B 148

RESOLVING AMBIGUITY IN LEXICAL ITEMS AND IDIOMS *Laurie A. Stowe[1], Monika Z. Zempleni[2], John C.J. Hoeks[1], Remnco Remken[1], Richard Bruggeman[3]; [1]University of Groningen, [2]University of Zurich, [3]University Medical Center Groningen* – We report the results of two fMRI studies carried out with the same subjects in which we examined the neural networks involved in resolving ambiguity. In the first study, neurologically healthy adults read sentences in which ambiguous words (e.g. bank) were resolved to the more frequent (dominant: financial institution) or less frequent (subordinate: boundary of river) meaning. The results showed that a bilateral network involving inferior frontal and temporal areas was activated in this task. In the second study, subjects read sentences containing ambiguous and unambiguous idioms (kick the bucket (ambiguous) vs. be in a blue funk (unambiguous)). This task also showed the involvement of a bilateral network involving generally the same areas (inferior frontal and inferior temporal gyri). Taken together the results suggest that the hemispheres collaborate in order to deal with ambiguity resolution. However, they also suggest that the collaboration is triggered by the greater processing demands of ambiguity (dealing with an initially implausible reading) rather than by ambiguity per se. The functions of the individual regions involved in the networks will be discussed in more detail. Additional data concerning the processing of ambiguities by patients diagnosed with schizophrenia will also be discussed. Schizophrenics perform less well in comprehending sentences containing ambiguous words or idioms. Preliminary results suggest that schizophrenics are less able to make use of the bilateral resources offered by the network invoked by normal adult comprehenders.

Poster Session C

Cognitive And Brain Development

C 1

GENETIC DISSECTION OF THE DEVELOPMENT OF ATTENTION NETWORKS: A CONVERGING PATHWAYS STRATEGY. *John Fossella[1,2], Jin Fan[1], Deborah Mann[1], Tobias Sommer[3], Michael Posner[4]; [1]Mount Sinai School of Medicine, [2]Weill Medical College of Cornell University, [3]University Medical Center Hamburg Eppendorf, Germany, [4]University of Oregon* – We have examined the reliability and heritability of the Attention Network Task (ANT) in adult subjects (Fan et al., 2001; 2002). Gene association studies using DNA obtained from cheek swabs showed suggestive evidence of association in executive attention in the dopamine D4 receptor (DRD4) and monoamine oxidase A (MAOA) genes (Fossella et al., 2002). Imaging genetic studies on these genes as well as the DRD2 gene showed a relationship to brain activity in the anterior cingulate cortex (ACC) (Fan et al., 2003). The recurrent finding of genetic associations with brain activity in the ACC by our group as well as others has prompted us to evaluate genes that are expressed in, or functionally linked to the development of, the ACC. We present the results of bioinformatic-search strategies that yield provisional candidate genes for the ACC. Imaging genetic results of selected candidates and gene associations for Stroop task performance from a test population of 100 adult volunteers is also included as an assessment of the effects of genetic variation on ACC function.

C 2

NEURODEVELOPMENTAL CHANGES IN TASK-SWITCHING AND INTERFERENCE SUPPRESSION *Carol Baym[1], Michael Souza[2], Samantha Wright[1], Silvia Bunge[1]; [1]UC Berkeley, [2]UC Davis* – Interference suppression and task-switching are critical for effective selection of relevant thoughts and actions. Behavioral studies show improvements over childhood in both abilities, although it is unclear whether these behavioral improvements rely on common or distinct neurodevelopmental changes. In an event-related fMRI study designed to address this question, young adults (20-27; current N = 16) and healthy children (7-13; current N = 13) performed a test involving both cognitive abilities. On each trial, participants viewed an instructional word cue – "Color" or "Direction" – and a cartoon stimulus. On color trials, they were to press a left or right button depending on the color of the cartoon. On direction trials, they selected one of these two buttons depending on the direction in which the cartoon character was facing. The interference manipulation contrasted incongruent and congruent trials: trials on which the color and orientation of the stimulus specified opposite responses or the same response, respectively. The task-switching manipulation contrasted rule switch trials with rule repetition trials. Preliminary analyses show that adults' performance was less affected than childrens' by interference and by task-switches, indicated by strong Group x Congruency and Group x Switch effects on accuracy, and a moderate Group x Congruency effect on response times. In both groups, there were strong effects of both manipulations, and only minimal interactions between the two. FMRI analyses will be performed to determine whether these abilities rely on common or distinct neurodevelopmental changes.

C 3

THE ROLE OF MUSIC KEYBOARD TRAINING ON THE VOCABULARY AND VERBAL SEQUENCING SKILLS OF ELEMENTARY SCHOOL STUDENTS *Joseph Piro, Camilo Ortiz; Long Island University, C.W. Post Campus* – The effect of music lessons on non-musical aspects of cognitive development is a much-debated topic. Several studies have reported positive associations between formal music lessons and abilities in nonmusical (e.g., linguistic, mathematical, and spatial) domains. Nonetheless, compelling evidence for a causal link still remains elusive. The major aim of the research study we are reporting was to examine the effects of music study on the vocabulary and verbal sequencing skills of second grade students. Two cohorts of these students were studied over a period of one school year. The first (treatment) group (n=46) studied piano formally for a period of three years as part of the Music and the Brain Program (MATB), a program in which a scaffolded music curriculum was used to deliver a combination of piano performance, music notation, singing theory, ear training, and music appreciation. The second (control) group (n=57) had no exposure to music lessons either in school programs or in private study. Both groups were pre- and post-tested using two subtests from the Structure of Intellect (SOI) measure, vocabulary and verbal sequencing. Subjects were also asked to complete the Edinburgh Handedness Inventory to assess hand preference. Results showed that the intervention group had significantly better vocabulary and verbal sequencing scores at posttest than did the control group. Results of this study may help to clarify further the role of music study on specific cognitive skills and shed light on the question of the potential of music to enhance school performance in both verbal and spatial domains.

C 4

REALISTIC HEAD MODELS FOR CORTICAL SOURCE ANALYSIS IN INFANT PARTICIPANTS *John Richards; University of South Carolina* – Cortical source analysis of EEG/ERP with infant participants has used adult models for the electrical and spatial characteristics of the head. The current poster will overview a method for using infant MRIs to develop realistic head models for infant participants for cortical source analysis. The method consists of several steps: 1) the MRI of a representative infant or the infant in the psychophysiological experiment must be obtained; 2) the head must be "segmented" with computer programs that analyze the MRI recording; 3) values for impedance for skull, scalp, CSF, and brain for infant participants must be estimated; 4) sufficient number of electrodes must be recorded; 5) realistic "forward" models using the spatial topography of the MRI must be computed. These steps allow the use of "realistic models" in computer programs that do cortical source analysis (e.g., "equivalent current dipole" analysis in BESA, or Source-Signal EMSE programs). This technique is illustrated with analysis of cortical sources in infant spatial cueing, infant visual recognition memory, the response of infants to mother's and stranger's face, and EEG during object disappearance and appearance. It is also shown that changing the impedances of infant skull and scalp (lower than adults) results in cortical sources much closer to the surface and improved fit.

C 5

DEVELOPMENT CHANGES IN ACTIVATION PATTERNS AND EFFECTIVE CONNECTIVITY DURING PHONOLOGICAL AND SEMANTIC PROCESSING AND ITS BREAKDOWN IN READING DISORDERS *James Booth[1], Tali Bitan[2], Fan Cao[1], Tai-Li Chou[1], Genna Bebko[1], Douglas Burman[1]; [1]Northwestern University, [2]Haifa University* – Children with and without reading disorders (9- to 15-year-olds) were given rhyming judgment and meaning (association) judgment tasks while undergoing functional magnetic resonance imaging (fMRI). In the rhyming tasks, children saw two sequentially presented words and had to determine whether they rhymed. Development was associated with greater activation in left inferior frontal gyrus and inferior parietal lobule, suggesting greater reliance on phonological segmentation/articulation and more elaborated mapping between orthographic and phonological representations. Development was also associated with increasing effective connectivity with dorsal inferior frontal gyrus, suggesting greater top-down modulation. Children with reading disorders showed less activation in left inferior frontal gyrus, inferior parietal lobule, lateral temporal cortex and fusiform gyrus during conflicting trials (e.g. pint-mint, grade-laid) only. Children with reading disorders showed weaker effective connectivity for conflicting pairs, but stronger effective connectivity for non-conflicting pairs (e.g., fall-ball, press-list), possibly reflecting compensatory processing. In the meaning tasks, children either saw or heard two sequentially presented words and had to determine whether they were associated in meaning. Development was associated with increasing activation in left inferior parietal lobule and middle temporal gyrus for both modalities, suggesting greater integration and elaboration of semantic representations. Children with reading disorder showed a weaker correlation between association strength and activation in left inferior parietal lobule, middle temporal gyrus and inferior frontal gyrus for both modalities. Together, these results show developmental changes in brain networks for phonological and semantic processing and suggest that children with reading disorder have brain deficits in these networks.

C 6

SOCIAL DISPARITY AFFECTS PREFRONTAL DEVELOPMENT IN CHILDREN: AN ERP STUDY *Mark Kishiyama[1], Amy Jiminez[1], Lee Perry[1], Thomas Boyce[2], Robert Knight[1]; [1]University of California, Berkeley, Helen Wills Neuroscience Institute, [2]University of British Columbia* – Societal inequalities have a profound effect on children's health. Children of lower socioeconomic status (SES) are at greater risk for most forms of childhood morbidities including chronic medical conditions and behavioral disorders. Recent evidence suggests that chronic stressors in the early life experiences of low SES children may adversely affect development of the prefrontal cortex (PFC). To address this, we tested both low and high SES children (10 in each group; ages 8-11) using a visual novelty oddball paradigm with event-related potential (ERP) techniques. SES was determined by maternal education and family income-to-needs ratio. In the oddball task, subjects detected infrequent target events (10%) embedded in a series of repetitive background stimuli (75%) and task-irrelevant novel items (15%). This paradigm allowed us to assess two prefrontal dependent attention effects including top-down PFC control of extrastriate processing and the automatic response to novelty (Barcelo et al, 2000; Knight and Scabini 1998). Simple target detection was comparable between groups as indexed by the parietal target ERP (P3b). Low SES children had reduced early visual extrastriate ERPs (N1) ($p < .01$) and reduced fronto-central novelty detection ERPs (N2) ($p < .05$) relative to high SES children. Low SES children have electrophysiological deficits resembling that observed in patients with lateral PFC lesions. These results indicate that stressors associated with social disparity may lead to disrupted development of the lateral PFC in children. Supported by NIMH Grant MH070950 (P.I., W.T. Boyce) and NINDS Grant NS21135 (P.I., R.T. Knight)

C 7

A FUNCTIONAL MAGNETIC RESONANCE IMAGING STUDY OF OVERT WORD GENERATION IN CHILDREN AND ADULTS *Kai Hwang, Kiley J. Hill, Molly M. Davies, Erica D. Palmer, Ralph-Axel Müller; San Diego State University* – The present study examined neurodevelopmental differences related to word generation with functional magnetic resonance imaging (fMRI). In the few fMRI studies that have applied verbal fluency paradigms to children and adults, participants responded covertly and results were inconsistent. The present study adopted overt word generation, which has advantages over covert generation because it allows monitoring of task compliance and performance. Twelve children (ages 8-10 years) and fifteen young adults (ages 20-29 years) were included. In each 40-second experimental block, participants were presented with a different semantic category (8 categories total) and were asked to overtly produce exemplars every 3 seconds (prompted by an exclamation mark on the screen). An overt speech control condition (saying the word "nothing") and a resting baseline were also included. Imaging data were analyzed by the general linear model and subjects' verbal responses were recorded to measure task performance. Children and adults activated overall similar brain regions, predominantly in left inferior frontal gyrus (LIFG) and anterior cingulate cortex (ACC). Additional ROI analyses showed greater activity in LIFG for adults, and greater activity in ACC for children. Our finding in LIFG is consistent with some previous studies using covert word generation (e.g., Szaflarski et al. Ann Neurol 59). The group difference observed in ACC may relate to more effortful processing in children, which underscores the importance of behavioral performance measures unavailable in previous covert word generation studies.

C 8

CONSISTENT EVIDENCE FROM CONVERGING ANALYSES OF FRACTIONAL ANISOTROPY FOR CORPUS CALLOSUM CONNECTIVE CHANGES IN CHROMOSOME 22Q11.2 DELETION SYNDROME *Tony J. Simon[1], Zhongle Wu[1], Hui Zhang[2], James C. Gee[2]; [1]University of California, Davis, M.I.N.D. Institute, [2]University of Pennsylvania* – Children with chromosome 22q11.2 deletion syndrome manifest impairments in attentional, spatial and numerical cognition. Our recent analyses of the morphology of corpus callosum found multiple significant differences in the shape and size of the anterior half of the corpus callosum between the children with deletion and typical developing controls. These and other results lead us to hypothesize that the above cognitive impairments are related to dysfunction in the frontoparietal attention network that may arise from changes in neural connectivity. However, statistical tests of fractional anisotropy (FA) maps from diffusion tensor imaging (DTI) are difficult to interpret, especially in the case of atypical development in children. Therefore, we carried out voxel-based statistics, tract-based spatial statistics and regional statistics on the parcellation of the mid-sagittal corpus callosum based on the cortical projection. DTI Images at 3T with 12 gradient directions were acquired from 11 children with 22q11.2 deletions and 11 typically developing controls aged 7-14 years scanned on a MRI machines. Despite differences in significance values and cluster sizes, the different analyses produced consistent maps with higher FA values in the anterior corpus callosum (mostly in the genu and rostrum) in children with the deletion. These findings further support our hypothesis of connective changes in brains of children with the deletion exist and that these strongly contribute to cognitive impairments. We discuss whether these connective changes are indicative of smaller axons and reduced fiber branches that could delay interhemispheric transfer through smaller diameter fibers in the frontoparietal attention network.

C 9

VENTROMEDIAL PREFRONTAL CORTEX MEDIATES IMAGINED PHYSICAL AGGRESSION IN MALE ADOLESCENTS *Maren Strenziok[1], Frank Krueger[1], Rhoshel Lenroot[1], Elke van der Meer[2], Jordan Grafman[1]; [1]NINDS\NIH, [2]Humboldt-University Berlin, Germany* – Clinical observations in humans indicate that the prefrontal cortex, particularly the ventromedial prefrontal cortex (vmPFC), plays a critical role in the regulation of social and aggressive behavior. To our knowledge there are no functional imaging studies to date that investigate the neural substrates of aggressive behavior in male adolescents - a population that displays higher levels of aggression compared to adults. In a block design fMRI experiment combined with self-reported aggression measurement, 17 healthy adolescents (16.0 ±1.2 years, range 14 to 17) were instructed to imagine self-defense scenarios with a teenage opponent varying in physical aggression: (a) minor: kicking and pushing; and (b) major: savagely beating. In addition, control conditions were applied in which participants were asked to imagine non-aggressive interactions with the teenager: (c) neutral: exchanging objects/information, and (d) exciting: offering valuables and playing. We hypothesized that the imagined scenarios involving aggressive behavior will decrease activation in the vmPFC compared to imagined control scenarios. Overall, all conditions engaged an imagining network including premotor cortex, superior parietal lobule, paracingulate cortex, and a secondary sensory area. Consistent with our hypothesis, the imagined aggressive scenarios evoked less activation in the vmPFC compared to imagined control scenarios. This functional decrease in vmPFC activation is supported by a significant correlation with self-reported aggressive behavior. In conclusion, our results along with findings from structural and functional brain studies in adults give support to the assumption that abnormal expression of aggressive behavior in aggressive adolescents are accompanied by a functional dampening of the vmPFC.

C 10

PHONOLOGICAL PROCESSING AND READING DEVELOPMENT IN CHILDREN EXPOSED TO DOMESTIC VIOLENCE *Judith Blackburn; Towson University* – This study examined the impact of witnessing domestic violence on children's phonological processing and reading development. Forty children 6-9 years old were recruited from domestic violence shelters and the community. Their mothers completed the following questionnaires: the Conflict Tactics Scales-Revised, measuring the frequency of violence in the home (CTS2; Straus, Hamby, & Warren, 2003), and the Conflict Tactics Scales-Parent Child Version, measuring the frequency of child maltreatment in the home (CTSPC; Straus, Hamby, & Warren, 2003). The participants were divided into two groups (control or domestic violence) based on the mother's responses on the CTS2. The two groups were matched on age, gender, nonverbal IQ, and socioeconomic status. The children completed the following tests: the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen & Rashotte, 1999), measuring phonological awareness and phonological memory skills; the Woodcock Reading Mastery Tests-Revised (WRMT-R; Woodcock, 1987), measuring word decoding, nonword decoding, and reading comprehension; the Matrices subtest of the Kaufman Brief Intelligence Test, measuring nonverbal IQ (K-BIT; Kaufman & Kaufman, 1990); and a hearing screening. The groups were significantly different on phonological awareness and all of the reading measures, but not on phonological memory. As expected, the domestic violence group had significantly lower scores than the control group. Factors correlated with phonological awareness and reading development in the domestic violence group included family history of reading disabilities, psychological aggression between the mother and her partner, externalizing behavior problems, socioeconomic status, and length of residence.

C 11

IMPAIRED IMPLICIT SEQUENCE LEARNING BUT NOT SPATIAL CONTEXTUAL LEARNING IN CHILDHOOD ADHD *Kelly A. Barnes[1], Jennifer Foss-Feig[2], Devon Shook[1], James H. Howard[3], Darlene V. Howard[1], Laura Kenealy[4], Chandan J. Vaidya[1,4]; [1]Georgetown University, [2]Vanderbilt University, [3]Catholic University of America, [4]Children's National Medical Center* – Attention Deficit Hyperactivity Disorder (ADHD) is a common neurodevelopmental disorder characterized by symptoms of inattention, impulsivity and hyperactivity that are mediated by dysfunction in frontal and striatal brain regions. Neural circuits that are dysfunctional in ADHD, including fronto-striatal-cerebellar networks, support implicit learning of temporal sequences. We hypothesized that learning that relies on fronto-striatal-cerebellar networks would be impaired in ADHD. Further, in order to determine the extent to which an implicit learning impairment was selective to fronto-striatal-cerebellar circuits, we included a task examining implicit learning of spatial context (Contextual Cueing) that is known to depend on medial temporal lobe structures. Children with ADHD and age, gender, and IQ matched controls performed the Contextual Cueing task (Chun & Jiang, 1998), a measure of implicit learning of spatial context, and the Alternating Serial Reaction Time (ASRT) task (Howard & Howard, 1997), a measure of implicit learning of higher order temporal sequences. Learning on the contextual cueing task was obtained in children with ADHD, but the timecourse differed from controls. Specifically, children with ADHD showed early learning that was not maintained throughout the task. In contrast, children with ADHD did not show learning on the ASRT task, relative to controls. Therefore, results indicated a selective impairment in learning temporal sequences in ADHD children. Impaired implicit learning of temporal sequential information is likely to reduce ADHD children's ability to predict when events will occur, thereby, preventing effective adaptation to the environment.

C 12

INTEGRITY OF THE ARCUATE FASCICULUS AND LANGUAGE OUTCOME IN CHILDREN WITH PERINATALLY ACQUIRED BRAIN INJURY *Gemma Northam[1], Frederique Lie[1], Angela Morgan[2], Donald Tournier[3], Kling Chong[4], John Wyatt[5], Brigitte Vollmer[1], Torsten Baldeweg[1]; [1]UCL Institute of Child Health, London, UK, [2]Murdoch Childrens Research Institute, Melbourne, Australia, [3]Brain Research Institute, Melbourne, Australia, [4]Great Ormond Street Hospital for Children, London, UK, [5]UCL Institute for Women's Health, London, UK* – Perinatal brain injury in the preterm child typically involves the periventricular white matter. Such injury may impair development of tracts essential for speech and language functions, such as the superior longitudinal/ arcuate fasciculus (AF) which connects anterior and posterior language areas. The present study examined language abilities in preterm children (born <33 weeks gestation) aged 10-16 years with perinatal brain injury, and investigated associations with structural and functional imaging findings, specifically the integrity of the AF. Twenty children with unilateral or bilateral lesions on neonatal cranial ultrasound were eligible for inclusion in the study. Outcome was assessed using standardised tests of language functions including tests of expressive and receptive language (CELF-3UK). Neuroimaging included conventional structural MRI (T1, T2 weighted sequences), functional MRI (fMRI) to determine language reorganisation and Diffusion Tensor Imaging (DTI) for assessment of white matter (WM) integrity. Volumes of the SLF/AF were obtained by tracing the anatomical boundaries in the frontal and parieto-temporal WM on colour-coded eigenvector maps. Results showed language abilities (CELF-3UK total score) in preterm children correlated with the volume of the AF, even after correcting for total WM volume. This correlation was strongest for the left AF, in agreement with findings of left language lateralisation on fMRI. In one case with severe unilateral damage to the left AF language reorganisation to the contralateral side occurred. This data suggests that the integrity of the AF constrains the development of language abilities in children with perinatal brain injury.

C 13

BRAIN REGIONS MEDIATING FEEDBACK PROCESSING ACROSS DEVELOPMENT: AN FMRI STUDY *Kiki Zanolie[1,2], Linda van Leijenhorst[1,2], Serge Rombouts[3,2], Michiel Westenberg[1], Eveline Crone[1,2]; [1]Leiden University, [2]Leiden Institute for Brain and Cognition, [3]Leiden University Medical Center* – To adjust performance appropriately to environmental demands, it is important to monitor ongoing action and process performance feedback for possible errors. Performance feedback may indicate that prior performance is no longer correct, that current hypotheses are invalid, or that a performance error has been made. Several behavioral studies have shown that children fail to adjust performance appropriately following negative performance feedback, but the neural substrates that underlie this development are poorly understood. In the current study, 18 children aged 8-11 years, 20 children aged 14-15 years and 20 adults aged 18-25 years performed a rule-switch task (Crone et al., 2004) in an fMRI session. Adults showed more activation in medial prefrontal cortex (PFC) when negative feedback indicated that the previous rule was no longer correct, but more activation in dorsolateral (DL) PFC when negative feedback was used for hypothesis testing. Adolescents showed adult-like activation in medial PFC, but reduced activation in DLPFC following negative performance feedback. In contrast, 8-11-year-old children showed immature activation in both medial PFC and DLPFC. The results show that (1) different PFC regions contribute to different types of negative feedback in adults, and (2) medial PFC and DLPFC have separate developmental trajectories, with DLPFC showing the slowest developmental time course.

C 14

THE DEVELOPMENT OF HOLISTIC FACE PROCESSING: BEHAVIORAL AND ERP MEASURES USING THE COMPOSITE FACE TASK *Susan M. Letourneau[1], Teresa V. Mitchell[2]; [1]Brandeis University, [2]University of Massachusetts Medical School* – Holistic processing of faces was measured using a composite face task in 69 subjects aged 6-22 years. Participants judged whether the top or bottom half of a pair of composite faces was the same or different while behavioral and ERP data were recorded. Holistic processing was observed in all age groups; spatial misalignment of the stimuli improved performance, and this improvement was greatest when the attended halves of the faces were the same. ERP amplitudes of the P1, N170, and N250 showed inverted U-shaped functions with age, with peak amplitudes increasing between ages 6-7 and 8-9, gradually decreasing through adolescence, and slightly increasing again in early adulthood. P1 and N170 latencies decreased steadily with age, while latencies of the N250 increased with age, causing this peak to gradually separate from the N170 with increasing age. Misaligned faces elicited larger amplitudes than aligned faces in all age groups, and this effect was larger over the right hemisphere. Young children showed the largest P1 alignment effects, whereas older children and adults showed larger N170 alignment effects than younger age groups. As observed in previous research with adults, children showed greater alignment effects in the right hemisphere than the left specifically when attended halves were the same, suggesting that holistic processing supports right hemisphere asymmetries while piecemeal, featural processing does not. The results of this study indicate that holistic processing takes place similarly in children and adults, but that perceptual discrimination may change with age, influencing early ERP components.

C 15

LATERALIZATION OF WORKING MEMORY PROCESSING IN DEVELOPMENT *Moriah Thomason Caires[1], Brittany E. Burrows[1], Elizabeth Race[1], Gary H. Glover[1], John D.E. Gabrieli[2]; [1]Stanford University, [2]Massachusetts Institute of Technology* – We examined the development of hemispheric asymmetry in working memory (WM), as measured by functional magnetic resonance imaging, by comparing activations in children (ages 7-12 years) and adults (ages 20-29 years) as they performed separate tests of verbal and spatial WM. For spatial relative to verbal WM, clusters of significant activation were observed in both groups across a large extent of the right hemisphere, including the inferior parietal lobule, the visual association area of the occipital lobe, and premotor regions in the frontal lobe. For verbal relative to spatial WM, widespread activations were observed for both groups in the left inferior and middle frontal gyrus, including BA 44, and regions of the left temporal lobe. Laterality indices (LIs) were obtained for each age group as quantitative measures of hemispheric activation asymmetry. LIs for the spatial WM > verbal WM scans were not significantly different in adults (LI = 0.533) compared with children (LI = 0.523); t (1) = 0.355, p = 0.78. and, LIs in the VWM > SWM scans were not significantly different in adults (LI = -0.892) compared with children (LI = -0.947); t (1) = 0.327, p = 0.79. This similar lateralization in children and adults occurred despite large differences in activation as a function of WM loads in both the spatial and verbal WM tasks. Thus, children and adults demonstrated similar hemispheric asymmetries, with greater activation in the right hemisphere for SWM and greater activation in the left hemisphere for VWM.

C 16

DEVELOPMENTAL CHANGES IN BRAIN ACTIVITY ASSOCIATED WITH THE COMMISSION OF RESPONSE INHIBITION ERRORS. *Katerina Velanova, Enami Yasui, Beatriz Luna; University of Pittsburgh* – Correct antisaccade performance requires the active inhibition of a prepotent response to saccade towards a stimulus, and a voluntary saccade to an empty space in the mirror location. Errors typically take the form of a rapid saccade towards the stimulus, followed by a second corrective saccade towards the intended “target” location. Behaviorally, error rates are known to decrease from childhood through adolescence and into adulthood. This decrease has variously been attributed to performance optimization (associated with improvements in inhibitory control), and with improvements in error monitoring, evaluation, and subsequent adjustment. Here we examined developmental changes in brain activity associated with corrected antisaccade errors (versus correct trials) and hence with failures in performance optimization, and with error feedback processing. BOLD fMRI data were acquired in 66 participants (22 children, aged 8-12 years, 22 teens, aged 13-17 years, and 22 adults, aged 18-27 years) across four runs, during which jittered antisaccade (and prosaccade) trials were presented. Timecourses of activity were derived from functionally defined regions of interest and were compared across age groups. Consistent with prior reports, differential timecourses of activity for error versus correct trials were prominently observed in distinct regions of rostral and dorsal anterior cingulate cortex. These effects were attenuated in adolescents, and even more so in children, with younger age groups showing more robust (and differential) activity in canonical eye-movement regions and in subcortical structures. Our results are discussed in terms of a developmental transition from simple execution to feedback utilization.

C 17

SOCIOECONOMIC STATUS PREDICTS HEMISPHERIC SPECIALISATION OF BROCA'S AREA IN YOUNG CHILDREN *Rajeev Raizada, Patricia Kuhl; University of Washington* – Reading is a complex skill that is not mastered by all children. At the age of five, on the cusp of pre-reading development, many factors combine to influence a child's future reading success, including behavioural factors such as phonological awareness, neural factors such as the auditory processing of phonetic input, and environmental factors, such as socioeconomic status, or SES (Noble, Norman & Farah, 2005; Noble et al., 2006). We investigated the interactions between these factors in five-year old children, by administering a battery of standardised cognitive and linguistic tests (PPVT, CELF, WPPSI, PAT), measuring SES with the standard Hollingshead scale, and using fMRI to record neural activity during a behavioural task, rhyming, that is predictive of reading skills (T.L.Richards et al., 1999). Correlation tests were performed, and then corrected for multiple comparisons using the False Discovery Rate (FDR) procedure (Benjamini & Hochberg, 1995). It emerged that only one relationship linking neural with behavioural or environmental factors survived as significant after FDR-correction: a correlation between SES and the degree of hemispheric specialisation in Broca's area. This neural-environmental link remained significant even after controlling for the children's scores on the standardised language and cognition tests. These findings suggest that the weaker language skills of low-SES children may be a consequence of reduced underlying neural specialisation, and that these neural problems go beyond what is revealed by behavioural tests alone.

C 18

NEUROCOGNITIVE DEVELOPMENT OF IMITATION INHIBITION: AN FMRI STUDY *Jonne Oldenburg[1], Egbert Hartstra[1], Serge Rombouts[1], Marcel Brass[2], Eveline Crone[1]; [1]Leiden University, [2]Ghent University* – Whereas the ability to imitate has an early onset in life, the ability to inhibit imitative actions has a much slower developmental trajectory. Thus, with age children learn to exert voluntary control on which actions to inhibit. Here, we use fMRI to study the neurocognitive development of imitation inhibition relative to cognitive inhibition in children aged 8-12 and adults aged 18-25. Participants perform two tasks in the scanner (1) an imitation inhibition task adapted from Brass et al. (2000) and (2) a Simon task. In both tasks, participants are asked to press the index finger when a ‘1’ is presented and the middle finger when a ‘2’ is presented. In the imitation task, the numbers are presented in front of a mirror hand which can make the same (congruent condition) or a different movement (incongruent condition). Likewise, in the Simon task the number can be presented on the same side as the required response finger (congruent) or the opposite side (incongruent). Behavioral findings show that adults (current n=12, anticipated n=20) respond slower and less accurate in the incongruent compared to the congruent condition, and the response cost is the same for both tasks. In both tasks, participants show increased activation in lateral prefrontal cortex, consistent with the hypothesis that both tasks require response inhibition. The data for twenty 8-12-year-old children are currently being collected. The results will be discussed vis-à-vis current theories on mentalizing and response inhibition.

C 19

EVALUATING THE PROCEDURAL DEFICIT HYPOTHESIS IN PRESCHOOL CHILDREN WITH LANGUAGE AND MOTOR DEFICITS *Renee Fabus[1,2], Peter Gordon[3,4], [1]Brooklyn College; [2]City Univeristy of New York, [3]Teachers College, [4]Columbia University* – The aim of this study was to examine the relationship between speech, language, and motor deficits in 28 four-to-five-year-old preschool children. Four groups of children were tested: (1) children receiving occupational therapy (OT) only, (2) children receiving speech-language therapy (SLP) only, and (3) children receiving therapy for both OT and speech-language deficits (O.T. + SLP), and (4) a control group of normally developing age-matched children, with a battery of speech, language, and motor measures. The Procedural Deficit Hypothesis (PDH) (Ullman, 2001) was evaluated as a possible theoretical explanation for why speech, language and motor deficits might be associated in the three impaired groups of children. Several correlations between language, speech and motor abilities were significant. These data support the co-occurrence of speech-language and motor deficits in these populations. A past tense elicitation task with irregular and regular verbs was administered to evaluate the declarative and procedural memory systems, respectively. Unlike previous tests of past tense production, where the verb was initially modeled with first person uninflected forms (e.g., "Everyday I eat …"), the current study modeled the present tense with third person forms (e.g., "… he eats"), which take the –s inflection. All three impaired groups, but not the unimpaired group, showed a significant tendency to perseverate with the third person form in past tense contexts (e.g., "yesterday he eats"). This error supports a deficit in the analysis of past tense morphology in both language and motor-impaired children that could possibly be due to sequencing problems in procedural memory.Word Count: 249

C 20

IMPAIRED NEURAL SYNCHRONY IN THE AUDITORY SYSTEM COMPLEX IN CHILDREN WITH AUTISM DISORDER: A MULTIDISCIPLINARY INVESTIGATION *Nicole Gage, Sharon Fujikawa-Brooks, A. Lisette Isenberg, M. Anne Spence; University of California, Irvine* – We hypothesize that language dysfunction in autism disorder (AD) stems from impaired neural synchrony in the auditory system complex (ascending and descending pathways, cortex). We have reported latency prolongation in auditory brainstem response (ABR) for AD vs. typically developing (TD) children (7-14 yrs), providing evidence for neural dysynchrony at brainstem, and reduced M100 modulation by speech contrasts, providing evidence for impaired feature extraction at cortex. Here we assess the medial olivocochlear (MOC) circuit in the descending path, critical for neural tuning and under indirect cortical control, using distortion product otoacoustic emissions (DPOAEs) to evaluate the correspondence between MOC dysfunction and brainstem abnormalities. DPOAES were recorded in silence and noise: 'typical' response in noise is suppression (~2-3 dB) in the contralateral ear. RESULTS: both groups showed mixed findings, some children had bilateral (B) and some had unilateral (U, left/right only) suppression. ABR CORRESPONDENCE: TD: all showed typical left (L) and right (R) ABR latency and no ear differences (L=5.54ms, R=5.56ms) regardless of condition (B, U). AD: B – prolonged latency vs. TD but no ear differences (L=5.75ms, R=5.75ms). AD: U – prolonged latency in the unsuppressed ear (0.17ms). Thus impaired suppression in the MOC circuit corresponds to abnormal ABR latency, but only in AD. The auditory system has many redundancies and is typically highly resilient to even moderate impairment. Our findings here provide evidence that descending pathway impairments have profound, early onset (<3yrs), and long-lasting effects on neural synchrony and signal processing at brainstem and cortex for AD but not TD children.

C 21

QUALITY OF LIFE AND PSYCHOSOCIAL FUNCTIONING IN CHILDREN WITH LATERALIZED EPILEPTIC SEIZURES *Krystyna A. Mathiak[1], Magorzata Uba[2], Katarzyna Karzel[2], Tomasz Wolaczyk[3], Klaus Mathiak[1], Jolanta Bielicka-Cymerman[4], Elbieta Szczepanik[5], Pawe Ostaszewski[6]; [1]RWTH Aachen University, Germany, [2]Warsaw University, Poland, [3]Medical University of Warsaw, Poland, [4]Warsaw Hospital for Children, Poland, [5]Institute for Mother and Child in Warsaw, Poland, [6]Warsaw School of Social Psychology, Poland* – Quality of life (QOL) is an individual's overall satisfaction with life and general sense of well-being. Focusing on this measure leads to broad-based treatment approaches and helps to delineate the mechanisms underlying the interaction of disease and psychosocial factors. In adults, seizures in the left temporal lobe led to lower QOL and higher depression and anxiety as compared to right. No such studies have been performed in children, leaving the development of those disturbances unknown. We examined the QOL of children with lateralized seizures.Thirty one parents of children with epilepsy (12 female and 19 male, age 11.4±2.6 years) filled the Quality of Life in Childhood Epilepsy Questionnaire. Fifteen children had seizures in the left and sixteen in the right hemisphere, as verified with multiple EEG examinations. There were no significant differences in age and clinical measures between the groups. The parents of children with right-hemispheric seizures reported lower overall QOL ($t(29)=1.769$; $p=0.044$). Five out of sixteen subscales contributed significantly to this result: anxiety ($t(29)=1.726$; $p=0.048$), social activities ($t(29)=1.734$; $p=0.047$), stigma item ($t(29)=2.090$; $p=0.023$), general health item ($t(29)=1.795$; $p=0.042$), and quality-of-life item ($t(29)=3.055$; $p=0.002$). We demonstrated for the first time that in children left- and right-hemispheric seizures have different impact on QOL. In contrast to findings in adults, seizures in the right hemisphere led to worse emotional and social functioning. This confirms that seizures impact the brain differentially across development. Supported by State Committee for Scientific Research 2H01F04325 in Poland and International Research Training Group 1328, German Research Council.

C 22

AMYGDALA RESPONSE TO OVERT AND MASKED FACIAL EXPRESSIONS OF EMOTION: A DEVELOPMENTAL FMRI STUDY *Angela Tseng[1], Nathalie Vizueta[2], Kathleen M. Thomas[1]; [1]Institute of Child Development, University of Minnesota, [2]University of Minnesota* – Adult neuroimaging literature indicates the amygdala's critical role in processing facial expressions of emotion, even when emotions are not consciously perceived. Prior research in children has shown that overt presentations of face emotion effectively elicit amygdala response. However, it is unknown whether children activate the amygdala to covert facial expressions in the absence of explicit awareness of the emotion. Additionally, it is unclear whether these amygdala responses are early maturing or show developmental change. The present study utilized fMRI and a backward masking paradigm to examine amygdala response to overt and covert presentations of fearful and neutral facial expressions. Twelve children (8-9 years) and 12 adults completed 3 runs: 1) alternating blocks of fixation and neutral faces; 2) fixation and overt fearful and neutral faces; and 3) fixation and masked (covert) fearful and neutral faces. In the covert condition, participants viewed a brief (26ms) face stimulus (neutral or fearful) masked immediately by a neutral face (169ms). Preliminary analyses with adults replicate the finding of greater amygdala activity to overt fearful than to overt neutral faces. In addition, there was a trend towards increased amygdala response to masked fearful faces relative to neutral. While children also showed amygdala activation to overt fearful and neutral faces, they did not demonstrate the adult patterns. Masked emotional faces did not reliably activate the amygdala in children. Results are discussed in terms of developmental differences in the amygdala response to facial emotion, as well as implications for using backward masking in pediatric research.

C 23

DOPAMINE-TRANSPORTER GENOTYPE INTERACTS WITH FAMILIAL RISK FOR ATTENTION-DEFICIT/HYPERACTIVITY DISORDER AND STRIATAL ACTIVITY *Sarah Durston[1,2], John A. Fossella[2], Martijn J. Mulder[1], B.J. Casey[2], Tim B. Ziermans[1], M. Nathalie Vessaz[1], Herman van Engeland[1]; [1]University Medical Center Utrecht, [2]Sackler Institute for Developmental Psychobiology* – Background: The dopamine-transporter (DAT1) gene has been implicated repeatedly in ADHD, although the mechanism by which it exerts its effects remains unknown. The polymorphism associated with ADHD has been shown to affect expression of the transporter in vitro and in vivo. Dopamine-transporters are predominantly expressed in the striatum, although they are also present in the cerebellar vermis. Stimulant medication is often effective in ADHD and is believed to exert its effects by blocking dopamine transporters in the striatum. We hypothesized that DAT1-genotype would affect brain activation patterns in a manner similar to stimulant medication, with the lower expressing allele mirroring its effects. Methods: We investigated DAT1-gene effects on brain activation patterns in a sample of sibling-pairs discordant for ADHD and controls (N=29). All subjects participated in an fMRI session using a go/no-go paradigm, and provided a DNA-sample for analysis. Results: We found that dopamine-transporter genotype affected activation in striatum and cerebellar vermis. Genotype interacted with familial risk for ADHD in striatum, but not vermis.Discussion: These results suggest that dopamine-transporter gene effects in striatum may be involved in translating genetic risk for ADHD into a neurobiological substrate. This may point towards long-term possibilities for tailoring individual therapies by DAT1-genotype: If DAT1-genotype has differential effects on striatal activation, it may become possible to use this as a surrogate endpoint in individualized treatments targeting genotype/fMRI-activation profiles.

C 24

THE NEURAL CORRELATES OF RESPONSE INHIBITION IN ADULTS BORN PRETERM *Emma Lawrence, Rubia Katya, Robin Murray, IPhilip McGuire, Larry Rifkin, IChiara Nosarti; Institute of Psychiatry, King's College London* – Background: In comparison to controls, individuals who were born very preterm display altered neural activation during response inhibition at age 14, despite intact behavioural performance. This study explored response inhibition in a similar sample aged 20. Methods: A 'go-no-go' task was used including 'oddball' trials for attentional control. A rapid, mixed trial event-related fMRI design was employed. 26 preterms (16 males; age 20.11 years, ± .65; gestation 28.77 weeks ± 1.94) and 21 controls (9 males; age 20.13 years ± 1.71) were tested. Participants were scanned using a GE Signa 1.5T neuro-optimised MR system (General Electric, Milwaukee, USA). 3.3mm thick high resolution structural scans were acquired along with T2-weighted images at 16 7mm thick near-axial planes. Results: There were no group differences in performance. When 'no go' were contrasted with 'oddball' trials, preterm participants showed increased blood-oxygen-level-dependent signal in the middle temporal gyrus (BA39) extending to the angular gyrus and inferior parietal lobule (BA40), and precuneus (BA7/BA31) extending to the cingulate gyrus (BA31) and paracentral lobule (BA4). Conclusions: In comparison to controls, and despite intact performance, preterm individuals exhibit differential neural activation during response inhibition. The precuneus and cingulate gyrus form part of a posterior attention network, suggesting this group may have relied on additional attentional resources in order to achieve the comparable behavioural performance to controls.

C 25

OPTIMIZED VOXEL-BASED MORPHOMETRY IN DYSCALCULIC AND NORMALLY ACHIEVING CHILDREN *Stephanie Rotzer[1], Karin Kuc[1], Michael von Aster[1,2], Erst Martin-Fiori[1], Thomas Loenneker[1,3]; [1]University Children's Hospital Zurich, Switzerland; [2]DRK Hospital Berlin, German, [3]University of Zurich, Switzerland* – Functional imaging studies indicate an involvement of prefrontal and parietal cortices in arithmetic tasks. In particular, the intraparietal sulcus seems to play a major role in number processing. The aim of the present study was to analyze if children with developmental dyscalculia (DD) show structural differences in above-mentioned areas compared to normally achieving children. T1-weighted volumetric MRI data were acquired in 12 children with DD (9.30.2 years) and 12 control children without any learning disabilities (9.70.2 years). Voxel-based brain morphometry with an optimization of the spatial segmentation and normalization (OVBM) was applied to identify volume differences in cerebral gray and white matter. Compared to controls, children with DD showed a significant reduction in gray matter volume in the anterior cingulum, the bilateral middle frontal gyri, the left inferior frontal gyrus, and the right intraparietal sulcus. Analysis of white matter volume revealed a reduction in the left frontal lobe and adjacent to the right parahippocampal gyrus. Children with DD did not show increased volume in any cluster compared to controls. A neural equivalence to developmental dyscalculia constitutes the decrease of gray matter volume in the right intraparietal sulcus. However, volume differences in frontal regions, especially the anterior cingulum, refer to early impairments of the attentional system and the working memory, which might have a preliminary negative effect on the acquisition of number representation and number processing capacities.

C 26

ASSESSING INFANT'S SPEECH PERCEPTION WITH NEAR-INFRARED SPECTROSCOPY *Yasuyo Minagawa-Kawai[1,2], Heather van der Lely[2], Emmanuel Dupoux[1]; [1]ENS-EHESS-CNRS, [2]University College of London* – Although human infants are born with almost universal biological functions, regardless of their culture or language, their brains are quickly tuned to a language-specific pattern within the first year of life. In order to elucidate this neural development, particularly for language-specific phonemic acquisition, we performed a longitudinal auditory study using near-infrared spectroscopy (NIRS). Cerebral hemodynamic responses of Japanese infants to native ([i] vs. [unrounded u]) and non-native ([unrounded u] vs. [u]) vowel contrasts within pseudo-word contexts were measured at the ages of 4 months and 8 months. The NIRS results showed that at 8 months of age hemodynamic responses to the non-native contrast were attenuated indicating that the auditory area are specifically sensitive to the native vowel contrast at this age. The principal finding from the present study, however, is a cerebral lateralization process: 4 month-olds exhibited bilateral activation for both native and non-native contrasts whereas at 8 months of age, infants showed left-dominant responses solely to the native contrast. We suggest that these results reveal the neurophysiological basis underlying previous behavioral findings that an infant's perceptual ability to discriminate vowels is altered to a language-specific pattern within 6-months of life. We will discuss our data in relation to recent behavioral findings of phonemic acquisition focusing on the behavioral correlates of left-dominant responses.

C 27

COGNITIVE AGING AND DECISION MAKING: THE IMPACT OF INHIBITION ON CHOICE *Rui Mata; University of Michigan* – Decision field theory (Busemeyer, Jessup, Johnson, & Townsend, 2006) was used to test the plausibility of the hypothesis that cognitive aging impacts decision making abilities trough deficits in inhibitory function. Age-related cognitive decline impacts several higher order cognitive capacities such as decision making abilities. One potential factor underlying older adults' decision-making deficits may be their deficits in inhibitory function: There is consensus that neuromodulatory efficiency declines with age in brain areas associated with decision making abilities such as the basal ganglia, which have important inhibitory functions. Decision field theory is a connectionist model of decision making which has been proposed as a link between the neural and behavioral levels of description. According to decision field theory, lateral inhibition, the inhibitory connections between alternatives being evaluated, is related to a number of effects that challenge conventional views of rational decision making. Simulations suggest that decreased inhibitory function may indeed play a role in decision making behavior of older adults. Decision field theory can account for older adults' superior performance in conditions eliciting the attraction effect (Kim & Hasher, 2005) and suggests a similar result concerning the compromise effect. However, the simulations suggest that older adults' inhibitory deficits could make them more prone to choosing a a poorer option when a similar alternative is added to the choice set (i.e., similarity effect). Neural correlates of the model and empirical tests of the predictions are discussed.

C 28

PHONOLOGICAL MECHANISMS OF SPOKEN WORD RECOGNITION IN CHILDREN AND ADULTS: EVIDENCE FROM EVENT RELATED POTENTIALS *Amy S. Desroches[1], Randy Lynn Newman[2], Erin K. Robertson[1], Marc F. Joanisse[1]; [1]University of Western Ontario, [2]Acadia University* – We used event-related potentials [ERPs] to investigate the time course of spoken word recognition in children and adults. Neurologically healthy right-handed English speaking adults and children (7-12 yr olds) were tested during a visual-auditory mismatch paradigm. Scalp potentials were recorded from 32 sites as participants viewed a target picture followed by an auditory word that was either a match (picture: CONE, word: cone), a rhyme mismatch (CONE-bone), a cohort mismatch (CONE-comb), or an unrelated mismatch (CONE-fox) to the target picture. The conditions of greatest interest, rhyme and cohort, elicited different ERP components in adults. The Phonological Mismatch Negativity [PMN], a component associated with phonological processing, was elicited at approximately 250 ms post stimulus onset in the rhyme condition. In the cohort condition an N400 component (commonly associated with semantic processing) peaked around 450 ms post stimulus onset. While these same components were present in children, they differed in scalp distribution and latency. The findings provide evidence that phonologically similar items compete for recognition as speech perception unfolds; however, different competition effects are reflected in distinct neural markers (PMN and N400). The developmental changes in these components also provide useful information as to how phonological similarity impacts spoken word recognition in children.

C 29

ENHANCEMENT AND BILATERALIZATION OF EARLY SENSORY PROCESSING IN THE VENTRAL VISUAL STREAM MAY BE A FEATURE OF NORMAL AGING: A HIGH-DENSITY ELECTRICAL MAPPING STUDY *Pierfilippo De Sanctis[1], Richard Katz[2], George S. Alexopoulos[2], Glenn R. Wylie[3], John J. Foxe[1]; [1]Nathan S. Kline Institute for Psychiatric Research, [2]Weill Medical College of Cornell University, [3]Kessler Medical Rehabilitation Research and Education Corporation* – Across a variety of electrophysiological investigations of normal aging, evidence has emerged for age-related changes in sensory processing, indexed by early components of auditory (AEPs) and visual evoked potentials (VEPs). Because these age-related differences have often been incidental to the main focus of these studies, many of which have investigated task performance in cognitive designs, researchers have been unable to determine if the effects seen are performance dependent or alternately, represent intrinsic changes in sensory processing. A test employing a design without task or performance confounds is clearly warranted. Here, participants passively viewed centrally presented alphanumeric stimuli to investigate whether age-related differences in sensory processing persist even without task involvement. High-density VEPs were acquired from 19 healthy elderly participants (74.2 years) and of 15 young control subjects (23.6). Results show a robust increase in N1 amplitude and latency with age. Using spatiotemporal topographic analysis and source solutions we found both enhanced and delayed neural responses within structures of the ventral visual stream with age. A reduced hemispheric asymmetry in the elderly may be indicative of a decline in hemispheric specialization. Additionally, considerably enhanced early sensory-driven frontal cortical activation was observed in the older subjects, suggesting a hyper-activation of these structures. These age-related differences in early sensory processing are discussed in terms of recent proposals that normal aging involves large-scale compensatory reorganization. Our results suggest that such compensatory mechanisms are not restricted to later higher-order cognitive processes but may also be a feature of early sensory-perceptual processes.

C 30

ORBITOFRONTAL RECRUITMENT VARIES WITH TRAIT-RELATED IMPULSIVITY IN CHILDHOOD *Ericka Burgos-Ruiz[1], Jenn Foss-Feig[2], Philip Lee[1], Chandan Vaidya[1,3]; Georgetown University, [2]Vanderbilt University, [3]Children's Research Institute, Children's National Medical Center* – Functional neuroimaging of inhibitory functions that contribute to executive function has revealed involvement of several prefrontal cortical regions (e.g., orbitofrontal –OFC, ventrolateral, and cingulate). The extent to which involvement of these regions relates to trait-related inhibitory control is relatively unknown. We examined whether involvement of these regions correlated with parent reported ratings of behavioral impulsivity (ADHD rating scale) and of deficits in everyday executive functioning (BRIEF global executive composite) in 7-13 year-old children with Attention Deficit Hyperactivity Disorder and age and IQ-matched controls. Event-related fMRI was performed during a visual task that required children to ignore salient distracting information. Regions activated during trials with perceptually-salient distractors (e.g., novel, colorful) relative to those without salient distractors (e.g. no-color) included OFC and medial parietal cortex. ADHD children also activated ventral striatum whereas control children activated the amygdala. We performed voxel-wise correlational analyses to determine regions that correlated negatively with impulsivity and executive function ratings across all children. Results indicated that children with lower behavioral impulsivity/hyperactivity activated the left OFC (BA 11) to a greater extent. Similarly, children with lower executive function impairment activated that same OFC region to a greater extent. Thus, childhood individual differences in impulsivity and its debilitating effect on executive function in every day life depend upon functioning of the orbitofrontal cortex.

C 31

NEURAL CORRELATES OF CORRECT AND INCORRECT INHIBITION: RELATIONSHIP TO BEHAVIORAL MEASURES OF PERFORMANCE *Jessica Kirkland, Marilyn Essex, Jeffrey Armstrong, Richard Davidson; University of Wisconsin, Madison* – This study used functional magnetic resonance imaging (fMRI) to examine neural activation during a go/no-go task, in a sample of adolescents at risk for psychopathology (N = 54, 29 female). Significant activity during correct and failed button press inhibition was examined in relation to behavioral measures of performance (signal detection ability, reaction time variability). Consistent with inhibition literature, group t-tests on mean percent signal change revealed increased MR signal during correct inhibition in a network of regions including right anterior cingulate (ACC), bilateral basal ganglia, prefrontal areas, and left cerebellum. Failed inhibition showed similar MR signal increases in areas including the ACC, but attenuated activity in several areas including basal ganglia and ventral prefrontal cortex. Individual subject mean percent signal change values were extracted for regions significant for correct and failed inhibition at the group level, and relationships of these values to individual performance measures were explored. During correct inhibition, increased activity in several motor and cognitive control-related areas, including basal ganglia and ACC, was correlated with more variable reaction time (ACC: R=.364, .007) and poorer signal detection ability (left putamen: R = -.387 , .005). Increased activation in the basal ganglia during failed inhibition was also related to greater reaction time variability (R = .338 , .013). These results have potential to advance our understanding of the relationship between inhibitory neural activity and behavioral performance in adolescents.

C 32

DEVELOPMENTAL DIFFERENCES IN RECOLLECTION AND FAMILIARITY: AN FMRI STUDY. *Dana DeMaster, Simona Ghetti, Silvia Bunge, Andrew Yonelinas; University of California, Davis* – Recognition memory – the capacity to determine whether an event has been previously encountered – can be based on two distinct processes: 1) recollection, the process that allows for retrieval of qualitative features associated with the context in which the event originally occurred and 2) familiarity, the process that results in a general sense that the event occurred. Recent behavioral studies indicate a developmental dissociation between the two processes: whereas familiarity stabilizes during childhood, recollection continues to develop until adulthood. The neural mechanisms underlying this dissociation remain largely unknown. In this study, 64 healthy, right-handed, native English speakers from four age groups (8yr, 10-11yr, 14yr, and adult) will participate in an fMRI study (current N = 55). During fMRI data acquisition, participants semantically process drawings presented either in green or red ink. After the scanning session, participants complete a self-paced recognition test on studied and new drawings. Participants report whether each item was studied, and provide confidence judgments on a 3-point scale. For items identified as studied, participants indicate the color in which the item was originally viewed. Behavioral results confirm age-related improvements in recollection, but not familiarity. Based on fMRI research with adults, it is proposed that recollection- and familiarity-based recognition will recruit dissociable areas in the medial temporal lobes (hippocampus/posterior parahippocampal gyrus vs. perirhinal cortex) and in the prefrontal cortex (ventral-lateral vs. orbital frontal) for adults. Selective recruitment of areas critical for recollection and familiarity is expected to emerge and increase with age.

Higher Level Cognition: Disorders

C 33

NEONATAL LESIONS OF THE RAT NUCLEUS ACCUMBENS / SEPTUM *Michael T. Amlung[1,2], Sarah A. Berg[1,2], R. Andrew Chambers[1,2]; [1]Indiana University Bloomington, [2]Institute of Psychiatric Reseaerch, Indiana University School of Medicine* – BACKGROUND: The nucleus accumbens (NAc) is implicated in major psychiatric disorders including addiction, schizophrenia, ADD, and OCD. Collectively, these disorders are associated with disturbances of motivational control as reflected by abnormal addictive drug responsivity, compulsivity, and/or impulsivity. Neonatal lesions to brain regions that project into the NAc (including hippocampus and amygdala) and adult lesions directly to the NAc have previously been shown to alter one or more aspects of motivational control. The behavioral impact of neonatal NAc lesions is unknown. METHODS: To explore the NAc in a neurodevelopmental context, we pioneered techniques for bilateral neonatal lesions (ibotenic acid) of the NAc and septum in 7-day-old rat pups. In adulthood, rats with sham surgeries were compared to those with neonatal NAc lesions (NNAcL) and neonatal septal lesions (NSL) in behavioral sensitization to cocaine (15 mg/kg IP per day) followed by measures of compulsivity and impulsivity in food-rewarded operant conditioning paradigms. RESULTS: Preliminary trends suggest that NNAcL vs. NSL produce differential activity profiles compared to control rats upon repeated cocaine injections. In control rats, cocaine history tended to increase compulsivity but decrease impulsivity. This drug effect tended to be attenuated by the presence of NSLs. CONCLUSIONS: The results suggest the feasibility of neonatal lesioning of the NAc and septum. Lesions to these regions may produce differential effects on motivational endophenotypes reflected in cocaine sensitization and profiles of compulsivity and impulsivity. Further work is needed to better characterize the role of the NAc and septum in neurodevelopmental models of psychiatric syndromes.

C 34

SPEEDED PROCESSING OF GRAMMAR AND TOOL KNOWLEDGE IN TOURETTE'S SYNDROME *Michael Ullman[1], Matthew Walenski[1], Stewart Mostofsky[2]; [1]Georgetown University, [2]Kennedy Krieger Institute, Johns Hopkins University School of Medicine* – Tourette's syndrome (TS) is a developmental disorder characterized by motor and verbal tics. The tics are fast and involuntary, and result from frontal/basal-ganglia abnormalities leading to unsuppressed behaviors. Language has not been carefully examined in TS. We tested the processing of two basic aspects of language, idiosyncratic and rule-governed linguistic knowledge. Evidence suggests that idiosyncratic knowledge (e.g., in irregular past-tense formation; bring-brought) is stored in a mental lexicon that depends on the temporal-lobe-based declarative memory system, which also underlies conceptual knowledge. In contrast, rule-governed combination (e.g., for regular past-tenses; walk + -ed) takes place in a mental grammar that relies on the frontal/basal-ganglia based procedural memory system, which also underlies motor skills such as how to use a hammer. We found that TS children were significantly faster than control children at producing rule-governed past-tenses (slip-slipped, plim-plimmed, bring-bringed) but not irregular and other unpredictable past-tenses (bring-brought, splim-splam). They were also faster than controls at naming pictures of manipulated (hammer) but not non-manipulated (elephant) items. These data were not explained by a wide range of potentially confounding subject- and item-level factors. The results suggest that the processing of procedurally-based knowledge, both of grammar and of manipulated objects, is particularly speeded in TS. Therefore the frontal/basal-ganglia abnormalities in the disorder may lead to not only tics, but to a wider range of unsuppressed and rapid behaviors and types of processing, including in the cognitive processing of rule-governed forms in language and other types of procedural knowledge.

C 35

THE PROCEDURAL DEFICIT HYPOTHESIS OF DYSLEXIA *Joshua Hartshorne[1,2], Claudia Bonin[3,1], Michael Ullman[1]; [1]Georgetown University, [2]Harvard University, [3]University of Maryland* – Although the most salient characteristic of developmental dyslexia may be its associated reading impairments, an array of seemingly unrelated co-occurring deficits have been observed, including impairments of motor coordination, implicit learning, visual motion detection, working memory, and grammar. Analogous to a recently proposed explanatory account of Specific Language Impairment, we hypothesize that a substantial portion of the deficits in dyslexia are tied to abnormalities in a single brain system: procedural memory. This system, which subserves the learning and processing of sensory-motor and cognitive "skills", depends on a network of structures that is rooted in frontal/basal-ganglia circuits, but includes parietal, superior temporal, and cerebellar regions. These structures have been linked to a wide range of tasks and functions, including some whose relationship with actual procedural memory functions are not yet clear (e.g., sequencing, rule learning, motor function, working memory, grammar, dynamic mental imagery). As a first step in testing the "Procedural Deficit Hypothesis", or PDH, we compiled a list of functions linked to procedural system brain structures, as well as functions dissociated from this system. A detailed literature examination of the status of these abilities in dyslexia suggests that most impairments in the disorder can explained by the PDH, whereas at least certain abilities that are spared do not depend on this system. Should future studies confirm that the PDH has explanatory power for dyslexia, findings from the wide range of animal and human studies on the procedural memory system may be applicable to the disorder.

C 36

EXPLORING SEMANTIC KNOWLEDGE OF CHINESE CHILDREN WITH WILLIAMS SYNDROME: NEW INSIGHTS FROM FALSE MEMORY TASKS *Ching Fen Hsu[1], Annette Karmiloff-Smith[1], Ovid, J.-L. Tzeng[2], Chi-Rung Tai[2], Hua-Zhen Wang[3]; [1]Birkbeck College, UK, [2]National Yang Ming University, Taiwan, [3]National Chiao Tung University, Taiwan* – The aim of this study is to explore the relationship between the context-using abilities of people with Williams syndrome (WS) and their semantic knowledge. Previous work has shown that their semantic priming performance is no different from normal controls (Tyler, et al., 1997), but an abnormal N400 is observed in their processing of semantically anomalous sentences (Neville, Mills & Bellugi, 1994). To clarify the inconsistencies in the data on WS, we used an auditory false memory paradigm taking both behavioral and neurological (ERPs) measures from three groups: WS, mental-age matched children and college students. Behavioral results indicate that people with WS display the same pattern of recognition for semantically related non-presented lures as their controls. However, their neural correlates tell a different story. College students display brainwave differences between studied words and unrelated new words, whereas people with WS show the same effect in a shorter time window. Furthermore, college students differentiate between semantically-related lures and unrelated new words, but the brains of people with WS reveal no such difference. Unlike college students, people with WS show a difference between studied words vs. semantically-related lures. Our findings suggest that in WS proficient behavior camouflages a deviant neural pathway in context use. Our results also reveal developmental changes in typical development, since children show a distinctive pattern from college students. Overall, our findings suggest that semantic organization develops slowly in the typical case, and abnormally in the WS case.

C37

THE NEURAL REORGANIZATION OF LANGUAGE AFTER DAMAGE: AT THE CROSSROADS OF NEUROIMAGING AND COGNITION *Birgit Keisker[1], Spyridon Kollias[1], Dorothea Weniger[1]; [1]University Hospital Zurich* – The neural reorganization of language after brain damage continues to be a matter of debate. The crucial issue is whether language improvement represents sparing or restoration of function in perilesional zones or recruitment of homologous right hemisphere regions. With the advent of functional imaging the relationship between brain damage and recovered language functions can be examined in vivo. In examining the neural reorganization of language functions following brain damage few attempts have been made to investigate the residual and/or restored language processing capacities by a set of linguistic activation tasks that minimizes the demands on working memory and attentional resources. The present study is concerned with the patterns of reorganization in individuals with lesions affecting language-related areas. We present behavioural data and f-MRI activation patterns of normal controls and brain-damaged individuals performing a lexical decision and a picture/word matching task, in a blocked design with an auditory and visual mode of stimulus presentation. Normal controls displayed more correct responses and faster reaction times with visual rather than auditory stimulus presentation. Specific activation patterns were obtained for the two tasks, with the mode of stimulus presentation being reflected in expected differences. Brain-damaged individuals performed on a comparable level of accuracy, but had longer reaction times. They showed specific activation patterns for the two tasks, related to lesion location. The correlation of their reaction times and the time course of their activation patterns are discussed within a neuroanatomical framework combining neuroimaging data with cognitive models of word processing.

C 38

TAKE-IT-OR-LEAVE-IT: THE ROLE OF THE VENTROMEDIAL PREFRONTAL CORTEX IN THE ULTIMATUM GAME *Laura Moretti[1], Irene Cristofori[2], Davide Dragone[2], Elisabetta Ladavas[2], Giuseppe Di Pellegrino[2]; [1]Istituto di Psicologia, Università di Urbino, Italia, [2]Università di Bologna, Italia* – In the Ultimatum Game (UG), a Proposer offers a division of a sum of money to a Responder, who can accept or reject it, ending the game. Rational choice model predicts that responders should accept all non-zero offers, however about half of the unfair offers are rejected. fMRI data show that unfair offers activate brain areas involved in negative emotional states, suggesting a role for emotions in decision-making. Here we studied UG in patients with ventromedial prefrontal cortex (vmPFC) lesion, a brain region interfacing cognition and emotion. Six vmPFC patients and 12 healthy controls played in the role of the responder in the UG. Participants played 12 rounds, each with a different anonymous partner, via a computer interface. Offers were predetermined so that all participants saw the same set of offers (4 fair, 8 unfair), in random order. For all participants, the acceptance rate decreased as offers became less fair. Importantly, vmPFC patients rejected unfair offers with a significantly higher rate than controls, ending the game with lower gains. In the UG, behavioural choice reflects the competition between conflicting states. Thus, unfair offers generate an impulse to reject. However, the negative prospect of losing money if offers are declined may be anticipated through the vmPFC, motivating people to override emotional forces. Damage of vmPFC weakens the neural mechanism that enable one to make decisions according to long-term outcomes, thus leading to loss of adaptive decision-making in favour of more automatic, impulsive behaviour.

C 39

FMRI ACTIVATION OF LANGUAGE AREAS IN AUTISTIC CHILDREN *Tracey A. Knaus[1], Andrew M. Silver[1], Kristen A. Lindgren[1], Nouchine Hadjikhani[2], Helen Tager-Flusberg[1]; [1]Boston University School of Medicine, [2]Massachusetts General Hospital, Harvard Medical School* – Language deficits are one of the core symptoms of autism. Functional neuroimaging has examined language functions in autism however their results have been variable. We used fMRI to examine language functions in autistic children compared to typically developing children. We examined brain activation during a language task in 10 right-handed autistic boys compared to 9 normal right-handed boys. Performance was similar in both groups. Both groups demonstrated activation in the left pars triangularis and the superior, middle, and inferior temporal gyri, as well as bilaterally in the amygdala and hippocampus. Autistics had additional regions activated, including parieto-occipital regions and the caudate. In both groups, regions of interest located in frontal and temporal language-related areas (pars triangularis and pars opercularis and posterior superior temporal gyrus) revealed left lateralization of activation in both groups ($p<.001$). In addition, autistics had higher percent signal change in frontal regions compared to controls ($p=.009$). A correlation between signal change in the left frontal with left temporal areas was found in the control group ($r=.908$, $p=.001$), but not in the autism group ($r=.621$, $p=.051$). These results suggest that language functions may be organized differently in autism, resulting in more activation than typically developing controls despite similar performance level. The lack of correlation between frontal and temporal language region activation in autism also suggests that these regions may not be working together as efficiently in autism as in controls.

C 40

CONTROL OVER CONFLICT DURING MOVEMENT PREPARATION: ROLE OF THE POSTERIOR PARIETAL CORTEX *Elizabeth Coulthard[1], Parashkev Nachev[2], Masud Husain[1]; [1]University college London, [2]Imperial College London* – Conflicting information activates parietal as well as prefrontal cortices, while lesion studies suggest involvement of parietal regions in directional movement planning. Here we use a modified Eriksen flanker task in patients with and without neglect to assess how they resolve conflict between competing motor programmes. Importantly, to control for lateralised perceptual bias, we present stimuli in the vertical midline. Twenty-four right-hemisphere stroke patients (16 neglect, 8 without) and 14 age-matched controls were tested. Subjects moved a joystick left or right in response to a central target arrow flanked vertically by incongruent, congruent or neutral flankers. Two patterns of performance emerged within the neglect group. Neglect patients with posterior parietal damage were paradoxically faster to move rightward in the incongruent than the neutral condition, i.e. rightward movements were actually facilitated by leftward flankers. In contrast, these individuals had normal incongruence cost for leftward movements. The second group of neglect patients, who had a common frontal focus of lesion involvement, were disproportionately slowed bilaterally by incongruent flankers. A second, free choice experiment established that parietal neglect patients were biased toward rightward movements, even in the absence of visual directional information. These results suggest there are two complementary systems activated by conflicting information. The first requires intact posterior parietal cortex and activates competing motor plans in response to incongruent flankers, resulting in reaction time delay and most likely being important for the selection of movement programmes. The second system involves prefrontal cortex and limits the intrusion of distracting information by increasing 'cognitive control'.

C 41

THE PERVASIVE SUBJECTIVE EXPERIENCE OF DETERIORATION; A DISTINCT TYPE OF IMPAIRED INSIGHT. *Edward De Haan[1], Martine van Zandvoort[1], Jaap Kappelle[2]; [1]Utrecht University, [2]University Medical Center Utrecht* – Insight into one's own functioning, be it physical, cognitive or emotional, is a central human ability crucial for survival. The clinical literature holds many examples of deficits in conscious awareness that may occur after brain disease. For instance, amnesic patients may still be able to learn new skills althought they have no explicit recollection of learning. 'Anosognosia' concerns neurological patients who are unaware that they suffer from a demonstrable impairment, such as blindness (Anton's syndrome). Finally, there is one case description of a patient with 'inverse Anton's syndrome who actively denies his residual functioning. Here, we report a man who suffered a posterior bilateral stroke and as a result has visuoperceptual problems and a memory impairment. The right upper quadrant of his visual field is relatively intact (he can still watch television and read large print) and this has been stable for a year. In contrast to the objective assessment, he is convinced that his vision is deteriorating and that he is 'going blind'. This conviction is not influenced by evidence to the contrary and he contiuously demands medical care to counteract the experienced progressive visual decline. This pervasive subjective experience of deterioration does not include his memory problems which he feels have somewhat improved. We suggest that this is a specific type of disorder of insight characterised by a false belief of deterioration.

C 42

IMPAIRMENTS IN COGNITIVE CONTROL IN CHILDREN WITH CHROMOSOME 22Q11.2 DELETION SYNDROME *Yukari Takarae[1,2], Joel Bish[3], Tassone Flora[1], Leeza Kondos[1], Tony Simon[1]; [1]M.I.N.D. Institute, [2]University of California, Davis, [3]Ursinus College* – Individuals with Chromosome 22q11.2 Deletion Syndrome (DS22q11.2) have impairments in visual attention, numerical cognition, and executive function that negatively impact their intellectual and behavioral development. We examined performance of 7-14 year old children with DS22q11.2 on the Stroop task, the SNARC task, and the Attention Networks Test (ANT). Children with DS22q11.2 had increased Stroop interference relative to typically developing children. The SNARC task, which manipulates spatial and numerical conflict, produced increased RT cost for children with DS22q11.2 on trials requiring incongruent spatial responses to numerical judgments. The ANT results replicated our previous finding (Bish et al., 2005) of reduced ability in children with DS22q11.2 to adapt when presented with two contiguous incongruent trials but showed adaptation for sequences of three incongruent trials. This suggests that conflict adaptation is not absent but takes more time to affect behaviors in DS22q11.2. Based on our previous data suggesting normal psychomotor speed in a simple reaction time paradigm, we conclude that a specific impairment of the cognitive processes involved in top down control is responsible for the performance decrement. Further experimental and computational modeling studies are investigating its nature. Performance on the ANT also differed with alleles of the COMT gene, which is located in the deleted region of chromosome 22 and is critical in metabolizing dopamine in prefrontal cortex. These findings suggest general impairments in cognitive control in DS22q11.2. and relationships between cognitive control and dopamine levels in prefrontal cortex.

C 43

NEUROCOGNITIVE CORRELATES OF IMPULSIVITY AND ALCOHOLISM: EVOKED OSCILLATIONS DURING A GAMBLING TASK *Chella Kamarajan, David Chorlian, Ramotse Saunders, Madhavi Rangaswamy, Yongqiang Tang, Nagaraj Roopesh, Niklas Manz, Arthur Stimus, Bernice Porjesz; SUNY Downstate Medical Center* – Neurocognitive correlates of impulsivity have been thought to underlie several of externalizing/disinhibitory disorders including alcoholism. The current study examines the aspects of impulsivity in terms of behavioral measures as well as event-related oscillations (EROs) while performing a gambling task that involves monetary gain and loss. Behavioral measures of impulsivity were analyzed and brain oscillations were decomposed into time-frequency-amplitude data using the S-Transform algorithm. The mean amplitude in the outcome-related negativity (ORN) time window (225-275 ms) in each frequency band was statistically analyzed in both groups across four outcomes that involved valence (loss or gain) and magnitude (50 or 10 cents). Alcoholics showed higher impulsivity as measured in Barratt Impulsivity Scale (BIS) and in other task-related impulsivity responses. Further, alcoholics showed significantly decreased amplitude in delta (1-3 Hz) and theta (4-7 Hz) band during the ORN time window. The frontal theta activity was markedly suppressed in alcoholics during all the outcomes. These results are discussed in the light of possible frontal lobe dysfunctions that may mediate high impulsivity and neurocognitive deficits in alcoholics.

C 44

PRIMING DEFICIENCY IN MALE SUBJECTS AT RISK FOR ALCOHOLISM: THE N4 ERP DURING A SEMANTIC TASK *Nagaraj Roopesh[1], Madhavi Rangaswamy[1], Chella Kamarajan[1], David Chorlian[1], Yongqiang Tang[1], Arthur Stimus[1], Lance Bauer[2], John Rohrbaugh[3], Sean O'Connor[4], Samuel Kuperman[5], Marc Schuckit[6], Bernice Porjesz[1]; [1]SUNY Downstate Medical Center, Brooklyn, NY, [2]University of Connecticut Health Center, Farmington, Connecticut, [3]Washington University, St. Louis, Missouri, [4]Indiana University Medical Center, Indianapolis, [5]University of Iowa Hospitals, Iowa City, Iowa, [6]University of California, San Diego* – While there is extensive literature on the relationship between the P3 component of event-related potentials (ERPs) and risk for alcoholism, there are few published studies regarding other potentially important ERP components. One important candidate is the N4(00) component in the context of semantic processing, as abnormalities in this component have been reported for adult alcoholics. A semantic priming task was administered to young male offspring (18 to 25 years) of alcoholic fathers [high risk (HR) n = 23] and non-alcoholic fathers [low risk (LR) n = 28], in order to determine if N4 deficits antecede the development of alcoholism. Subjects were presented with 150 words and 150 non-words sequentially. Among the words, 50 words (prime) were preceded their antonyms (primed, n=50), whereas the remaining 50 words were unprimed. For the analysis, N4 amplitude and latency, as well as behavioral measures for the primed and unprimed words were considered. A significant interaction effect was observed between semantic condition and group, where HR subjects failed to suppress N4 for primed stimuli. HR subjects scored significantly less correct responses compared to LR. The lack of N4 attenuation to primed stimuli and/or inability to differentiate between primed and unprimed stimuli, without latency and reaction time being affected, suggest neuronal structural abnormalities with normal speed of information processing in HR male offspring. This N4 deficit in HR, similar to that of alcoholics indicates that it antecede the development of alcoholism and may provide another electrophysiological endophenotype that reflects genetic vulnerability to develop alcoholism

C 45

RESPONSE INHIBITION AND PRODUCTION IN ALCOHOLICS: AN ERP ANALYSIS OF N2 COMPONENT IN A GO/NO-GO TASK *Ashwini Pandey, Bernice Porjesz, Chella Kamarajan, Madhavi Rangaswamy, Yongqiang Tang, David Chorlian, Nagaraj Roopesh, Niklas Manz, Arthur Stimus, Henri Begleiter; SUNY Downstate Medical Center* – Numerous studies in the literature have focused on P3 deficits in alcoholics. The objective of the present study is to elucidate characteristics of the N2 (N200) component of the event-related potential (ERP) in alcoholics during response inhibition and production using a Go/No-Go task. The sample consisted of 78 alcoholic males with an age range between 21 and 50 years and 58 healthy controls aged between 18 and 25 years. The N2 component of the ERP was compared across task conditions and groups. Alcoholics produced significantly reduced anterior N2 amplitude during No-Go condition and weaker current density during both Go and No-Go conditions. Behaviorally, the alcoholic group was slower in executing a motor (GO) response. Additional analysis using LORETA (Low Resolution Electromagnetic Tomography) indicated that the alcoholic group had less activation in the frontal regions during both Go and No-Go conditions. These findings suggest that alcoholics have deficits in effortful processing during response inhibition and execution as well as possible frontal lobe dysfunctions.

C 46

FUNCTIONAL ABNORMALITY IN COVERT SPEECH PRODUCTION SYSTEM IN CHRONIC SCHIZOPHRENIA *Ryu-ichiro Hashimoto, KangUk Lee, Alexander Preus, Robert McCarley, Cynthia Wible; Schizophrenia Research Group, Clinical Neuroscience Division, Harvard Medical School* – Previous functional imaging studies suggested that several core symptoms of schizophrenia (e.g. auditory hallucinations) derive from deficits in functional abnormality of the speech production/perception system, involving the left prefrontal cortex (PFC), temporo-parietal cortex (TPC) and the posterior middle/superior temporal gyrus (STG/MTG), and homologous regions in the right hemisphere (Hans et al., in press). In the present fMRI study, we measured brain activity of 10 chronic schizophrenic patients (CSZs) and 10 normal control subjects (NCs) during a covert (inner) speech, with the specific aims of localizing functional abnormality within the speech production system in patients with auditory hallucinations and/or formal thought disorders, and elucidating how such localized deficits exert their influence on functional integrity among other cortical areas. During the task, subjects were presented with three words (e.g. "bear, coal, flood") either aurally or visually, and then asked to subvocally rehearse these words during the ensuring rehearsal period of 16 sec for subsequent recall. Significant task-related activations were found in the bilateral STG/MTG, TPC, and PFC in both groups, but the CSZs showed reduced activation especially in the left PFC compared with NCs. Subsequent functional connectivity analyses using the methods described by Rissman et al (2004) revealed significantly reduced connectivity between the left PFC and the left temporal lobe, and reduced inter-hemispheric connectivity of the temporal lobes. These findings suggest that there are deficits in functional integrity in fronto-temporal connections as well as in connections among key temporal regions, which may underlie core clinical symptoms of schizophrenia, such as auditory hallucinations.

C 47

DEFICITS OF PROCEDURAL LEARNING IN PATIENTS WITH OBSESSIVE-COMPULSIVE DISORDER *Norbert Kathmann[1], Anja Bauer[2], Kathrin Holzschneider[1], Edgar Geissner[2], Tanja Endrass[1]; [1]Humboldt-University at Berlin, [2]Medizinisch-Psychosomatische Klinik Roseneck, Prien am Chiemsee* – Procedural learning, as measured in the serial reaction time task (SRTT), is a product of fronto-striatal brain function. Neuropsychological and brain imaging studies revealed that obsessive-compulsive disorder (OCD) may be associated with fronto-striatal dysfunction (Saxena et al., 1998). Deckersbach et al. (2002) reported an experiment showing reduced procedural learning in OCD patients in a dual task situation requiring the concurrent performance of a memory task. We conducted two experiments to further address this issue. Experiment 1 was run with 33 OCD patients and 27 healthy controls demonstrating reduced procedural learning in patients using a single task SRTT (p = .005). This deficit remained stable across time although symptoms remitted substantially (Kathmann et al., 2005). In Experiment 2, using new samples of OCD patients and healthy controls and a depressive control sample, both single and dual task versions of the SRTT were administered. OCD patients had deficits in each of the two tasks. It is concluded that deficits in procedural learning are a stable finding in OCD patients. The deficit is independent of the working memory load of a concurrent task. This replicates and extends earlier findings from Deckersbach et al. (2002) in two new samples. The results support the fronto-striatal model of OCD. More information regarding the diagnostic specificity of this deficit is needed.

C 48

AN FMRI STUDY OF THE CROSSED RESPONSE INHIBITION TASK IN PARKINSON'S DISEASE *Benzi Kluger, Keith McGregor, Valeria Drago, Michelle Benjamin, Tomoyuki Mizuno, Keith White, Bruce Crosson, Kenneth Heilman; University of Florida* – Background: The crossed response inhibition (CRI) task has been shown to be impaired in many non-demented patients with Parkinson's Disease (PD). Previous studies of this task suggest a critical role for the supplementary motor area (SMA). While pathological studies show specific cell loss in the SMA of PD patients, functional imaging studies have shown mixed results using other paradigms, including both increased and decreased activation. Objective: To determine the activity of medial motor systems in PD utilizing the CRI task. Methods: Five non-demented patients with PD and 9 healthy right-handed age-matched controls performed a simple unimanual hand raise in two response conditions. During Uncrossed trials, subjects were to move the hand ipsilateral to a tactile stimulation (computer-controlled air puff) given to the hand. In Crossed trials, subjects were asked to move the hand contralateral to the tactile stimulation. Subjects performed a total of 200 counterbalanced response executions (50 per hand per condition). A group analysis of the healthy controls was performed using a three-factor ANOVA (Age x Response Condition x Handedness) for the whole brain using area under the curve of the estimated hemodynamic response functions obtained from a deconvolution procedure. Individual analyses were done for the PD patients due to an expected increase in response and signal variability in this group. Results: Our preliminary analyses indicate that patients with PD demonstrate less activity than controls in medial motor areas during crossed response trials. Conclusions: fMRI and the CRI task may be useful in documenting medial frontal pathology in PD.

C 49

ABNORMALITIES IN WHITE MATTER STRUCTURE IN AUTISM SPECTRUM DISORDERS DETECTED BY DIFFUSION TENSOR IMAGING *Roger J. Jou[1], Sarah J. Paterson[1], Andrea P. Jackowski[2], Marcel Jackowski[1], Xenophon Papademetris[1], Nallakandi Rajeevan[1], Lawrence H. Staib[1], Robert T. Schultz[1]; [1]Yale University School of Medicine, [2]Federal University of São Paulo, Laboratório Interdiciplinar de Neuroimagem e Cognição* – Objective: The neurobiology of autism spectrum disorders (ASD) is currently unknown. This study tests the hypothesis that ASD are attributable to impaired connectivity between those cortical areas responsible for social cognition and language function. Methods: Diffusion tensor magnetic resonance imaging was performed in 20 males, ages 9 to 22 years: 10 with ASD and 10 typically developing controls (TDC). Subjects were group-matched according to age, handedness, and full-scale IQ. Fractional anisotropy (FA), a useful measure of the structural integrity of axonal tracts, was compared between groups using an integrated image analysis software suite. Volumes of interest (VOIs) were identified using predetermined probability and cluster thresholds. Diffusion tensor tractography was performed to confirm anatomic location of all VOIs. Results: Significantly reduced FA values were observed along portions of the following white matter structures: corpus callosum, cingulum, superior and inferior longitudinal fasciculi, and inferior fronto-occipital fasciculus. Significantly reduced FA values were also observed bilaterally in the white matter adjacent to the fusiform gyri. All findings survived after covarying for age, FSIQ, and TBV. Tractography yielded fiber bundles bearing strong resemblance to those major fiber tracts known to course through the identified VOIs. Conclusions: These data provide evidence for impaired corticocortical connectivity in ASD. Aberrant axonal connections between those cortical areas implicated in social cognition and language function may contribute to the impairments characteristic of ASD.

C 50

FMRI EVIDENCE THAT CHILDREN WITH ADHD RELY ON DIFFERENT NEURAL MECHANISMS FOR SUCCESSFUL MOTOR INHIBITION *Stacy Suskauer[1,2], Daniel Simmonds[1], Sunaina Fotedar[1], Joanna Blankner[3], James Pekar[1,2], Martha Denckla[1,2], Stewart Mostofsky[1,2]; [1]Kennedy Krieger Institute, [2]Johns Hopkins University School of Medicine, [3]University of Tennessee College of Medicine* – Objective: Deficient response inhibition is a hallmark of ADHD. The few prior fMRI studies of response inhibition in children with ADHD have used tasks with a range of additional cognitive demands. We used a simplified Go/No-go task with minimal cognitive demands to better identify differences in neural activation associated with response inhibition in ADHD. Methods: Twenty-five children with ADHD and twenty-five typically developing (control) children, 8-12 years old, completed a simple Go/No-go task incorporating a well-ingrained stimulus-response association (Green=Go, Red=No-go). fMRI data were acquired on a 1.5T Phillips scanner; analyses were completed using SPM2. For each subject, voxel-wise contrast maps were created for Go and No-go conditions; this was followed by random effects comparisons within and between the groups (ADHD and control). Results: The groups were matched for percent commission errors. In group contrast maps for No-go activation, children with ADHD showed greater activation in the right superior parietal lobe (BA40, BA7); control children showed greater activation in right angular gyrus (BA 39), right inferior parietal lobe (BA40), and left rostral supplemental motor area ("pre-SMA", BA6). Conclusions: The findings suggest that children with ADHD rely on different neural mechanisms for successful motor inhibition. Compared to typically developing children, children with ADHD demonstrate less activation in the pre-SMA, an area that is important for motor response selection, as well as differences in the pattern of activation within parietal regions important for integrating cues and motor actions into stimulus-response associations necessary to guide response inhibition.

C 51

THE INFLUENCE OF PRISM ADAPTATION ON EXOGENOUS AND ENDOGENOUS ORIENTING OF ATTENTION *Tanja Nijboer[1], Robert McIntosh[2], Gudrun Nys[1], Chris Dijkerman[1], David Milner[3]; [1]Utrecht University, [2]University of Edinburgh, [3]Durham University* – Prism adaptation has been shown to temporarily ameliorate the symptoms of unilateral neglect. The underlying mechanisms, however, are not fully understood or identified as yet. In this study, we further investigate the influence of prism adaptation on attentional orienting, by exploring the effect of prism adaptation on exogenous and endogenous orienting of attention, using a Posner Reaction Time task. In two patients, we found that prism adaptation does not seem to remediate exogenous orienting of attention, whereas it does improve endogenous orienting of attention. We therefore concluded that prism adaptation seems to improve compensatory processes or voluntary orienting of attention.

C 52

NORMALIZING EFFECT OF METHYLPHENIDATE ON WORKING MEMORY MAINTENANCE IN CHILDHOOD ADHD: A PHFMRI STUDY *Devon Shook[1], Colin Brady[1], Jen Foss-Feig[1], Philip Lee[1], Laura Kenealy[2], Chandan Vaidya[1]; [1]Georgetown University, [2]Children's National Medical Center* – Cognitive dysfunction in Attention Deficit Hyperactivity Disorder (ADHD) often involves reduced ability to maintain information in working memory. While stimulant medication (e.g., methylphenidate–MPH) improves working memory, the neural basis of that efficacy is unknown. ADHD children performed a Sternberg task (loads 1, 3, 5 letters) on and off their therapeutic MPH dose during fMRI; control children performed the same task without MPH. Overall accuracy was lower with increasing load and improved on-MPH in ADHD children. Efficacy of MPH and associated activation patterns differed for loads 3 and 5 (vs. load 1). For load 3, control children activated a left-lateralized network comprising inferior frontal (BA 45/47), superior parietal (BA 7) and posterior superior temporal (BA 22) regions. Off-MPH, ADHD children activated right superior temporal gyrus (BA 22) and hippocampus, and cuneus. MPH reduced activation in the cuneus and engaged bilateral anterior temporal (BA 34) and right cerebellar regions. Thus, MPH improved maintenance of a low load in working memory by engaging an atypical neural network. For load 5, controls activated bilateral inferior frontal (BA 45, 47), superior parietal (BA 7), and medial frontal (BA 6, 32) regions in addition to right cerebellum and left premotor cortex. While a subset of these regions were activated by ADHD children off-MPH (bilateral inferior and medial frontal), MPH increased involvement of the same neural network as that in controls. Thus, MPH improved maintenance of a high load in working memory by engaging a typically activated neural network.

C 53

ENHANCED PICTURE NAMING IN AUTISM *Matthew Walenski[1], Stewart Mostofsky[2,3], Jennifer Gidley-Larson, Michael Ullman[1]; [1]Georgetown University, [2]Kennedy Krieger Institute, [3]Johns Hopkins University School of Medicine* – 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 lexical processing in autism with a picture-naming task, in which subjects named pictures of objects, whose names varied in their frequency of occurrence in English. We tested native English-speaking high-functioning boys with autism and typically-developing control boys and control girls. Although no group differences in response time were found for higher-frequency names, the groups differed significantly on lower-frequency names, where the boys with autism responded faster than control boys, but not faster than control girls, who were themselves faster than the control boys. These response-time differences cannot be explained by a speed-accuracy tradeoff, as no group differences were found in accuracy. They are also not explained by potentially confounding variables such as word-length, item-order, age, education, and IQ, among others. The results may indicate enhancements in high-functioning autism of at least certain aspects of declarative memory, which underlies lexical and conceptual knowledge. The sex difference between the typically-developing groups is consistent with a female advantage at lexical and declarative memory. The lack of a difference between the boys with autism and typically-developing girls is therefore also consistent with enhanced memory in autism, relative to typically-developing boys. The findings extend to language the view that the "disorder" of autism may constitute not simply a set of deficits, but rather a set of relative strengths and weaknesses within and across domains. Additional implications will be discussed.

C 54

APHASIA AND LIMB APRAXIA ARE NOT DUE TO A DAMAGE TO A UNIQUE MECHANISM: EVIDENCE FROM A STUDY WITH LEFT-BRAIN DAMAGED PATIENTS. *Raffaella Ida Rumiati[1], Gioia A.L. Negri[1], Nicola Canessa[1,2], Paola Mengotti[3], Alessia Tessari[4,1], Alberta Lunardelli[5]; [1]SISSA International School for Advanced Studies, Trieste, [2]CRESA, San Raffaele Scientific Institute, Milan, [3]University of Trieste, [4]University of Bologna, [5]Azienda Ospedaliera Ospedali Riuniti di Trieste* – Patients with left-brain damage often show both apraxia and aphasia. Whether the co-occurrence of the two deficits depends on damage to a single system that processes both action and language, or whether these two functions are independent, but due to the contiguity of the areas sustaining, a lesion in the left-hemisphere often impair both, is still under debate. Here we present the performance of 52 left brain-damaged patients on tests assessing language (comprehension) and praxis (imitation and tool use). Overall, comprehension deficits correlated with Ideomotor Apraxia (IMA), (Spearman's rho: p<.05) but not with Ideational Apraxia (IA). However, single-cases analyses showed that apraxia and aphasia double-dissociated: 12 patients showed IMA without aphasia, whereas 6 patients showed the opposite pattern; seven patients had IA without aphasia, whereas 17 aphasic patients did not show IA. Lesion analysis of the double-dissociating cases showed that both Aphasia and IMA, and Aphasia and IA, are associated with damage to middle and superior-temporal gyri. Aphasia and IMA also show common damage in the Putamen. Relative to either IMA or IA, Aphasia is specifically associated with lesions of the superior-temporal-gyrus posteriorly (Wernicke area, BA 22). Relative to aphasia, IMA and IA are associated with lesions in the anterior and posterior cortex, respectively. These data support a separation of action and language systems.

C 55

DISSOCIABLE COMPONENTS OF MOTOR SWITCHING IN CHILDREN WITH ADHD *Philip Lee[1], Jennifer Foss-Feig[1], Leah Lozier[1], James Herrera[2], Devon Shook[1], Elizabeth Poggi[1], Michael Billington[1], Laura Kenealy[2], Chandan Vaidya[1]; [1]Georgetown University, [2]Children's National Medical Center* – Attention-Deficit/Hyperactivity Disorder (ADHD) is a developmental disorder marked by dysfunction of prefrontal-striatal-cerebellar circuitry important for executive control. An important operation of executive control is switching flexibly between multiple task sets. We used event-related fMRI in 8-12 year old children with ADHD and age and IQ matched controls to examine whether the neural basis of task set switching was atypical in ADHD. Subjects responded to targets (circles, squares) according to a cue indicating the mapping of responses to hands (e.g., right – circles; left - squares). "Stay" cues instructed subjects to continue the same mapping whereas "Switch" cues instructed reversing of the mapping (e.g., left – circles; right - squares). Comparison of cue trials (Switch vs. Stay) reflected activation associated with planning the new response set whereas comparison of response trials (first response trial after Switch vs. Stay cue) reflected activation associated with executing the new set. Response accuracy and speed were worse for Switch relative to Stay trials (switch cost) for both groups. However, activation patterns differed between groups – For cue trials, both groups recruited dorsolateral prefrontal cortex (BA9/46) but differed medially such that controls recruited anterior cingulate (BA32) whereas children with ADHD recruited anterior regions (BA10). For response trials, children with ADHD showed greater recruitment of premotor (BA8), superior parietal (BA7/40) and lateral cerebellar regions during execution of the motor switch. This suggests that children with ADHD may require greater recruitment of both regions associated with maintenance of the rule set and regions associated with planning the motor response.

Higher Level Cognition: Executive Functions

C 56

THE NEURAL CONSEQUENCES OF STEREOTYPES: AN FMRI INVESTIGATION OF THE EFFECTS OF STEREOTYPE THREAT ON COGNITION *Anne Krendl[1], Jennifer Richeson[2], William Kelley[1], Todd Heatherton[1]; [1]DartmouthCollege, [2]Northwestern University* – Research has shown that being the target of a stereotype can have a deleterious effect on academic performance. For instance, recently emerging research on stereotype threat suggests that simply reminding a group (e.g., women) of a common stereotype (e.g., gender differences in math aptitude) can negatively impact that group's performance on relevant tasks (e.g., difficult math problems). The present study used functional magnetic resonance imaging (fMRI) to identify the underlying neural mechanisms that give rise to this effect. Twenty women were imaged for the present study, with half in the "threatened" condition, and the other half in the control condition. In both conditions, women were asked to complete 50 difficult math problems while being imaged. Halfway through the scan, the women in the threatened condition completed an implicit task to activate the math-gender stereotype. The women then completed 50 additional difficult math problems. Women in the control condition performed the same tasks, but were given a neutral implicit task followed by the 50 difficult math problems. The neuroimaging results underwent a state-item analysis to evaluate state (extended) and transient (brief) neural effects over the duration of the task. Analyses revealed that the stereotype threat effect was related to global state effects in the anterior cingulate cortex and left inferior prefrontal cortex, regions that have been implicated in working memory, inhibition, and complex processing. Transient effects were observed in the dorsolateral prefrontal cortex, a region commonly engaged during working memory and cognition depletion tasks.

C 57

FMRI AND ERP ANALYSIS OF HYPOTHESIS TESTING WHEN SWITCHING BETWEEN INTRADIMENSIONAL AND EXTRADIMENSIONAL RULES *Sarah Donohue[1], Santani Teng[2], Guido Band[3], S. A. Rombouts[3], Eveline Crone[3]; [1]Duke University, [2]UC Davis, [3]Leiden University* – A crucial element when testing hypotheses about rules for behavior is the use of performance feedback. Neuroimaging studies have reported that medial prefrontal cortex (PFC) is important for signaling the need for behavioral changes (Holroyd et al., 2005), but these results are not conclusive (Nieuwenhuis et al., 2005). In this study, we used fMRI and EEG in order to test the role of medial PFC in hypothesis testing using a modified intra-dimensional/extra-dimensional rule shift task. Eighteen adults were asked to infer rules about color or shape on the basis of negative and positive feedback in sets of 2 trials. Half of the trials involved color-to-color or shape-to-shape trials (intradimensional switches) and the other half involved color-to-shape or shape-to-color trials (extradimensional switches). All participants performed the task in two sessions: an fMRI and an EEG session. Extradimensional trials were associated with reduced accuracy relative to intradimensional trials. Negative feedback resulted in increased activation in medial PFC and dorsolateral (DL)PFC, for both intradimensional and extradimensional rules. Additionally, around 250 ms following negative performance feedback participants showed a feedback-related negative scalp potential, which was larger for extradimensional trials. These results show that medial PFC and DL PFC have a monitoring function in hypothesis testing.

C 58

DISSOCIABLE MECHANISMS OF RESPONSE INHIBITION REVEALED BY THE STOP-SIGNAL PARADIGM *Matthew Hughes[1], Bill Budd[1,2], Ross Fulham[1,2], Johanna Badcock[3,4], Patricia Michie[1,2]; [1]University of Newcastle, Callaghan, NSW, AUS, Neuroscience Institute of Schizophrenia and Allied Disorders (NISAD), Sydney, NSW, AUS, [2]James Fletcher Hospital, Newcastle, NSW, AUS, [3]University of Western Australia, Perth, WA, AUS,* *Neuroscience Institute of Schizophrenia and Allied Disorders (NISAD), Sydney, NSW, AUS, [4]Graylands Hospital, Perth, WA, AUS* – Response inhibition refers to the ability to suppress prepotent and on-going actions, and is one function of the executive system. Neuroanatomical loci commonly reported as having roles in response inhibition include middle (MFC) and inferior (IFC) frontal corticies, pre-SMA, inferior parietal lobe (IPL), ACC and premotor cortex (Aron et al., 2003; Aron and Poldrack, 2006; Mostofsky et al., 2003; de Zubicaray et al., 2000). The stop-signal paradigm (SSP) is often used to investigate response inhibition as inhibition difficulty is easily manipulated, and an estimate of the speed of response inhibition processes (stop-signal reaction time, SSRT; Logan, 1994) is afforded. Recent evidence using the SSP suggests that a network including right hemispheric IFC and subthalamic nucleus (STN) constitute a hyper-direct pathway that is recruited when fast response inhibition is necessary (Aron et al., 2006; Nambu et al., 2002). In the current study, we used a stop-signal variant where each participant was given equal time to inhibit responses over a range of stop-signal delays. This meant that participants with faster SSRTs should inhibit more often than participants with slower SSRTs; SSRT predicted the probability of inhibition ($R2$ = .86). Use of this variant enabled an analysis of areas generically recruited for response inhibition (one-sample t-test of inhibition contrast images), and areas recruited when inhibition is increasingly difficult (areas predicted by SSRT in inhibition contrast images). The network generically recruited for response inhibition included right MFC and right IPL. Faster inhibition required recruitment of the rIFC/insula - STN network.

C 59

THE ROLE OF EXPECTANCIES IN ERROR-DRIVEN LEARNING: AN ERP STUDY *Nicola K. Ferdinand, Anja Weiten, Axel Mecklinger, Jutta Kray; Saarland University* – Error-monitoring plays an important role in knowledge acquisition, as it allows error detection and the adaptation of behavior to varying situational demands. We examined whether the detection of committed and perceived errors (deviant events in the otherwise repeating sequence) and their role for learning require an intention to learn, or can occur without awareness. To do so we compared event-related potentials (ERPs) in a sequence-learning task under explicit and implicit learning conditions. We obtained an error-related negativity (ERN/Ne) to incorrect responses irrespective of learning condition. Deviant stimuli elicited a negativity (N2b) approximately 200ms after stimulus onset in both learning conditions. Interestingly, this component was related to the gradual development of knowledge about the sequence structure. In a model recently proposed by Holroyd and Coles (2002) the ERN/Ne was related to a reduction of reinforcement learning signals from the dopamine system in situations in which an event is worse than expected. Our results suggest that the N2b might be generated by a similar mechanism in response to perceived errors. With growing knowledge about the sequence structure expectations about the next stimulus occur and a deviant stimulus signals that the event is worse than expected. By this the N2b serves as internal feedback signaling a perceived error and plays an important role for error-induced learning. To explore age-related changes of error-induced learning, we conducted an additional study with healthy elderly subjects. Since the dopamine system is impaired in the elderly this should be visible in reduced ERN/Ne and N2b components.

C 60

THE NEURAL EFFECT OF OPERATION-RESPONSE CONFIGURATION ON DUAL-TASK PERFORMANCE: AN EVENT-RELATED FMRI STUDY *Bo-Cheng Kuo, Yei-Yu Yeh, Keng-Chen Liang, Jyh-Horng Chen; National Taiwan University, Taipei, Taiwan* – Previous fMRI studies manipulated stimulus-response modality compatibility and showed that the right inferior frontal sulcus (IFS) is involved in resolving process interference in dual-task coordination. Yet, no study investigates the neural mechanisms of the operation-response configuration in the dual-task context. The present study aims to investigate the role of the IFS in coordinating dual-task performance with different operation-response task configurations. Using an event-related fMRI, task configuration between operations (similar and dissimilar) and responses (compatible and incompatible) were manipulated in a dual arithmetic calculation paradigm. On each trial, the first numeric pair was the base for arithmetic calculation on the following pair of digits. When operations were similar or responses were compatible, a task set could be configured using one task rule. When operations were dissimilar or responses were incompatible, no task set could be configured as the task representation differed between the two tasks. Our previous results showed that the IFS activation was enhanced when reconfiguration was required between operation and response processes. When no reconfiguration was required, activation in the middle frontal gyrus and superior parietal lobule increased.

C 61

THE IMPACT OF GENOTYPES IN THE DOPAMINERGIC SYSTEM ON EXECUTIVE FUNCTIONS – BEHAVIORAL AND NEUROPHYSIOLOGICAL EVIDENCE *Ulrike M. Krämer[1], Antoni Rodriguez-Fornells[2,3], Estela Càmara[1], Toni Cunillera[3], Josep Marco-Pallarés[1], David Cucurell[3], Anna Mestres-Missé[3], Wido Nager[4], Jürn Möller[1], Rebecca Schüle-Freyer[5], Ludger Schöls[5], Thomas F. Münte[1]; [1]Institut für Psychologie II, Universität Magdeburg, [2]Institució Catalana de Recerca i Estudis Avançats (ICREA), [3]Universitat de Barcelona, [4]Medizinische Hochschule Hannover, [5]Hertie-Institut für Klinische Hirnforschung, Universität Tübingen* – Executive functions enable humans to dynamically adapt their behavior to an ever changing and demanding environment. However, the executive system underlies considerable interindividual variation. Several lines of research suggest that the dopaminergic system is of special importance for the regulation of executive control. As the function of the dopaminergic system is partly determined by certain genetic polymorphisms, the question arises to which degree interindividual differences in executive processes can be explained by genetic variance. We therefore screened a sample of 658 subjects for polymorphisms of four dopaminergic genes (DRD4, DAT, COMT, MAO-A). The participants additionally underwent a neuropsychological test battery measuring working memory processes, attentional, control and inhibition aspects of executive functions. We found significant differences in behavioral markers ("endophenotypes") between the groups, clarifying the relation of functions in the executive system and the different dopaminergic polymorphisms. Smaller subgroups were formed on the basis of the presence of specific alleles (COMT Val108Met and DRD4 SNP 521). These subjects took part in event related potential experiments assessing self-monitoring of behavior (error detection and correction) observed with the error-related negativity and the lateralized readiness potential, the ability to inhibit an initiated motor action by studying the N2-stop component of the ERP in a stop-signal task as well as the dynamics of attentional allocation in an orienting task using novel auditory stimuli. Again, an influence of genetic factors was found for specific ERP components suggesting a specific modulating effect of these polymorphisms on distinct functions of the executive system.

C 62

POST-ERROR PERFORMANCE ADAPTATION: AN EVENT-RELATED FMRI DESIGN COMPARING ERROR-RELATED NEURAL ACTIVITY FOR ADAPTIVE AND MALADAPTIVE COGNITIVE CONTROL. *Robert Hester[1], Natalie Barre[1], Jason B. Mattingley[1], John J. Foxe[2], Hugh Garavan[3]; [1]University of Melbourne, Melbourne, Australia, [2]Nathan S. Kline Institute for Psychiatric Research, Orangeburg, New York, USA, [3]Trinity College Institute of Neuroscience, Trinity College, Dublin, Ireland* – The magnitude of anterior cingulate cortex (ACC) activity has been shown to relate to adaptive post-error changes in response behaviour, ostensibly improvement in response speed that suggest heightened cognitive control, or generalised slowing of responding that appears to reflect more cautious post-error behaviour. These studies have focused on immediate changes in response behaviour, typically the trial immediately following an error. Here, we examine the neural mechanisms underlying sustained adaptive changes in task performance that avoided repetition of errors. We administered a Go/No-go response inhibition task during fMRI data collection. In the 'adapt' condition, participants learned that no-go inhibition performance influenced the trial sequence, whereby commission errors were followed 1-7 trials later by another No-go trial, but correct inhibition ensured the next no-go was not for 10-15 trials. A second control condition had a similar distribution of go and no-go trials, but which did not vary as a function of performance. Behavioural data (n=15) indicated significantly higher levels of post-error slowing and response inhibition during the adapt condition, as-well-as fewer consecutive commission errors. Preliminary fMRI analyses suggested error-related ACC activity predicted increases in cognitive control, with higher levels of activity seen during errors that preceded elevated post-error slowing and successful inhibition on the next no-go trial. These data suggest that error-related ACC activity may influence sustained adaptive changes in behaviour. Our continuing analysis investigates how the magnitude of error-related activity in regions such as the ACC relates to post-error implementation of cognitive control, via cortical regions such as the prefrontal cortex.

C 63

THE EFFECTIVE CONNECTIVITY OF ANTERIOR CINGULATE CORTEX DURING CONFLICT *Jin Fan[1], Patrick[1], Kevin Guise[1], John Fossella[1], Michael Posner[2]; [1]Mount Sinai School of Medicine, [2]University of Oregon* – Although the functional activation of the anterior cingulate cortex (ACC) related to conflict resolution has been studied extensively, the effective connectivity of the ACC with other brain regions during conditions of conflict is still unclear. In this study, we examined the physiological response of brain regions in terms of an interaction between the cognitive process of conflict resolution and activity in the ACC. Participants performed the attentional network test (ANT) while they were scanned using functional magnetic resonance imaging (fMRI). Conflict resolution was tested using flanker interference with target response. We found effective connectivity of caudal ACC with other subdivisions of ACC (e.g., area 24d) and other brain regions, such as left superior frontal gyrus, right middle frontal gyrus, bilateral precentral gyrus, left postcentral gyrus, right cuneus, and caudate nucleus above and beyond the main effect of conflict and ACC baseline activity. These findings suggest that conflict resolution significantly modulates the effective contribution of caudal ACC to the neuronal activity of other subdivisions of the cingulate cortex, as well as other cortical regions such as lateral prefrontal, primary and supplementary motor areas.

C 64

NEURAL IMPLEMENTATION OF BEHAVIORAL ADJUSTMENTS *Joseph King, Markus Ulsperger, D. Yves von Cramon; Max Planck Institute for Human Cognitive and Brain Sciences* – Effective adaptation of behavior to ever-changing environmental demands is dependent on fine-tuning of perceptual processes to goal-relevant aspects while attention to less relevant features is suppressed. Current theory of how the human brain achieves this end proposes that the posterior medial frontal cortex (pMFC) is not only intrinsically involved in monitoring performance by means of detecting response conflicts, errors and unfavorable/unexpected action outcomes, but moreover, in light of such circumstances, in signaling the lateral prefrontal cortex (LPFC) to exert top-down attentional bias on relevant posterior sensory inputs. By employing a speeded Simon task comprised of face targets in this fMRI study, we investigated the implementation of post-performance monitoring behavioral adjustments in the fusiform face area (FFA) of healthy individuals as defined by a localizer task. Main expectations were twofold: (1) conflict adaptation and post-error slowing would be associated with phasic FFA activation (2) blockwise stimulus-response compatibility frequency manipulations would be associated with tonic modulation of FFA activity. Whole brain contrasts of pre-response conflict level and response accuracy revealing partially overlapping context dependent activation patterns in the pMFC were confirmed by region-of-interest (ROI) signal change analyses. Further analyses found FFA activation patterns associated with component performance monitoring and cognitive control mechanisms to be dependent on experimental block context. The current study extends recent findings of pMFC involvement in a performance monitoring network engaging brain sensory processing centers in the subservence of action outcome optimization. However, electrophysiological data is needed to fully answer the question of how behavioral adjustments are neurally implemented.

C 65

ELECTROPHYSIOLOGICAL ACTIVITY IN THE HUMAN NUCLEUS ACCUMBENS DURING REWARD-GUIDED LEARNING *Michael Cohen[1], Nikolai Axmacher[2], Roshan Cools[3], Doris Lenartz[4], Christian Elger[2], Volker Sturm[4], Thomas Schlaepfer[2]; [1]UC Davis, [2]University of Bonn, Germany, [3]University of Cambridge, [4]University of Cologne, Germany* – The nucleus accumbens acts as a "gateway" between motivation and action: It receives inputs from limbic structures involved in emotion (i.e., amygdala and orbitofrontal cortex) and projects to structures involved in action selection and behavioral control (i.e., basal ganglia output structures). Studying the human nucleus accumbens is difficult because of limitations in spatial and temporal resolution of neuroimaging techniques such as PET and fMRI. To overcome these limitations, we recorded local field potentials from the nucleus accumbens of patients undergoing Deep Brain Stimulation for treatment of major depression. Electrodes were implanted into the nucleus accumbens, and before stimulation began, externalized leads were used to record electrical potentials. We recorded these potentials while patients engaged in a reward-based reversal learning task, in which patients could maximize their rewards by learning to adapt their behavior to changes in reinforcement contingencies. Behaviorally, patients quickly adapted their decision-making to maximize rewards, demonstrating that reinforcement learning circuits remained intact. ERPs from around 300-400 ms following feedback differentiated wins from losses, and predicted whether patients would choose the same or the opposite decision option on the following trial as on the current trial. Frequency decomposition revealed enhanced power in the gamma frequency band from 100 – 400 ms following feedback onset, and increased alpha band activity following wins compared to losses. The spatial and temporal resolution of these electrophysiological recordings provide novel insights into the function of the nucleus accumbens' role in using reinforcement information to guide behavior.

C 66

PERCEPTUAL SIMILARITY OF GAIN AND LOSS STIMULI AFFECTS THE FEEDBACK-RELATED NEGATIVITY *Yanni Liu, William Gehring; Univeristy of Michigan* – A medial-frontal negativity (MFN) is elicited by error- and loss-related feedback in simple gambling and decision tasks. Investigators have assumed the perceptual properties of the feedback stimuli are unimportant in determining these feedback effects. In the present study we tested this assumption. We recorded ERP data from 12 subjects who chose one of four doors displayed on the computer and received letter feedback indicating a monetary gain or loss. The perceptual similarity of feedback was manipulated: in four blocks (a.k.a. SIM blocks), E(/F) and F(/E) denoted gain and loss respectively; in the other four (a.k.a. DIS blocks), S(/T) and T(/S) denoted gain and loss. Letter feedback was presented as classical flanker stimuli: half were congruent, in which five letters were identical (e.g., EEEEE); the other half were incongruent, in which the center letter was different from peripheral ones (e.g., TTSTT). Rewarding information was only conveyed by the center letter. Loss feedback elicited a larger MFN than gain feedback. However, the interaction between block (SIM/DIS) and reward (gain/loss) was significant, revealing a larger MFN effect in DIS compared to SIM blocks, which indicated that the perceptual similarity of gain and loss feedback contributes to the MFN effect. We also found a significant interaction between congruency and reward: when the feedback was a gain rather than a loss, the incongruent feedback elicited a larger negativity than did congruent feedback. The results suggest that theories assuming that the feedback-related MFN is driven only by the reward properties of the feedback must be modified.

C 67

STRIATO-HIPPOCAMPAL INVOLVEMENT IN COGNITIVE SET SHIFTING *Steven Graham; National University of Singapore* – Using event-related fMRI, this study explored the interaction of caudate and hippocampal regions during performance of a cognitive set shifting task. Activation differences were interrogated at each time-point of the BOLD signal in an event-related fMRI experiment. Different temporal profiles of activation were seen in multiple brain regions including prefrontal cortex (PFC), parietal lobes, basal ganglia, thalamus and hippocampi. In particular, quite different activation profiles were observed in the caudate nuclei and hippocampi. Whereas caudate nuclei were involved in the early parts of cognitive set shifting (learning of the new cognitive set), the hippocampus was seen to deactivate during early stages of set shifting. Caudate activation may reflect the need to rapidly form a response strategy under time-pressure. In contrast, hippocampal deactivation may reflect inhibition of recently formed pre-potent stimulus-response associations which following rule change would no longer be appropriate. Reciprocal striato-hippocampal relationships have been noted elsewhere and the interaction of complementary learning systems that may underlie cognitive set-shifting performance is discussed.

C 68

ERROR-RELATED BRAIN POTENTIALS TO PERCEIVED AND UNPERCEIVED ERRORS IN A PERCEPTUAL DECISION MAKING TASK. *Tanja Endrass, Katja Schwitzkowski, Christian Kaufmann, Norbert Kathmann; Humboldt-University Berlin, Germany* – Studies on error processing identified two event-related brain potential (ERP) components associated with the execution of incorrect actions, the error related negativity (ERN or Ne) and the error positivity (Pe). Previous studies compared aware and unaware antisaccade errors: Error awareness did not affect the ERN amplitude, but larger Pe amplitudes were reported for aware than for unaware errors. The primary goal of the present experiment was to extend the findings from oculomotor system reactions to manual motor system reactions. Therefore, we designed a visual discrimination task with three difficulty levels to examine effects of decision uncertainty. In addition, participants were asked to indicate whether their response was correct or incorrect. This allowed us to compare aware and unaware correct and incorrect reactions. After incorrect reactions the ERN was reduced in our study with higher task difficulty. Interestingly, whereas the ERN did not vary with error awareness, a significantly reduced Pe amplitude was obtained for unaware compared with aware errors. Results for correct reactions indicated a substantial correct-related negativity (CRN) that did neither differ with task difficulty nor with awareness. The present results provide further support to the view that the ERN emerges independently from subjective error awareness, as an ERN was observed even though participants thought their manual response was correct. In contrast, the Pe was strongly associated with subjective error perception. Regarding the CRN and ERN amplitudes, we found only the latter to be sensitive to trial-to-trial variation of task difficulty.

C 69

FMRI INVESTIGATIONS OF TASK PREPARATION PROCESSES IN THE FACE OF CONFLICT: SELECTION VS. INTERFERENCE CONTROL *Franziska M. Korb, Marcel Brass, D. Yves von Cramon; Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – Adaptive behaviour requires the efficient filtering of goal-relevant from goal-irrelevant environmental information. During task preparation, the brain must select which aspects of the environment signalling diverse behavioural options will lead to desired action outcomes. Few neurophysiological studies of task preparation processes have accounted for how ambiguity inherent in natural situations influences the selection of task-relevant features. The current fMRI study explored the Stroop-like effect of dominant albeit irrelevant features of a cue indicating an upcoming task by employing a task switching paradigm in which cue congruency was manipulated. Two dimensional cues were comprised of dominantly and subordinately represented features. While the latter were relevant for task goals, the former included verbal information that was related either to the task at hand (congruent condition), to the other possible task (incongruent condition), or to neither of the two possible tasks (neutral condition). Thus, the design enabled us to reveal brain regions involved in the selection of task-relevant information by contrasting activation patterns elicited from the incongruent and congruent conditions. As hypothesized, greater activity in the posterior inferior frontal sulcus (pIFS) and the intraparietal sulcus (IPS) under the incongruent condition reflected the behavioral interference effect incited by the equivocal cue. However, brain regions independently involved in the selection of task-relevant cue information from that of the inhibition of interfering task-irrelevant cue information were not clearly dissociated. To address this question, a follow-up experiment designed to disentangle these processes was employed.

C 70

DECISION UNDER RISK AND AMBIGUITY – BEHAVIOR AND NEURAL CORRELATES *Ifat Levy[1], Jason Snell[1], Aldo Rustichini[2], Paul W. Glimcher[1]; [1]New York University, [2]University of Minnesota* – For most people a sure bet of a $100 is preferable to a 50% chance of winning $120, which is in turn preferable to an ambiguous chance of winning $500, even though the average chance of winning remains 50% across many ambiguous trials. These preferences are the result of risk and ambiguity aversion respectively. Both have been extensively studied, but it is not known whether each stems from a unique process or whether they are two manifestations of a single process. Investigating brain regions that are involved in their processing may help answering this question. We characterized decision under risk and ambiguity behaviorally and examined their neural basis using fMRI. In each trial of the ambiguity experiment subjects chose between a constant non-ambiguous choice (50% chance of winning $5) and an ambiguous choice, which varied in both ambiguity and reward levels. Both choices were represented by urns containing colored chips. Ambiguity level was manipulated by occluding portions of the urn (25%, 50%, 75%). Reward levels were indicated by a number next to the urn. Six trials were randomly selected at the end and the choices made by the subject in these trials were played for real money. To make subjects indifferent between the ambiguous and non-ambiguous choices, the 25% ambiguity payoff had to be 90% higher than the non-ambiguous payoff. For 50% and 75% ambiguity this payoff had to be 450% and 800% higher respectively. fMRI results implicate a network of frontal and parietal areas in the processing of ambiguity.

C 71

MECHANISMS OF ACTION SELECTION AND INHIBITION IN THE BASAL GANGLIA: CONVERGING COMPUTATIONAL AND EXPERIMENTAL EVIDENCE *Michael Frank[1], Johan Samanta[2], Ahmed Moustafa[1], Adam Aron[3], Scott Sherman[1]; [1]University of Arizona, [2]Muhammad Ali Parkinson Research Center, Barrow Neurological Institute, [3]University of California at San Diego* – The basal ganglia (BG) interact with frontal cortex to facilitate adaptive actions while suppressing competing actions. Neural network simulations have been particularly useful for investigating the interactive dynamics of this system, and have led to novel testable predictions. Here we focus on the role of the subthalamic nucleus (STN) within the overall BG system in action selection. Our model suggests that the STN provides a "Hold your Horses" signal that prevents premature responding during difficult decisions. This STN signal is dynamically modulated by the degree of frontal cortical decision conflict, providing an adaptive mechanism for modulating decision thresholds. We tested model predictions in Parkinson's patients on and off STN deep brain stimulation. As predicted, patients on DBS failed to modulate their reaction times by the degree of decision conflict. This same effect was seen across multiple measures. We also extended the model to include inferior frontal cortex, and showed how the same functional circuitry can be recruited for outright response inhibition in the context of a stop-signal task, in a manner consistent with more abstract mathematical horse race models. Finally, neuroimaging data corroborates model predictions regarding the roles of the STN and frontal areas in both conflict-induced slowing and response inhibition.

C 72

THE ROLE OF PREFRONTAL INHIBITORY ATTENTIONAL CONTROL DURING SEMANTIC AMBIGUITY RESOLUTION: ERP EVIDENCE FROM A NOVEL RESPONSE-FREE PARADIGM *Klaus Hoenig, Susanne Hellwig-Brida, Markus Kiefer; University of Ulm, Germany* – Semantic ambiguity is pervasive in natural languages and constitutes an omnipresent challenge to the human brain. A central mechanism in ambiguity resolution is the inhibition of contextually inappropriate homonym meanings. To date, the neurocognitive correlates of this mechanism have remained largely unexplored. The available behavioral evidence is largely indirect, i.e. inhibitory control is frequently inferred from the amount of processing interference to subsequent target words. The current ERP study is a novel experimental approach that allows for relating behavioral target interference from residual activation of an irrelevant homonym meaning to differences in brain activation pertaining to disambiguation of a prior homonymy without requiring any response to the homonym. Our task asked healthy subjects (N = 32) 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 significantly slower and less accurate compared to unambiguous ones reflecting response costs due to interference from the irrelevant meaning of the preceding homonym. Analysis of the ERP time-courses to the second word (ambiguous vs. unambiguous) revealed a substantial difference between high- and low-interference subjects, with the latter exhibiting a much more pronounced positivity to ambiguous trials at left prefrontal electrode sites starting at 300 ms following word onset. These findings suggest that the increased prefrontal activity for low-interference subjects reflects effective inhibitory attentional control over contextually inappropriate homonym meanings in service of the disambiguation of lexico-semantic ambiguity.

C 73

EFFECTS OF CONFLICT AND GRAMMATICAL CLASS ON LIFG ACTIVATION DURING ACTION AND OBJECT NAMING *Hannah Snyder[1], Benjamin Greene[2], Sharon Thompson-Schill[2]; [1]University of Colorado, [2]University of Pennsylvania* – A current debate in cognitive neuroscience concerns domain-general versus domain-specific processing in prefrontal cortex. One domain-specific hypothesis has posited a role for the left inferior frontal gyrus (LIFG) in action naming. Previous research has suggested that patients with prefrontal damage are selectively impaired in verb, as compared to noun, picture naming (e.g. Tranel, Damasio & Damasio, 2001). Likewise, imaging studies have reported greater prefrontal activation for processing verbs than nouns (e.g. Etard et al., 2000). However, others have failed to find a prefrontal specialization for verbs (e.g. Hillis, Tuffiash, Wityk & Barker, 2002). An alternative account that reconciles these divergent findings is that LIFG plays a domain-general role in cognitive control. Critically, studies that found a verb advantage in prefrontal cortex used stimuli for action and object naming which differed in response conflict. While action pictures often depict agents and objects, object pictures generally included only single objects. In the current study, participants underwent event-related fMRI while naming high- and low-conflict pictures as nouns and verbs. We show that controlling for cognitive control demands in picture naming stimuli eliminates the putative verb advantage in prefrontal cortex. Our results indicate that LIFG does not respond more to action naming compared to object naming, but instead to the level of conflict within stimuli. The findings of this study support the hypothesis that LIFG functions in multiple domains to resolve competition between conflicting representations of a stimulus.

C 74

DUAL-TASK-RELATED MODULATION OF ACTIVITY IN POSTERIOR TASK-RELEVANT BRAIN REGIONS *Christine Stelzel[1], Stefanie Kehrer[1,2], Stephan A. Brandt[2]; Torsten Schubert[1]; [1]Humboldt-University Berlin, [2]Charité Berlin* – Previous dual-task neuroimaging studies indicate a crucial role the lateral Prefrontal Cortex in the simultaneous processing of two tasks. However, little is known about how neural activity in posterior task-relevant regions is regulated during interference processing in dual tasks. We hypothesised that activity in regions relevant for Task 1 processing depends (a) on the task relevance of a second stimulus, i.e. the need to perform an action on that stimulus, and (b) on the degree of temporal overlap between the stimuli of two tasks. To investigate this, we manipulated both factors in a mixed blocked and event-related fMRI study. In each trial, participants performed a manual choice reaction on male and female faces as Task 1. In half of the blocks, participants were instructed to ignore a second visual number stimulus (ignore-S2) presented at different stimulus onset asynchronies (SOA). In the other blocks, participants performed a manual choice reaction task on the number stimuli as well (respond-S2). Task-relevant regions for face processing were determined with independent localizer tasks. The behavioral results indicated RT2-slowing with decreasing SOA - the effect of the Psychological Refractory Period. RT1 remained fairly constant across SOA but was significantly slowed in the respond-S2 condition compared to the ignore-S2 condition. FMRI data: Activity in the Fusiform Face Area was modulated by the SOA. Importantly, this SOA-effect depended on S2 relevance with stronger activity changes for respond-S2 compared to ignore-S2 trials. This suggests that modulation of posterior brain regions serves the protection of sensory processes from dual-task interference.

C 75

EFFECTS OF EMOTIONAL DISTRACTION ON MAINTENANCE OF RULE INFORMATION *Sarah Hart[1], Aysenil Belger[1,2]; [1]University of North Carolina at Chapel Hill, [2]Duke-UNC Brain Imaging and Analysis Center* – Distracting emotional information has been found to divert attentional resources away from active maintenance processes during working memory tasks. However, the effects of emotional distraction on maintenance of abstract rule information have remained unexplored. The current study aimed to assess the effects of emotional distraction on prefrontal activation patterns during active rule maintenance with fMRI. We presented 15 healthy participants with either a blue or yellow colored cue, which indicated the specific rule to be followed for that trial. Following a delay period, participants were presented with circles and triangles, to which they responded according to the currently relevant rule. During the delay period when the rules were being actively maintained, task-irrelevant emotional and neutral pictures were presented. The results indicated that emotional distraction led to relatively greater activation in the amygdala, orbitofrontal cortex, anterior cingulate, and ventrolateral prefrontal cortex (vlPFC). Neutral distraction led to relatively greater activation in the dorsolateral prefrontal cortex (dlPFC) and posterior parietal cortex. Activation in the dlPFC indicated sustained delay-period activation during neutral distraction, but it was reduced to below baseline levels during emotional distraction. In contrast, although clusters of emotion-related activation were found in the vlPFC, the majority of vlPFC activation showed sustained activation across the delay regardless of distracter type. The results suggest that emotional interference may disrupt executive processing in the dlPFC during rule maintenance. The vlPFC, in contrast, may generally support active maintenance of rules in the face of distraction, with some areas specifically supporting resistance from emotional interference.

C 76

PREDICTION OF INTELLIGENCE FROM BRAIN STRUCTURE AND FUNCTION *Jeremy Gray[1], Yu Yong Choi[2], Noah Shamosh[1], Colin DeYoung[1], Sunhee Cho[2], Kyungjin Kim[2], Kun Ho Lee[2]; [1]Yale University, [2]Seoul National University* – How well can individual differences in complex psychological functions be predicted from the structure and function of the human brain, as assessed with magnetic resonance (MR) images? Intelligence provides an interesting test case because suggestive correlations are well-established—notably, of intelligence with brain volume, regional structure, and activity within circumscribed regions. To our knowledge, the prediction of intelligence from multiple MR-based measures simultaneously has not been attempted. More importantly, to avoid conceptual circularity, a prediction model must be tested in a sample that is statistically independent of the sample used to specify the model. We identified regions in which gray matter thickness was correlated with IQ (WAIS full scale; n = 120 healthy Koreans, age 18-27), and regions in which activation during a reasoning task was correlated with IQ (n = 61). In an independent group of subjects (n=48), IQ was predictable to an impressive degree (r = .69 with no free parameters; R = .72 with six free parameters) using a combination of brain volume, gray matter thickness, and activation in the identified regions. This relation was significantly stronger than prediction from brain volume alone (r = .35), and not significantly weaker than the correlation of IQ with performance on one of the best single-measure tests of intelligence, Raven's Advanced Progressive Matrices (r = .75). This proof-of-concept demonstration may help guide neurobiological theories of intelligence and the development of neurometric measures of complex psychological functions.

C 77

THE CHOICE IS YOURS! CONTEXT-DEPENDENT VOLUNTARY TASK SET SELECTION REVEALED BY FMRI *Birte U. Forstmann[1], Uta Wolfensteller[2], Jan Derrfuss[3], Jane Neumann[2], Marcel Brass[2], K. Richard Ridderinkhof[1]; [1]Acacia, University of Amsterdam, the Netherlands, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [3]Institute of Medicine, Juelich, Germany* – The prefrontal cortex is thought to play an important role especially for our ability to voluntarily select among a set of alternatives in choice. Most importantly, is has been shown that the frontomedian cortex (FMC) plays a crucial role for the voluntary selection between movements, response sets, or task sets. However, in most studies the participants are explicitly asked by the experimenter to select among different alternatives. The present experiment was set out to investigate the role of the FMC when participants themselves decided or were explicitly instructed by the experimenter to choose or not to choose among different task sets. The fMRI results revealed an activation in the rostral part of the FMC when participants themselves decided to choose and when they were instructed by the experimenter not to choose. This result indicates that it does not only matter whether we have any options to choose from but also who is making the choice.

C 78

INVOLVEMENT OF THE BASAL GANGLIA IN ACTION CONTROL: A STUDY WITH DEEP BRAIN STIMULATION OF THE BASAL GANGLIA *Torsten Schubert[1], Franziska Plessow[1], Jens Volkmann[2], Guenter Deuschl[2]; [1]Humboldt-University, Berlin, Germany, [2]Christian-Albrechts-University Kiel, Germany* – Recent monkey studies suggest a role of the basal ganglia (BG) for the inhibition of motor actions. However, unequivocal evidence supporting this assumption in humans is still missing. The aim of the present study was to investigate the involvement of the BG in different types of inhibitory mechanisms by applying deep brain stimulation (DBS) of the nucleus subthalamicus in patients with Parkinson's disease (PD). Based on psychological models, we distinguished between non-selective and selective inhibitory mechanisms. While non-selective inhibition is assumed to lead to a complete interruption of all actually ongoing motor activity, selective inhibition enables the fast activation of a specific overt motor response at the cost of inhibiting other alternatives. The first was required in a stopping paradigm, where PDs had to interrupt an action on the presentation of a stopping signal in stop-trials and to perform the action in go-trials. The second was required in a Simon-interference task involving congruent and incongruent conditions. DBS ON led to an increased congruency effect in the Simon-task, which, moreover, disappeared in the DBS OFF condition. In the stopping paradigm, DBS ON resulted in impaired stopping performance due to faster go reactions and due to increased stopping time compared to the DBS OFF condition. Together, the findings suggest that the BG manipulation due to DBS led to an improved activation and execution of ongoing motor actions. This supports views assuming an involvement of the BG in selective inhibition and disconfirms theories assuming an involvement of the BG in non-selective inhibition.

C 79

SPATIOTEMPORAL DYNAMICS UNDERLYING THE INTEGRATION OF PRIOR PROBABILITY INFORMATION IN DECISION MAKING *Christina Scheibe[1,2,3], Markus Ullsperger[4,5], Werner Sommer[3], Hauke Heekeren[1,2,5]; [1]Charité University Hospital, Berlin, Germany, [2]Max Planck Institute for Human Development, Berlin, Germany, [3]Humboldt-University of Berlin, Institute for Psychology, Germany, [4]Max Planck Institute for Neurological Research, Cologne, Germany, [5]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – The integration of prior probability of an event into the process of decision making is essential for an efficient navigation through the external world and the dynamic adjustment of behavior. In a previous EEG study we found that the Contingent Negative Variation (CNV) was modulated parametrically by prior probability suggesting an integration of prior probability at a central processing stage. To investigate the spatiotemporal dynamics of the integration of prior probability, we collected simultaneous EEG and fMRI data. Subjects performed a number comparison task with a precue providing probability information about the side of the higher number which is the response side. We replicated the parametric modulation of the CNV by prior probability in the noisy scanner environment. A conventional fMRI analysis revealed a network of prefrontal and parietal areas being associated with the parametric modulation of prior probability. Using an EEG-informed fMRI analysis, we related the CNV amplitude and BOLD correlates at a single-trial level. With this approach it is possible to combine the exploration of the temporal characteristics of the integration of prior probability in the decision process with the investigation of the underlying brain structures.

C 80

FUNCTIONAL BRAIN CORRELATES OF RESPONSE TIME VARIABILITY IN CHILDREN. *Sunaina Fotedar[1], Daniel Simmonds[1], Stacy Suskauer[1,2], James Pekar[1,2], Martha Denckla[1,2], Stewart Mostofsky[1,2]; [1]Kennedy Krieger Institute, [2]Johns Hopkins University School of Medicine* – Intra- individual response time (RT) variability has been shown to correlate with commission errors in Go/Nogo tasks. This study examined the correlation between RT variability and Go/Nogo fMRI activation in children, to determine regions important for efficient Go/Nogo task performance. Thirty healthy children, ages 8-12 years, completed a Go/No-go task with minimal cognitive demands. Stimuli were presented rapidly with a Go:Nogo ratio of 3:1. RT variability was measured as: (standard deviation of RT)/(mean RT). Behaviorally, RT variability correlated with commission error rate (r=.46,p=.006). Individual voxel-wise contrast maps were created for Go and No-go conditions. FMRI correlational analyses revealed that lower RT variability was associated with Go-activation in the anterior cerebellum (culmen) and with Nogo-activation in left supplementary motor area (SMA; BA6), right precentral gyrus (BA3/4) and left culmen. Higher RT variability was associated with Go and Nogo activation in the right middle frontal gyrus (BA9/10) and the caudate. These results reveal that for both Go and Nogo activation, lower RT variability was associated with activation in premotor circuits, while higher RT variability was associated with prefrontal circuits. The findings suggest that efficient Go/Nogo task performance relies upon automatic premotor circuits important for motor response selection (including selecting not to respond); less efficient performers who cannot effectively utilize these regions must alternatively rely on less automatic prefrontal circuits involved in higher-order cognitive control.

Higher Level Cognition: Numerical Processing

C 81

PROCESSING OF NON-SYMBOLIC NUMERICAL MAGNITUDES AS INDEXED BY ERPS *David Paulsen, Helen Neville; University of Oregon* – Priming effects have been documented using a variety of stimulus types, for example lexical semantic, pictorial, phonological, face, and arithmetic stimuli. The present event-related potential (ERP) experiments were designed to test the hypothesis that non-symbolic numerical stimuli generate negative ERP priming effects similar to those found using other stimulus types. Experiment 1 identified ERP responses to the target stimuli in pairs of dot stimuli comparing the same, a close, or a distant number of dots. Targets containing a different number of dots from the prime elicited greater negativity than targets containing the same number of dots as the prime. This effect was greater for targets that were preceded by primes with a close than with a distant number of dots. Experiment 2 was conducted to replicate the findings of Experiment 1 and furthermore ascertain that the effects found in Experiment 1 were indices of numerical processing rather than differential task demands across conditions. Using dot stimuli with colored backgrounds, ERPs were recorded while participants performed either color or number discrimination tasks with the same stimuli. The ERP priming effects for the number condition replicated the findings of Experiment 1. These effects were clearly different from the ERP priming effects for the color condition, which showed positive priming effects. These results indicated that the numerosity effects observed in Experiments 1 and 2 are not due to differential task demands across conditions. In addition, number condition ERP priming effects are modulated by the accuracy of performance in the task.

C 82

MENTAL LINES IN HEBREW SPEAKING HEALTHY INDIVIDUALS AND NEGLECT PATIENTS *Sharon Naparstek, Iftah Biran; Hadassah Hebrew University Medical Center, Jerusalem, Israel* – Background: Numbers and other ordinal stimuli can be mentally represented through ordinal lines receiving spatial representation. These lines extend from left to right. Spatial biases resulting from these representations were shown in healthy subjects as well as in patients suffering from neglect. Most research in this field was done with Latin languages speaking subjects, ignoring the possible effect of language direction. Objective: To investigate the existence and nature of mental number and Hebrew alphabet lines in Hebrew speaking subjects, a language extending from right to left, in both healthy individuals and neglect patients. Method: Ten healthy control subjects and two patients suffering from spatial neglect participated in a stimuli comparison task, having to judge whether a presented stimuli (number or Hebrew letter) is larger or smaller than a reference one. The experiment was built using a graphic system for experimental design and control (PsyScope). The response was obtained by key presses, using reversed key assignments. Error rate and reaction time were calculated for each stimulus. Results: In both numbers and Hebrew letters, error rates were larger and reaction time slower, when larger stimuli were assigned to a left key. This was true for both patients and controls. Conclusion: These results imply the existence of both number and Hebrew alphabet mental lines extending from left to right and suggest the existence of such a universal ordinal mental line. The results also suggest that the abilities required in comparison tasks lay outside the neglect-affected area of the brain.

C 83

SEMANTICALLY ELICITED SYNAESTHESIA: A NUMEROSITY STROOP TASK *Ilaria Berteletti[1], Edward M. Hubbard[2], Marco Zorzi[1]; [1]University of Padova, Italy, [2]INSERM Unit 562, Orsay, France* – This study contributes to the debate on synaesthesia whether the elicited colour (photism) arises at the perceptual or semantic level. NM, a colour synaesthete for single digits and letters, was tested with a numerosity Stroop task. A personalized task was designed where dot patterns – either canonical or non-canonical – were coloured either congruently or incongruently with the photism of the corresponding digit. The task was to name the colour of the dots as quickly and accurately as possible. Two baseline control tasks were also administered: one assessed the automaticity of the numerical information (dot enumeration task) and the other assessed colour naming reaction times. It was predicted that if the locus of the phenomenon were at a perceptual level, only canonical patterns (over-learned configurations) would generate Stroop interference. However, if the colour were elicited at a semantic level, interference would also be expected for non-canonical configurations. The pattern of NM's results showed interference for both kinds of stimuli, although the effect was significantly stronger for (canonical) dice patterns. This interference suggests that numerosity is accessed automatically since NM's photisms are consciously elicited by digits but not by dot patterns. Moreover, enumerating the dice pattern resulted in shorter reaction times and a flat performance curve compared to the non-canonical patterns, consistent with earlier findings concerning the automatic activation of numerical information from dice configurations. In conclusion, this data suggests that, at least for NM, synaesthesia for numbers is evoked at a conceptual level.

C 84

ARE SINGLE-DIGIT NUMBERS ALWAYS REPRESENTED ON THE MENTAL NUMBER LINE? *Liat Goldfarb, Avishai Henik; Ben Gurion University of the Negev* – When participants decide if a right or a left digit is numerically larger, response time increases as the numerical distance between the digits decreases (e.g., Moyer & Landauer, 1967). It is argued that this distance effect supports the existence of a mental number line that reflects the representations of numbers. The current study examines the role of spatial aspects of tasks in the emergence of a distance effect. When task instructions were changed from indicating the side of the larger digit (i.e., spatial task) to naming the larger digit (i.e., a non-spatial task) (Experiments 1-2) or to deciding if two digits were the same (Experiments 3-4), no distance effect was found. These results show that: (a) The conversion of single-digit numbers to a mental number line is not mandatory, but depends on task demands.(b) It appears that previous reports of a distance effect for single-digit numbers with non-spatial tasks were due to the inclusion of specific digits or the comparisons of specific distances.

C 85

ELECTROPHYSIOLOGICAL MARKERS OF NUMBER PROCESSING IN 7-MONTH-OLD INFANTS *Melissa Libertus, Laura Pruitt, Marty Woldorff, Elizabeth Brannon; Duke University* – This study examines the electrophysiological processes underlying numerical discrimination in 7-month-old infants. EEG was recorded continuously from a 19-channel electrocap while infants were familiarized to one numerosity (8 or 16), and then tested with novel exemplars of the familiar and a novel numerosity (8 and 16). ERPs were extracted by time-locking the EEG to the onset of stimulus presentation and selectively averaging for the first and second half of familiarization, and novel and familiar numerosity test trials. ERPs elicited during familiarization revealed a significantly larger negativity for the first half of trials between 350-430 ms post-stimulus that was broadly distributed over central areas and most pronounced over the left hemisphere. Additionally, in the first half of familiarization relative to the second half, ERPs showed a significantly larger late positivity between 870-950 ms post-stimulus that was largest over the central and parietal midline. In previous infant studies, the initial negativity and the late positivity ERP components have been linked to the encoding of stimulus templates and the updating of working memory, thus suggesting that infants may be forming a template of the familiar numerosity. Moreover, and consistent with this hypothesis, a comparison between novel and familiar test trials revealed a significantly larger positivity for the novel numerosities between 910-960 ms post-stimulus. Importantly, this novelty effect was strongest over left parietal and frontal scalp sites suggesting that a fronto-parietal network previously implicated for number processing in humans may already be in place by 7 months of age.

C 86

THE DISSOCIATION BETWEEN RETRIEVAL OF ARITHMETICAL FACTS AND ESTIMATION ABILITIES: A SINGLE CASE STUDY OF ACQUIRED DYSCALCULIA *Sarit Ashkenazi, Avishai Henik; Ben Gurion University of the Negev* – This single case study presents D.A., a 67-year-old engineer who showed dysgraphia and dyscalculia resulting from an infracted left intraprietal sulcus. We tested his numerical abilities and found that he was able to retrieve numerical facts. In contrast, he showed a severe difficulty in using numerical procedures, especially multiplication and division. In addition, he frequently replaced a minus sign with a plus sign. The comparison of estimation and exact calculations indicated longer reaction time for approximation trials, both for small and larger numerical values. Performance in a numerical Stroop-like paradigm was measured. The facilitation effect (the difference between congruent trials and neutral trials) was absent. This is the first study that examined the size congruency effect in a patient with acquired dyscalculia. According to Rubinsten and Henik (2005), participants with developmental dyscalculia (in contrast with non-dyscalculic participants) showed a lack of facilitation in this task. The present study provides further evidence for the dissociation between abstract representation of quantity and fact retrieval.

C 87

NUMERICAL AND SPATIAL NETWORKS UNDERLYING THE MENTAL NUMBER LINE *Edward Hubbard[1], Philippe Pinel[1], Manuela Piazza[1], Stanislas Dehaene[1,2]; [1]INSERM Unit 562, [2]College de France* – Functional neuroimaging and patient studies have suggested that human arithmetic abilities depend on a network of frontal and parietal regions, including the bilateral intraparietal sulcus (IPS) and frontal regions involved with eye movements, working memory and verbal processing. These mathematical competencies may depend, in part, on a spatially organized mental number line (Hubbard et al., 2005), which reaches conscious awareness in a minority of the population (number-form synesthetes). To asses the role of these regions in numerical-spatial interactions, and to clarify possible homologies with macaque parietal regions, we used whole brain fMRI to measure BOLD signal change in three tasks: mental arithmetic (addition and subtraction compared with a letter naming baseline), a multisensory localizer (visual optic flow and tactile stimulation of the face), and saccades. Random effects analyses showed substantial overlap between calculation and multisensory regions (putative human ventral intraparietal area, VIP) bilaterally, with less overlap between calculation and saccade related regions in parietal cortex (putative human lateral intraparietal area, LIP) and frontal eye fields (FEF). Within regions of interest defined by these localizer tasks, we are now more quantitatively examining activations to addition and subtraction tasks in individual subjects. We are also testing a group of number-form synesthetes to explore the hypothesis that number-form synesthesia arises from similar, but stronger, interactions between numerical and spatial regions than in non-synesthetes. These results shed light not only on the neural correlates of numerical-spatial interactions, but also on why they become conscious in a minority of the population.

C 88

SUBITIZING REQUIRES VISUAL ATTENTION *Petra Vetter, Bahador Bahrami, Brian Butterworth; Institute of Cognitive Neuroscience, University College London* – Subitizing, the fast and accurate enumeration of up to 4 items, has traditionally been thought of as a pre-attentive and parallel process. We employed a dual task paradigm in order to test the effects of reduced attentional resources on subitizing. Subjects were asked to perform a central detection task and, at the same time, to enumerate surrounding circularly arranged high-contrast gabor patches (amongst low-contrast distractor patches). The central detection task comprised two conditions, one of low attentional load (detecting a certain colour) and one of high attentional load (detecting a certain colour-orientation conjunction). Introducing a secondary task, even requiring few attentional resources (low load condition), already led to significantly decreased enumeration accuracy in the subitizing range compared to the single task condition. Subitizing accuracy was even more severely reduced under conditions of high attentional load. These results show that subitizing is severely impaired under conditions of reduced attentional resources which speaks against the traditionally held notion of a pre-attentive subitizing mechanism.

C 89

MODIFIABLE NUMBER-SPACE CORRESPONDENCE UNDER DIFFERENT CONTEXTS *Rocco Y.C. Chiou[1], Denise H. Wu[2], Daisy L. Hung[1], Ovid J.L. Tzeng[3]; [1]Institute of Neuroscience, National Yang Ming University, Taipei, Taiwan, [2]Institute of Cognitive Neuroscience, National Central University, Taoyuan County, Taiwa, [3]Institute of Linguistics, Academia Sinica, Taipei, Taiwan* – The correspondence between numbers and space is subject to the influence of different spatial contexts. We investigated such influence on the directionality of SNARC (Spatial-Numerical Association of Response Codes) effect by introducing different inducer phases before bimanual parity judgment. Since prefixing a numeral to the Chinese character "點" can refer to either the hour on a clock-face or the number of dots on a dice, we employed these ambiguous Chinese materials to examine whether the spatial mapping of identical numerical items would demonstrate flexible mapping between numbers and space. Our data indicated that when asked to make a parity judgment on the numeral character in an ambiguous item, Chinese participants showed a typical SNARC effect. The same effect was also detected when the same task was performed after an inducer phase wherein the participants perceived the ambiguous stimuli as representing dots on a dice, and a left-to-right alignment between numbers and space was encouraged. More importantly, a reverse (albeit insignificant) SNARC effect was observed for the same task when it was performed after the inducer phase wherein the participants perceived the ambiguous stimuli as representing hours on a clock-face and a right-to-left alignment was encouraged. In summary, the spatial mapping of numerical words is flexibly modified by the specific context in which the words appear, even when the spatial aspect of the context is irrelevant to the task. The role of the parietal cortex in mediating such flexible mapping between numbers and space is also discussed.

C 90

SUBITIZING AND COUNTING IN DYSCALCULIA *Nitza Mark-Zigdon[1], Sarit Ashkenazi[1], Gal Ifergan[2], Illan Shelef[2], Henik Avishai[1]; [1]Ben Gurion University of the Negev, [2]Soroka Medical Center* – Subitizing and counting abilities of third and forth grade dyscalculic and non-dyscalculic children were tested. The non-dyscalculic children showed a very small change in reaction time (RT) when tested with quantities in the range of 1 to 4 dots, and a linear increase in RT with quantities from 5 to 12 dots. In contrast, the dyscalculic chidren were able to process a smaller subitizing range of only 3 dots. In addition, their RT function was non-linear and showed a jump in RT when there were between 6 and 7 dots presented. This pattern of results was achieved regardless of the organization of dots in the display (i.e., domino vs. random). A brain-injured adult suffering from numerical processing deficits showed a pattern similar to the dyscalculic children for the random arrangements of dots but not for the non-random (i.e., domino) arrangements. These results suggest that organization of the display may enable circumventing deficient counting and subitizing due to brain injury. In addition, our results indicate that even processes that are considered basic and automatic (i.e., subitizing) may be deficient in developmental as well as acquired dyscalculia.subitizing abilities of third and forth grade dyscalculic and non-dyscalculic children were tested. The non-dyscalculic children showed a very small change in reaction time (RT) when tested with quantities in the range of 1 to 4 dots, and a linear increase in RT with quantities from 5 to 12 dots. In contrast, the dyscalculic chidren were able to process a smaller subitizing range of only 3 dots. In addition, their RT function was non-linear and showed a jump in RT when there were between 6 and 7 dots presented. This pattern of results was achieved regardless of the organization of dots in the display (i.e., domino vs. random). A brain-injured adult suffering from numerical processing deficits showed a pattern similar to the dyscalculic children for the random arrangements of dots but not for the non-random (i.e., domino) arrangements. These results suggest that organization of the display may enable circumventing deficient counting and subitizing due to brain injury. In addition, our results indicate that even processes that are considered basic and automatic (i.e., subitizing) may be deficient in developmental as well as acquired dyscalculia.

C 91

ARE ALL NUMBERS CREATED EQUAL? AN ELECTROPHYSIOLOGICAL INVESTIGATION OF SMALL AND LARGE NUMBER REPRESENTATIONS *Daniel C. Hyde, Elizabeth S. Spelke; Harvard University* – Behavioral studies of infants and of non-human primates provide evidence for two distinct systems of number representations: a system for representing a small number of individuals and a system for representing large approximate numerical magnitudes (Feigenson et al., 2004). In contrast, behavioral studies of adults provide only equivocal evidence for two distinct systems (Dehaene, 1997) and neuroimaging fails to directly address the issue at all. To clarify the matter, we attempt to characterize the neural electrophysiology of small versus large number representations in adults using event-related potentials (ERP). In an adaptation-type paradigm (Grill-Spector and Malach, 2001), ERP's were recorded as subjects passively viewed a continual stream of novel dot arrays. A majority of the arrays contained the same number of dots. Occasionally, a test array was presented containing either the same or a different number of dots. Strict controls were employed to ensure changes in brain electrophysiology were due to changes in the number of dots and not changes in other continuous stimulus dimensions. As observed in previous studies (Dehaene, 1996), comparisons of large number test conditions revealed modulation of a second posterior positivity according to the distance between the base number and test number, peaking around 250ms. Comparisons between small number test conditions revealed both similarities to and differences from established ERP modulation in the large number range. These findings suggest that while large and small number representations share similar neural resources, the actual representation of these numbers might be different.

C 92

SYMBOLIC & NON-SYMBOLIC NUMBER IN THE DEVELOPING BRAIN *Jessica Cantlon, Melissa Libertus, Elizabeth Brannon, Kevin Pelphrey; Duke University* – Functional imaging and lesion studies of adult humans have established neuro-cognitive links between number processing and posterior parietal cortex, and specifically, the intraparietal sulcus (IPS). Adults with lesions to areas of parietal cortex that encompass the IPS exhibit impaired performance on symbolic numerical tasks but not on tasks that test knowledge of other semantic domains (e.g., Dehaene & Cohen, 1991). Functional magnetic resonance imaging (fMRI) studies have revealed number-specific activity in the adult IPS relative to control tasks for non-symbolic numerical values (e.g., Ansari et al., 2006; Cantlon et al., 2006; Piazza et al., 2004). Thus regions of posterior parietal cortex in the adult brain respond to numerical values independent of notation. How does this pattern of brain activity develop? We performed fMRI while 7-y-old children chose the larger of two numerical values from two arrays of dots (non-symbolic condition) or two Arabic numerals (symbolic condition). The numerical comparisons were identical in both conditions and were either easy (0.5 ratio between values) or difficult (0.8 ratio). We examined BOLD activity during the symbolic and non-symbolic conditions as a function of the ratio between the numerical values of the comparisons. Adults exhibited a bilateral ratio effect in posterior parietal cortex, whereas children only exhibited this numerical ratio effect in the right hemisphere. The different patterns of brain activity evoked by children and adults may be related to the development of precise, automatic representations of numerical values that has not yet reached maturity by 7 years of age.

C 93

CHILDREN WITH AUTISM SHOW DIFFERENCES IN BRAIN ACTIVATION, DESPITE SIMILAR BEHAVIORAL PERFORMANCE, ON A MENTAL ARITHMETIC TASK *Kami Koldewyn[1,2], Melissa Henry[3], Lien Le[1], Susan Rivera[1,2]; [1]University of California, Davis, [2]UC Davis M.I.N.D. Institute, [3]Stanford Dept. of Psychology* – Previous behavioral studies have indicated that high functioning children with strictly defined autism perform as well as typically developing children on simple arithmetic calculation tasks. Evidence is rapidly accumulating, however, that those with autism may have general connectivity abnormalities regardless of whether or not they are impaired on a particular task. In this study, children with autism and their age, sex and IQ-matched typically developing peers performed simple two and three operand calculations while being scanned in a 1.5T MRI machine utilizing a single-shot gradient echo, echoplanar imaging (EPI) sequence. Despite the fact that the two groups did not differ in either their accuracy or reaction time, participants with autism showed a markedly unusual pattern of neural activation when compared to controls. Unaffected children showed activation in the expected network of prefrontal, parietal and cerebellar regions. In contrast, participants with autism, as a group, showed greater activation in prefrontal regions than controls but virtually no activation in parietal or cerebellar regions. Additionally, activation patterns in those with autism were much more variable than the activation seen in control participants. While further research is needed to determine whether these differences in brain activation patters stem from differences in task strategies or are indicative of a lack of long-range connectivity in those with autism, these findings support a growing body of evidence that functional neural architecture differences exist in those with autism independent of performance differences.

C 94

ELECTROPHYSIOLOGICAL MEASURES OF THE NUMERICAL DISTANCE EFFECT *Wido Nager, Anja Fellbrich, Thomas Frank Munte; Otto von Guericke University, Magdeburg, Germany* – Recent findings indicate that humans represent numbers along a continuous mental line. Little is known about how automatic number magnitude activation is attentionally used to select relevant information. Additionally, electrophysiological characterization of the mental number line and its impact on target processing is missing. Event-related potentials (ERPs) were recorded in 16 subjects, performing an Eriksen paradigm in a magnitude comparison task with the standard 5. We report behavioral and electrophysiological findings of the numerical distance effect for attentional target processing. For the analysis of the numerical distance effect, we collapsed the data acquired for each target number over all distractors. The size of the distance effect was calculated by computing a linear trend over the splits (i.e. the absolute distances between the target number and the standard 5). ERPs were analyzed with regard to the P300. RT data pointed to a highly significant common number magnitude effect as indicated by a linear trend: larger distances to the standard 5 produced faster responses than smaller distances. The P300 amplitude was correlated to the target numbers with increasing amplitudes for larger numerical distances. The numerical distance effect was observed for targets although these targets were surrounded by task-irrelevant numerical distractors. The current results underline the importance of the mental number line. It seems to be used to facilitate correct responses when interfering attentional distractors are present. So, in this task, the spatial location of the target on the mental number line determines the selection of numbers as relevant stimuli.

Higher Level Cognition: Other

C 95

INFERRING DECEIT IN HIGH FUNCTIONING AUTISTIC AND ASPERGER SUBJECTS: AN FMRI STUDY. *Julie Grezes[1], Sylvie Berthoz[2], Bruno Wicker[3]; [1]CNRS - Collège de France, Paris, France, [2]Institut Mutualiste Montsouris, Paris, France, [3]Institut de Neurosciences Cognitives de la Méditerranée - INCM, CNRS, Marseille, France* – Social exchange is a critical component of everyday life. It depends on an ability to predict and infer the mental states of others, such as their desires, beliefs and intentions. While interacting with others, it is important to judge accurately whether the person is honest or deceitful. We often use non-verbal cues to infer whether others are trying to deceive us. Impaired social communication and use of multiple nonverbal behaviours are core features in the autistic spectrum disorder. Using functional magnetic resonance imaging (fMRI), we study subjects watching videos of actors lifting a box, and judge 1) whether the box was light or heavy, 2) whether the actors had a correct or a false expectation of the weight of the box, and 3) whether the actors were trying to deceive them or not concerning the real weight of the box. Adults with high-functioning autism or Asperger Syndrome (HFA/AS) and controls are scanned. Three groups of control subjects are selected on the basis of their low (n=12), intermediate (n=12) and high (n=12) scores on the empathy quotient self-report questionnaire (Baron-Cohen & Wheelwright 2004). Behaviorally, there is no difference between the 3 groups of controls in the 3 tasks. The HFA/AS group show greater performances in recognizing the weight of the box and lower performances in detecting expectations and deceit as compared to all control groups. The common and specific neural networks associated to the 3 tasks and comparisons between controls and HFA/AS groups are discussed.

C 96

EFFECTS OF BASAL GANGLIA LESIONS ON REWARD-BASED LEARNING IN HUMANS *Christian Bellebaum[1], Benno Koch[2], Michael Schwarz[2], Irene Daum[1]; Institute of Cognitive Neuroscience, Ruhr-University Bochum, [2]Klinikum Dortmund* – Studies of patients suffering from Parkinson's Disease provided evidence for a crucial role of the basal ganglia in reward-based learning. Applying functional imaging techniques, attempts have been made to relate basal ganglia substructures to different learning processes. The present study aimed to elucidate the effects of focal basal-ganglia lesions on reward-based learning in humans. Seven patients with selective lesions affecting different regions of the basal-ganglia and seven healthy control subjects performed two probabilistic learning tasks in which abstract signs had to be associated with colours. Acquisition, reversal, effects of reward value and cognitive transfer were assessed. While patients and controls exhibited comparable learning curves across blocks of trials and showed similar performance in cognitive transfer, controls learned significantly faster, as revealed by a lower number of trials necessary to reach a learning criterion. Analysing the performance of individual patients yielded significant impairments in two patients with involvement of the right posterior putamen. Interestingly, one patient with a bilateral lesion of the putamen, which also involved the left caudate nucleus, showed a significantly higher total number of correct responses compared to controls. The results provide further evidence for the involvement of the basal ganglia in reward-based learning. Performance patterns in individual patients suggest that parts of the putamen may play a crucial role, with the right putamen being possibly more important. Enhanced learning in one patient may be related to earlier reports of facilitated learning in unmedicated Parkinson's Disease patients, but needs to be confirmed in a larger sample.

C 97

MOTIVATIONAL SIGNIFICANCE OF SOCIAL STIMULI CONTRIBUTES TO ACTIVATION IN MPFC *Wouter van den Bos[1,2], Samuel M. McClure[2], Lasana T. Harris[2], Leigh E. Nystrom[2], Susan T. Fiske[2], Jonathan D. Cohen[2,3]; [1]University of Leiden, Leiden, the Netherlands, [2]Princeton University, Princeton, NJ , [3]University of Pittsburgh, PA* – In recent studies an area in the medial prefrontal cortex, the paracingulate cortex (pACC), has been implicated in potentially very different cognitive functions: reasoning about the minds of other people and processing reward related information. We hypothesize that the activation in this area correlates with the reward value of the stimuli in general and is not specifically limited to social cognition. In this study we sought to gain further insight into the functional significance of the pACC by independently manipulating reward and social context. Neural activity was measured using fMRI while participants performed a time estimation task with trial-to-trial feedback (in the form of small squirts of fluid delivered orally). Social context was manipulated by instructing subjects that positive and negative feedback were determined either by a computer or another person. Our analysis revealed a main effect of positive feedback, but not of social context, in the PACC. This result suggests that this area of the mPFC serves a more general cognitive function in representing reward value, which can be modulated by social context. In addition, activity in other sub-regions of the mPFC, particularly the subgenual cingulate cortex (SGC), showed a significant interaction between reward value and social context: in these areas the social manipulation amplified the effect of different types of reward feedback. This effect in the SGC is especially interesting because of the implication of this area in severe depression.

C 98

NEURAL DYNAMICS OF DECISION-MAKING AT DIFFERENT LEVELS OF OUTCOME PREDICTABILITY. *Florian S. Fischmeister, Uta Sailer, Herbert Bauer; University of Vienna* – The aim of the present study was to characterise the neural dynamics of decision-making at different levels of outcome predictability using EEG. Slow cortical potentials (SCP) were measured via 61 scalp electrodes while subjects were choosing between two alternatives displayed on either side of a fixation cross. These alternatives were combined either to form true-decisions between two different alternatives resulting in low predictability, dummy-decisions, between identical alternatives with intermediate predictability, or nil-situations representing a high outcome predictability. After the response, each alternative was associated with a gain or loss. SCP time series were decomposed per subject into temporally independent but spatially fixed components using an extended-infomax algorithm. Cluster analysis was applied to components that could directly be related to brain activity using a robust k-means approach. Preliminary results revealed decision related component clusters localised to the orbito-frontal cortex (OFC), the anterior cingulate cortex (ACC), and the dorsal prefrontal cortex (BA 8). The normalised activity time course of the BA 8 cluster showed distinct amplitude differences modulated by different outcome predictability levels. The larger BA 8 activation found for true-decisions compared to dummy-decisions and to nil-situations might reflect the decreasing degree of uncertainty or non-predictability. For the ACC cluster a larger pronounced and longer lasting negative going waveform was observed for the two decision types compared to nil-situations. This could indicate a faster and less demanding resolution of a conflict between the competing alternatives in nil-situations.

C 99

HOW WE DECIDE SOMETHING IS MORALLY WRONG: AN FMRI STUDY OF MORAL JUDGMENT. *Jana Schaich Borg[1,2], Walter Sinnott-Armstrong[3], Kent A. Kiehl[1,4]; [1]Institute of Living, Hartford, CT, [2]Neuroscience Institute, Stanford University School of Medicine, [3]Dartmouth College, [4]The MIND Institute, University of New Mexico* – Is moral condemnation an outcome of "reason" or "emotion"? In the present study, we use fMRI to investigate the neurological networks involved in judging a concept or an act to be morally wrong. Participants were scanned while viewing fifty short phrases describing things most people judge to be morally wrong, fifty short phrases describing things most people judge to be morally not wrong, and fifty short phrases describing controversial issues about which people have disparate moral opinions. Participants indicated whether each phrase described something morally "wrong" or morally "not wrong" while in the scanner. Brain regions in affective networks (including the bilateral insula) as well as working memory networks (including the middle/superior frontal gyrus) were more active during judgments that concepts or acts were morally "wrong" than when concepts or acts were appraised as "not wrong" as long as the concepts or acts were non-controversial. However, for controversial moral concepts or acts, regions in a distinct (but overlapping) brain network involved in emotional appraisal and control (including the anterior cingulate and orbitofrontal cortex) were more active during judgments condemning concepts or acts to be "wrong" than when concepts or acts were judged to be "not wrong". There was no difference in regional activity during judgments that concepts or acts were morally "not wrong" versus morally "wrong", regardless of how controversial the concepts or acts described were. These results suggest that negative moral judgments are associated with neural activity in both "cognitive" and “emotional” brain systems.

C 100

HUMAN EMBODIMENT IN TIME *Shahar Arzy, Istvan Molnar-Szakacs, Olaf Blanke; Brain Mind Institute, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland* – Embodiment, the sense of being spatially localized within one’s own body, is a fundamental character of the self. However, the self is embodied not only spatially in the body, but also temporally in the present. To investigate functional and neural mechanisms of human embodiment in time, we asked individuals to make judgements about future (Forward in time) and past (Backwards in time) events after having imagined to be at three different time-points: Now (present time), Past (-10 years) or Future (+10 years). Reaction-times and error-rates measures were significantly higher for Past and Future than Now time-point. In addition, across all time-points, reaction-times and error-rates were significantly higher for Backward than Forward events. These results were reflected by brain activation (as measured by electrical neuroimaging of 192 channel EEG) at ~500ms after stimulus presentation, as activations in anterior temporal lobe (predominantly left) and extrastriate cortex (predominantly right) were significantly longer in Past and Future than in Now time-point, as well as longer for Backward than Forward events independent of time-point. In addition, Future time-point was also processed earlier (~300ms) and lead to prolonged activation at the same brain regions. These data were confirmed and extended by intracranial LFP recordings. Collectively, these data suggest that distributed brain activity at the anterior temporal and extrastriate cortex as well as its timing is crucial for the coding of the self as embodied and temporally located within the present and for the ability to mentally “travel” to past and future locations in time.

C 101

IN THE EYE OF THE BEHOLDER: POINTING OUT OBJECTS IN A HETEROCENTRIC REFERENCE FRAME *Laurent Cleret de Langavant, Philippe Remy, Joe McIntyre, Iris Trinkler, Emmanuel Dupoux, Alain Berthoz, Anne-Catherine Bachoud-Lévi; INSERM* – Communicative pointing (CP) is a gesture addressed to another person to communicate about an object. This social capacity seems to be specific to humans, emerging at the end of the first year. It seems to be lacking in autism.The acquisition of communicative pointing might represent a key step in cognitive development and form an essential basis for social cognition. In order to share information, the subject who points should possess some knowledge about the addressee's visual perspective on the target object. Thus, the ability to represent the addressee's perspective would be expected to be an essential prerequisite for CP. Previous studies on pointing gestures did not address this issue, since they focused on the goal-directed component of pointing, leaving aside its communicative function. They studied non communicative pointing (NCP), and no communicative intention directed toward an addressee was set. In our study, we compared pointing gestures addressed (CP) or not (NCP) to another person, using a behavioral and a PET paradigm in healthy subjects. We found that endpoint variability of pointing was spatially shaped according to whether there was a communicative interaction with an addressee and depending on the addressee's location. Furthermore, we found activation in the right posterior superior temporal sulcus to be specific to CP versus NCP. This area is known to be involved in social perception/interpretation and third-person visual perspective. We propose that communication through pointing takes place in a heterocentric reference frame which incorporates the addressee's visual perspective.

C 102

THIS HAND IS YOUR HAND, THIS HAND IS MY HAND: EVIDENCE FOR A VISUAL BODY-PART OWNERSHIP HOMUNCULUS *Istvan Molnar-Szakacs[1,2], Sebastian Dieguez Falcon[1], Olaf Blanke[1]; [1]Brain Mind Institute, Ecole Polytechnique Federale de Lausanne, Switzerland, [2]Semel Institute for Neuroscience and Human Behavior, UCLA, Los Angeles* – The capacities of agency and ownership secure our sense of identity, allowing us to distinguish the self from others. Evidently, the face plays a special role in self-identification, however it remains unknown how knowledge of other body parts may contribute to self-other distinction. To address this question 13 normal right-handed subjects made ‘self’-‘non-self’ responses to pictures of their own or another person’s body parts, including the arms, hands, legs, feet, chest and upper back, torso and lower back. Reaction times and accuracy rates were measured. We found that overall subjects were significantly faster at responding to pictures of their own than to a stranger’s body parts, confirming the salience of ‘self’ stimuli. Analysis of error rates yielded an interaction effect of body part and self-other. This effect was mostly due to a significant pattern for other people’s hands to be perceived as one’s own. Self-hands, however, were not perceived as other’s hands more often than any other body part. A significant pattern was also found for other people’s distal parts (hands and feet) to be perceived as one’s own and self proximal parts (arm and leg) to be perceived as someone else’s. Our results may be explained by the special role of hands in daily social exchanges, leading to the self-attribution of those body parts of others that most often share the same visual field with one's own. These results also allow us to propose an homuncular representation of visual ownership gradients of the human body surface.

Emotion

C 103

THE AMYGDALA IN THE EXPERIENCE OF AFFECT *Seth Duncan[1], Lisa Barrett[1], Eliza Bliss-Moreau[1], Scott Rauch[2], Chris Wright[2]; [1]Boston College, [2]Harvard Medical School, Massachusetts General Hospital* – The current study was designed to test the hypothesis that amygdala activation serves as a neural precondition that allows for negative affective experience by modulating visual sensitivity to evocative objects in the environment. Participants’ affective experience was measured by asking them to report on their momentary experiences several times a day over the course of a month using an electronic experience-sampling procedure. One year later, participants viewed backwardly masked depictions of fear while functional magnetic resonance imaging (fMRI) was used to measure their amygdala and fusiform gyrus activation. Negative affect, as measured during the experience-sampling procedure one-year prior, was positively correlated with amygdala activation in response to these brief presentations of fear depictions. Furthermore, descriptive analyses indicated that fusiform gyrus activation and negative affective experience in the scanner were associated for participants reporting increased nervousness during the imaging procedure. The results suggest that the amygdala contributes to negative affective experience by increasing perceptual sensitivity for negative stimuli.

C 104

AUTISM AND EMOTIONAL COMMUNICATION THROUGH MUSIC *Anjali Bhatara[1], Anna Tirovolas[2], Daniel Levitin[1]; [1]McGill University, [2]Harvard University* – Autism is characterized by impairments in empathy and in social and emotional communication. Deficits have been observed in understanding the emotional undertones of spoken conversation, many of which are communicated through variations in timing, loudness, and intonation. Music has similar prosodic aspects, so this study was to examine the role of timing and loudness variation on the ability of children and adolescents with autism to understand emotional communication through music. Previous experiments on unimpaired adults have shown that people can reliably judge the difference between an expressive music performance (one with all variation intact) and a "mechanical" performance (one in which all variation has been removed), as well as versions spanning these two extremes. We included a control condition of "random" expressiveness which contained full variability, but with timing and loudness variation randomly distributed across the notes. Adults and typically developing children (ages 7 - 17) rated the expressive version as most emotional and the mechanical and random versions as least emotional. The goal of the present study is to explore whether children with autism spectrum disorders (ASD) rate these excerpts the same as controls. Preliminary results indicate that they rate them differently; children with ASD tend to rate the random version as being equally as emotional as the expressive version, implying that they are making judgments based on complexity and not on musical conventions of expressive performance. This further suggests that the attraction that individuals with ASD have for music is based on structural features, rather than emotional ones.

C 105

EVENT-RELATED POTENTIALS REVEAL TEMPORAL STAGING OF DYNAMIC FACIAL EXPRESSION AND GAZE SHIFT EFFECTS ON ATTENTIONAL ORIENTING *Harlan Fichtenholtz[1], Joseph Hopfinger[2], Reiko Graham[3], Jacqueline Detwiler[1], Kevin LaBar[1]; [1]Duke University, [2]University of North Carolina at Chapel Hill, [2]University of North Carolina at Chapel Hill* – Multiple sources of information from the face guide attention during social interaction. The present study modified the Posner cueing paradigm to investigate how dynamic changes in emotional expression and eye gaze in faces affect the neural processing of subsequent target stimuli. Event-related potentials (ERPs) were recorded while participants viewed centrally-presented face displays in which gaze direction (Left, Direct, Right) and facial expression (Fearful, Neutral) co-varied in a fully crossed design. Gaze direction was not predictive of peripheral target location. ERP analysis revealed several sequential effects, including: (1) an early enhancement of target processing following fearful faces (P1); (2) an interaction between expression and gaze (N1), with enhanced target processing following fearful faces with rightward gaze; and (3) an interaction between gaze and target location (P3), with enhanced processing for invalidly-cued left visual field targets. Behaviorally, participants responded faster to targets following fearful faces and targets presented in the right visual field, in concordance with the P1 and N1 effects, respectively. The findings indicate that two nonverbal social cues – facial expression and gaze direction -- modulate attentional orienting across different temporal stages of processing. Results have implications for understanding the mental chronometry of shared attention and social referencing.

C 106

NEURAL CIRCUITRY FOR DETECTION OF THREAT RESPONDS TO SIMPLE GEOMETRIC SHAPES *Christine Larson, Joel Aronoff, David Zhu; Michigan State University* – The rapid detection of threat is a fundamental task for survival and so the recognition of potential danger in visual stimuli is thought to be preferentially processed by dedicated neural circuitry, including the amygdala. Our past work on threat detection suggests that simple geometric shapes containing downward-pointing V angles, similar to the shapes that are produced by the movement of the human face when forming an angry facial expression in point-light experiments, are perceived as being more aversive, even when presented devoid of other contextual cues. We used functional magnetic resonance imaging (N= 17), in a block design, to investigate neural responses to the simplest possible form of this shape, a downward-pointing triangle, compared to the same triangle with the vertex pointing upward. We also compared the neural response to the downward triangle to that recruited by a circle. The downward-pointing V elicited activation of the amygdala, subgenual anterior cingulate cortex, and an area of the fusiform gyrus known to respond to faces and facial expression of emotion. Importantly, activation of this affect-related circuitry was orientation-specific; downward-pointing triangles elicited greater activation in these regions than the identical triangle inverted. Thus, this very simple shape is capable of activating neural networks instantiating detection of threat and negative affect. These results suggest that the meaning of threat may be conveyed by very simple stimulus configurations containing a downward V angle without other cues representative of context or affect.

C 107

MODELING PERITRAUMATIC AMNESIA BY AGONISTIC NORADRENERGIC AND GLUCOCORTICOID EFFECTS *Rene Hurlemann[1], Andreas Matusch[2], Dietrich Klingmuller[1], Barbara Hawellek[1], Heike Kolsch[1], Wolfgang Maier[1], Raymond J. Dolan[3]; [1]University of Bonn, Germany, [2]Institute of Medicine, Research Center Juelich, Germany, [3]Institute of Neurology, University College London, United Kingdom* – Persistent peritraumatic dissociation, including amnesia, represents a robust predictive risk factor for posttraumatic stress disorder (PTSD). We used the strategy of challenging noradrenergic (norepinephrine, NE) and cortisol (CORT) signaling to probe the neurochemical substrates of persistent peritraumatic amnesia in a cohort of 54 volunteer subjects. Within an experimental context of an established emotion-induced amnesia paradigm, we tested the amnesic potential of hydrocortisone (30 mg p.o.) in the presence or absence of the NE-reuptake inhibitor reboxetine (4 mg p.o.), thus modeling two levels of an aroused emotional state. Under dual challenge conditions, we observed a linear dose-response relationship in the magnitude of emotion-induced amnesia, consistent with a phenotypic expression of emotion-induced amnesia that varies as a function of NE and CORT co-activation during emotional memory encoding. These findings suggest that the magnitude of NE and CORT release in the immediate aftermath of emotional trauma provides an early vulnerability marker of persistent peritraumatic dissocation and PTSD. Blocking NE and CORT signaling at this initial pathological stage may constitute a feasible pharmacological approach for secondary prevention of persistent peritraumatic dissocation and PTSD.

C 108

PARENTAL BRAINS ACTIVATE TO OWN BABY CRIES AND PICTURES ACCORDING TO PSYCHOLOGY, EXPERIENCE, TIMING AND DYADIC RELATIONSHIP *James Swain[1], James Leckman[1], Linda Mayes[1], Ruth Feldman[2], Elizabeth Hoyt[1], Hannah Kang[3], Pilyoung Kim[4], Robert Schultz[1]; [1]Yale University, [2]Bar Illan University, [3]Stanford University ,[4]Cornell University* – Objective: With childbirth, genetic and epigenetic processes reorganize hypothalamic, limbic, and cortical circuits. We hypothesize that these parenting circuits, which modulate a range of adaptive parental thoughts and behaviors, may be related to empathy, reward, and obsessive-compulsive disorder. Methods: We have studied parental attachment in 45+ sets of parents in several ways: with interviews, self-report forms, brief videos of parent-infant interactions, and functional magnetic resonance brain imaging during exposure to baby cries and pictures at two time-points within the first four months postpartum. Results and Discussion: A baby-cry response circuit, stable over the first 4 months postpartum and common to mothers and fathers, includes superior temporal, insula and cingulate regions plus frontal mirror-neuron, reward and emotion areas. Responses to own baby-cry develop over the first four months postpartum to include amygdala, midbrain and thalamus. Correlating baby-cry brain activations in parent subgroups with psychometric parenting measures, indicates parenting brain areas in the insula, amygdala, midbrain, frontal cortex and basal ganglia – regions critical for empathy, anxiety, arousal and OCD. Mothers and first-time parents activate anxiety centers more robustly than fathers, and experienced parents. Experienced parents activate more reward circuits. Parents at 4 months postpartum correlate activations to own baby face with a measure of dyadic interaction. Conclusions: Human parenting involves empathy, reward, and habit-related brain circuits. Activation in these circuits follows a postpartum time-course, and varies by gender, experience and postpartum timing. Our results fit with animal literature on affiliative behaviors, suggest the feasibility of further research with depressed parents.

C 109

WHAT'S THAT? SOCIAL ORIENTATION INCREASES THE SENSITIVITY TO UNATTENDED CHANGES IN SPEAKER EMOTION *Annett Schirmer[1], Nicoals Escoffier[1], Stefan Zysset[2], Dirk Koester[3], Tricia Striano[4], D. Yves von Cramon[2], Angela D. Friedericie[2]; [1]National University of Singapore, [2]Max Planck Institute for Human Cognitive and Brain Sciences, [3]Maastricht University, [4]Leipzig University* – Previous work indicates that women are more sensitive than men to unattended changes in speaker emotion. The present study aimed at specifying the neurofunctional underpinnings of these effects as well as their dependency on social orientation as measured with a questionnaire. Participants listened passively to a sequence of syllables that contained rare changes in tone of voice that could be emotional or neutral. Change in tone of voice activated the auditory cortex regardless of emotional valence. Moreover, in women, high social orientation was associated with increased activity in areas related to top-down regulation of processing resources and visual search. A contrast between emotional and neutral change elicited increased activity in a number of structures including the posterior superior temporal sulcus and the amygdala. While these latter activations showed independently of social orientation in women, they showed only as a function of social orientation in men. These results indicate that social orientation enhances sensitivity to changes in speaker emotion in a gender specific way. In women, social orientation facilitates more general responses to changes in tone of voice regardless of valence, whereas in men, social orientation facilitates differential responses to unattended emotional as compared to neutral change and thus makes processing more comparable to women.

C 110

WOLF DOWN A BUCKET OF LETTUCE? BEHAVIORAL AND NEURAL INTERACTIONS BETWEEN HUNGER AND FOOD PREFERENCE. *Richard M. Piech[1], Jade Lewis[1], Adrian M. Owen[2], Angela C. Roberts[3], Paul E. Downing[1], Caroline H. Parkinson[1], John A. Parkinson[1]; [1]University of Wales Bangor, UK, [2]MRC Cognition and Brain Unit, Cambridge, UK, [3]University of Cambridge, UK* – The attractiveness of food and the anticipation of its palatability (incentive value) are crucial for choices and eating behavior. Previous research has indicated the involvement of the amygdala, the insular cortex and areas in the prefrontal cortex in the assessment of incentive value. In this functional magnetic resonance imaging study, we investigated the neural basis of changes in subjective ratings of incentive value brought about by interactions between physiological state and food type. Participants rated the anticipated palatability of restaurant menu items in two experimental sessions, while hungry and while sated. We hypothesized that hunger would not simply produce a general increase of perceived incentive value, but instead the change would depend on the type of food, with sensory and cognitive characteristics mediating behavior in sated subjects, and energy content in hungry participants. Our study confirmed that certain food items were rated as more palatable when participants were hungry and others while they were sated. To explore the neural basis of the change, we contrasted the BOLD signal of items with unchanged ratings with items that were considered more, or less, palatable with an increase in hunger. On the cortical level, the overall increase in palatability was associated with activity in the subgenual anterior cingulate. More complex patterns of activation were identified for specific increases associated with hunger and increases associated with satiety.

C 111

EMOTIONAL PROSODY PROCESSING IN PATIENTS WITH LESIONS IN ORBITOFRONTAL CORTEX: THE POINT IN TIME MAKES THE DIFFERENCE *Silke Paulmann, Sonja A. Kotz; Max Planck Institute for Human Cognitive and Brain Sciences* – It is well established that lesions of the human orbitofrontal cortex (OFC) lead to large-scale changes in emotional behaviour. For example, it has been shown that patients with orbitofrontal lesions have impaired emotional face and voice expression recognition (e.g. Hornak et al., 1996; 2003). However, to our knowledge, previous studies have failed to acknowledge that emotional perception is a multi-level process, i.e. studies have not investigated different stages of emotional processing (early vs. late) in the same patient group. Therefore, the current study investigated emotional prosody processing in an on-line ERP-experiment (using an implicit emotional prosody processing task) and an off-line behavioural experiment (using an explicit emotional prosody processing task). We tested emotional prosody perception in OFC-lesion patients using vocal expressions (with and without lexical content) of anger, fear, disgust, and happiness compared to a neutral baseline. In line with previous evidence (Paulmann & Kotz, 2005), results show that early emotional prosody processing of different emotional prosodies elicit a similar P200 in the ERP in both OFC-patients and healthy controls. However, at later processing stages, i.e. decision and evaluation stages, healthy listeners show better emotional prosody recognition rates than OFC-patients. The current data serve as first preliminary evidence that emotional prosody perception is impaired only at later processing stages in OFC-patients.

C 112

ERP MARKERS FOR THE AFFECTIVE RECRUITMENT OF COGNITIVE CONTROL: IMPLICATIONS FOR ATTENTION AND EMOTION REGULATION *Tracy A. Dennis, Chao-Cheng Chen; Hunter College, City University of New York* – The behavioral approach (BAS) and behavioral inhibition (BIS) systems are dimensions of reactivity thought to influence the self-regulation of attention and emotion via the recruitment of cognitive control; the conditions under which reactivity competes with or enhances control, however, are poorly understood. Participants were 36 healthy adults (26 females) who self-reported on BAS and BIS sensitivity and on subjective arousal. Electroencephalographic recordings were made from 64 scalp electrodes while participants viewed fearful, sad, and happy faces for 50 msec prior to an attention task. ERPs reflecting early (P100) and later (medial frontal negativity; MFN) mechanisms in cognitive control, attention processing (N100), and affective processing (P200) were measured. Attention regulation was measured during a visual conflict resolution task, and emotion regulation was measured as self-report of reappraisal and expressive suppression. Those reporting high BIS reactivity showed increased recruitment of cognitive control and affective processing. Enhanced BAS and BIS reactivity was associated with improved attention regulation, but only when recruitment of cognitive control was high. Increased BAS was associated with reduced expressive suppression for those participants who also showed reduced MFN while processing sad and happy faces. Relatively reactive participants showed patterns consistent with affective enhancement of control. Results suggest distinct implications of BAS and BIS for the self-regulation of attention and emotion and risk for psychopathology.

C 113

EFFECT OF EMOTIONAL CONTENT ON WORKING MEMORY *Keely Muscatell, Elizabeth Kensinger; Boston College* – Prior research has demonstrated enhanced long-term memory for emotional information over neutral information. Relatively little is known, however, about the effect of emotional valence on working memory. To investigate this latter effect, forty young adults completed two versions of a 2-back task, each using emotionally valenced (surprised, happy, fearful, sad, angry) and neutral faces. In one version of the 2-back task, participants were asked to view a series of valenced and neutral faces and, for each face, to indicate whether the expression on the face was the same expression that was presented 2-faces prior (expression match condition). In the other version of the 2-back task, participants also viewed a series of valenced and neutral faces, but they were asked to ignore the facial expression and instead to indicate whether the person was the same as was presented 2-faces prior (identity match condition). During the expression match condition, participants were faster and more accurate at responding to emotional expressions (particularly fearful ones) relative to neutral expressions. However, during the identity match condition, participants were slower to identify emotional faces than neutral faces. These findings suggest that attention may be drawn to emotional (and particularly to fearful) facial expressions, enhancing working memory when identification of emotionality is essential to task success, but detracting from working memory when ignoring emotional content facilitates task success.

C 114

PASSIVE AVOIDANCE LEARNING IN INDIVIDUALS WITH GENERALIZED SOCIAL PHOBIA (GSP). *Pamela Ng, Karina Peschardt, Marilla Geraci, Daniel Pine, James Blair; National Institutes of Mental Health* – Generalized social phobia (GSP) is characterized by fear of social interactions and sensitivity to disapproval by others. Conditioning processes have been suggested to play a role in the generation and maintenance of the condition. However, this suggestion has received little empirical investigation. In this study we examine whether there is any systemic impairment in the ability to form stimulus-reward and stimulus-punishment associations in individuals with GSP. Twenty-five unmedicated individuals with GSP and fifteen healthy comparison individuals were given a passive avoidance learning task. In this task, participants learn to approach stimuli predictive of reward ('good' numbers) and avoid stimuli predictive of punishment ('bad' numbers). Individuals with GSP made more omission errors (failure to respond to a rewarded stimulus/CS+) but significantly less passive avoidance errors (inappropriate responding to punished stimuli/CS-) than comparison subjects. Such data are inconsistent with any impairment or superiority in basic stimulus-reinforcement learning. Instead, it suggests that the individuals with GSP had a bias towards omitting responses.

C 115

AFFECTIVE FACE PROCESSING AND EMPATHY: EFFECTS ON THE ELECTROENCEPHALOGRAPHIC (EEG) MU RHYTHM *Adrienne Moore, Jaime Pineda; UC San Diego* – Comprehension of facial expressions gives access to the inner worlds of others, facilitating theory of mind and empathy. Simulation Theory (ST) maintains that when viewing an emotional face we infer what the observed person feels by activating motor representations we'd use to generate the observed expression ourselves. The EEG mu rhythm is believed to reflect activity of a "mirroring system" for comprehending others by sensorimotor simulation. This study had three goals: to investigate whether the mu rhythm is modulated by viewing facial affect as ST predicts, to contrast particular categories of facial affect with reference to mu rhythm response, and to determine whether the simulation mechanism involved is largely automatic or voluntary. Subjects viewed images of faces expressing disgust and happiness, both with and without empathizing with the faces, and images of buildings as a control. Subjects' moods after empathizing with faces of each type was reported. EEG was recorded for 2 second epochs following the presentation of each image and the 11-13 Hz mu integrated power at electrodes C3/C4 was calculated. Increased mu power when viewing faces expressing disgust was demonstrated, occurring regardless of whether subjects deliberately intended to empathize. Particular expressions differed in power; a simulation mechanism was revealed for disgust but not happiness. Mood change while empathizing with disgust was correlated with mu power, suggesting that individual differences in mu reactivity are primarily cognitive not physiological in origin. This confirms that the mu rhythm indexes a "mirroring" system for automatically processing social stimuli (disgusted faces) via simulation.

C 116

INTERFACE BETWEEN COGNITIVE AND AFFECTIVE CIRCUITRY IN PEDIATRIC BIPOLAR DISORDER *Mani Pavuluri, Megan Marlow O'Connor, Erin Harral, John Sweeney; University of Illinois at Chicago* – In this study, we investigated the impact of affective challenge on cognitive function in pediatric bipolar disorder, given the close anatomic and functional connectivity between affective fronto-limbic (orbitofrontal cortex (OFC); ventral cingulum; amygdala) and cognitive fronto-striatal systems (dorsolateral prefrontal cortex (DLPFC); posterior cingulate; caudate; putamen). Methods: In an fMRI study, ten unmedicated euthymic bipolar type I subjects were compared with ten age (12-18 years) and gender matched healthy controls (HC). The task consisted of an affective Stroop paradigm, aiming to recruit attention under emotional challenge. Results: In the negative word condition, relative to the neutral word condition, bipolar subjects displayed increased activation in the amygdala, ventral anterior cingulate gyrus, insula and caudate. In comparison, HC showed increased activation in posterior cingulate gyrus and DLPFC. In the positive word condition, bipolar patients showed activation in the nucleus accumbens, while the HC displayed activation in DLPFC, posterior cingulate gyrus, and putamen. Discussion: Our findings suggest that matching negative affect in bipolar individuals leads to over activation of affective circuitry at the expense of attentional systems, while HC are less affected by emotional challenge and were able to better engage cognitive circuitry in the context of emotional arousal. When matching positive words, the reward based nucleus accumbens was engaged in bipolar subjects while HC have differentially recruited the cognitive system. These findings have direct clinical implications for pediatric bipolar disorder in suggesting that emotional disturbances may contribute to cognitive processing deficits in the disorder.

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DISTINCT NEURAL MECHANISMS UNDERLYING ALTERED MESOLIMBIC REWARD PROCESSING IN NORMAL AGING AND EARLY-STAGE PARKINSON'S DISEASE *Björn H. Schott[1], Ludwig Niehaus[2], Bianca C. Wittmann[3], Hartmut Schütze[2], Constanze I. Seidenbecher[1], Hans-Jochen Heinze[2], Emrah Düzel[3]; [1]Lebniz Institute for Neurobiology, Magdeburg, [2]University of Magdeburg, [3]Institute of Cognitive Neuroscience, University College London* – The ventral striatum is a key structure in human reward processing, and one of its most prominent roles is predicting rewards in response to dopaminergic stimulation from the midbrain. Reduced activity of the dopaminergic midbrain occurs, physiologically, in aging and, pathologically, in Parkinsonism. Here we used event-related fMRI to investigate mesolimbic processing of reward-predicting cues and reward outcomes in young and elderly healthy adults and in patients with early-stage idiopathic Parkinson's disease. In young adults, pictures of object drawings that predicted monetary reward were associated with stronger fMRI activity in the ventral striatum and in the dopaminergic midbrain, while positive reward outcome was associated with activation in anterior cingulate and medial prefrontal cortex. In contrast, both healthy elderly subjects and patients showed activation of the ventral striatum only in response to positive reward outcome, but not during reward anticipation. Patients additionally showed disrupted functional connectivity of the midbrain and ventral striatum. The striatal response difference between reward anticipation and outcome and the functional connectivity of the midbrain and ventral striatum were independently correlated with reward-related reaction time advantages. These results suggest that age-related alterations in the mesolimbic reward system might lead to a reduced ability to predict rewards, while the response to positive reward outcome is preserved in healthy elderly. Moreover, alterations of reward processing in Parkinson's disease appear to differ qualitatively from those found in healthy aging, thereby suggesting that Parkinson-related changes in the mesolimbic dopamine system do not simply reflect accelerated aging.

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AGE-RELATED DIFFERENCES IN MEDIAL PREFRONTAL ACTIVATION IN RESPONSE TO EMOTIONAL IMAGES *Christina Leclerc, Elizabeth Kensinger; Boston College* – Previous research has indicated preferential processing for emotional stimuli in our environment (i.e., stimuli that elicit physiological activation, goal-directed behavior, and subjective experience/feelings). Past research has begun to establish the neural mechanisms of emotional processing in younger adults, but little is known about the processing of emotional information in older adults. Moreover, even less research has attempted to distinguish the neural processes that younger and older adults use to process emotional information. Recent behavioral research has suggested a positivity effect (Carstensen & Mikels, 2005) in which older adults demonstrate increased processing of positive emotional material and decreased processing of negative emotional material. It has been hypothesized that this positivity effect is the result of the changing motivational goals discussed in Socioemotional Selectivity Theory in which time is perceived as limited and emotion regulation becomes a primary goal. The present fMRI study examined the underlying neural networks supporting the processing of emotional information in younger (ages 18-28) and older (ages 60-80) adults. Participants viewed positive, negative, and neutral images (e.g., sundae, snake, canoe) and were asked to indicate whether each would fit inside of a file cabinet drawer. More medial prefrontal activation was observed in younger adults for negative compared to positive images. In contrast, older adults showed more medial prefrontal activity when viewing positive compared to negative images. This pattern of results is consistent with the hypothesis that older adults may devote more resources toward processing positive information, whereas younger adults may be biased to process negative information.

C 119

A BITTER PILL TO SWALLOW: ORIGINS OF DISGUST IN THE ORAL REJECTION OF BITTER TASTES *Hanah Chapman[1], Marine Sutrisno[1], Adam Anderson[1,2]; [1]University of Toronto, [2]Rotman Research Institute* – Emotions are widely thought to have originated as evolutionary adaptations that assist organisms in responding to events that may have a significant impact on survival or reproduction. Since evolution can only build new adaptations out of pre-existing ones, differentiated human emotions such as anger, fear and surprise must have arisen from earlier motivational processes. For example, it has been proposed that disgust, a response to physical or ideational contamination, may have arisen from distaste, an oral rejection response to ingesting bitter substances, many of which are toxic. We tested this idea by comparing the facial expressions associated with distaste and disgust. Expressions were assessed by measuring facial skeletomotor activity via electromyography (EMG) of the brow, upper lip and cheek regions. In Study 1 we recorded facial EMG while subjects posed expressions of disgust, distaste, anger and happiness. Disgust and distaste were uniquely characterized by strong activation of the upper lip and brow regions. In Study 2 EMG was recorded while subjects sampled bitter (quinine), sweet (sucrose) and neutral (water) liquids. Compared to other liquids, bitter stimulation resulted in strong activation of the upper lip, brow and cheek regions. Thus, disgust and distaste both involve movements of the face that may facilitate expulsion of ingested material from the mouth. Since facial expressions have been the best evidence for distinct emotion classes, our demonstration of continuity between disgust and distaste in terms of facial expression provides evidence for their association.

C 120

SENSITIVITY TO AFFECTIVE DIMENSIONS OF EMOTIONAL PROSODY IN PATIENTS WITH PARKINSON'S DISEASE *Chinar Dara, Laura Monetta, Marc D. Pell; School of Communication Sciences & Disorders, McGill University* – There is recurring evidence that patients with Parkinson's disease (PD) are impaired for evaluating emotional speech prosody, suggesting that the basal ganglia are involved in processing vocal cues to emotion. These impairments may arise from an inability to process prosodic cues per se, or to interpret specific affective dimensions of vocal cues in PD patients. To better understand the role of the basal ganglia in processing emotional prosody, this investigation evaluated whether PD patients can judge specific affective properties of sentences, such as valence and arousal, in addition to specific emotional meanings of the stimuli. In three separate tasks, 16 PD patients and 17 healthy controls (HC) each listened to pseudo-utterances spoken in six emotional intonations (happy, pleasant surprise, sad, angry, fear, disgust). For each utterance, participants classified the emotional category of the prosody (identification task), rated how positive or negative the stimulus sounded (valence rating task), or rated how intense the emotion was expressed (intensity rating task). Results indicated that PD patients were impaired as compared to HC for categorizing the emotional meaning of prosody, and in addition, showed reduced sensitivity to valence (but not arousal) properties of the same emotional expressions. Findings imply that the basal ganglia play a role in integrating certain aspects of emotional information which refer to valence when processing prosodic cues in speech.

C 121

EXPLICIT AND IMPLICIT DETECTION OF VOCAL EMOTIONS BY ADULTS WITH PARKINSON'S DISEASE *Marc Pell, Chinar Dara; McGill University, School of Communication Sciences and Disorders* – The basal ganglia have been ascribed a role in the processing of sequential information, including the ability to assign meaning to vocal cue sequences which encode emotions in speech. However, present data do not specify whether contributions of the basal ganglia to vocal emotion recognition are more pronounced at stages of explicit or implicit processing of representative cues. Using Parkinson's disease (PD) as a context for understanding basal ganglia contributions to vocal emotion decoding, this study compared matched groups of adults with and without PD on tasks of explicit and implicit comprehension of vocally-expressed emotions. Participants were presented pseudo-utterances which unambiguously conveyed different emotions through the voice in an explicit and implicit processing task. In the explicit task (forced-choice recognition), participants were required to categorize the emotion conveyed by each utterance and the accuracy and direction of their errors were examined between groups. In the implicit task (emotional priming paradigm), participants made facial affect decisions about a series of emotional target faces which were preceded by an emotionally related or unrelated pseudo-utterance. For the implicit task, the presence of emotion congruency effects was examined between groups, indicating whether participants with or without PD varied in the ability to implicitly associate emotional meanings of vocal cues with corresponding features in the face. Results were examined for each task separately and then compared between explicit and implicit contexts to infer whether basal ganglia contributions to vocal emotion decoding are mandatory across tasks, or alternatively, are tied to specific processing environments.

C 122

PRIMARY AND SECONDARY EMOTIONS: A COMPUTATIONAL ANALYSIS OF FACIAL EXPRESSION STRUCTURE AND MEANING *Joshua Susskind[1], Javier Movellan[2], Marian Bartlett[2], Gwen Littlewort[2], Adam Anderson[1]; [1]University of Toronto, [2] UC San Diego, Institute for Neural Computation* – Computer models of facial expression judgments indicate that physical feature overlap in between expressions determines similarity amongst expression types (c.f., Adolphs, 2002; Susskind et al, in press). Using a Support Vector Machine based computer model trained to accurately discriminate amongst six basic emotional facial expressions (happiness, sadness, anger, disgust, surprise, and fear), we demonstrated that expressions the model was trained to discriminate were confused by the model in a systematic manner matching human ratings of emotion similarity, which is consistent with the claim that overlap in physical features explains subjective similarity (Susskind et al, in press). Here, we investigate the computer model's generalization performance on shame and contempt expressions, which have been conceptualized as blends of basic emotion categories (Plutchik, 1980). We first show that human observers consistently rate shame expressions as similar to sadness, and contempt expressions as similar to anger and disgust. If these similarity relations for shame and contempt are due to feature overlap with sadness and anger/disgust, respectively, computer model predictions should parallel human judgments. The computer model's generalization for shame and contempt was not systematic and did not resemble the human similarity ratings, thus providing evidence against the claim that human similarity ratings for these expressions are due to overlapping visual features. Rather, this finding suggests that whereas basic emotions are related to each other based on structural similarity, shame and contempt rating patterns are due to similarity in associated knowledge representations of emotion concepts or feeling states.

C 123

BRAIN REGIONS INVOLVED IN LEARNING AND APPLICATION OF REWARD RULES IN A 2-DECK GAMBLING TASK *Eveline Crone[1], Egbert Hartstra[1], Jonne Oldenburg[1], Serge Rombouts[2]; [1]Leiden University, the Netherlands, [2]Leiden Institute for Brain & Cognition, Leiden University, the Netherlands* – Decision-making involves the ability to choose between competing actions that are associated with uncertain benefits and penalties. The Iowa Gambling Task (IGT), which mimics real-life decision-making, involves learning a reward –punishment rule over multiple trials, and patients with damage to ventromedial (VM) prefrontal (PFC) cortex show deficits learning these rules. In this study, we used functional Magnetic Resonance Imaging to study the role of PFC regions involved in rule learning and rule application in healthy adults using an experimental version of the Iowa Gambling Task. Participants were asked to infer rules over 16 trials in a 2-deck card game. Reward was given on each trial and punishment was unpredictable. For half of the rules, those decks that gave high rewards were also the better decks, for the other half those decks that gave low reward were the better decks. Behaviorally, participants learned to find the advantageous rule after approximately 5-7 trials, and this learning occurred faster for decks where high reward was the better choice. Dorsolateral (DL) PFC cortex and anterior cingulate cortex (ACC) were most active during rule learning, whereas VMPFC was most active during rule application. These results suggest that DLPFC and ACC are important when directing behavior towards long-term goals, whereas VMPFC represents reward values.

C 124

EMOTIONAL MODULATION OF STRATEGY USE IN A PROBABILISTIC CLASSIFICATION LEARNING TASK. *Laura Thomas, Kevin LaBar; Duke University* – We investigated the influence of emotional outcomes on strategy use during probabilistic classification learning. Two groups of participants saw cue cards that predicted outcomes in a probabilistic manner. One group received neutral outcomes (flowers/mushrooms) while the other group received emotional outcomes (snakes/spiders). A subgroup of participants who exhibited phobic levels of fearfulness to the emotional outcomes were analyzed separately. Subjects completed 100 trials in Session 1, and returned 24 hours later for 100 additional trials in Session 2. Performance in Session 1 was equivalent between neutral and emotional control subjects, while phobic subjects performed worse than the emotional controls. In Session 2, however, there were no performance differences across groups. Strategy analyses were based on Meeter et al. (2006), and parsed intervals of each subject's performance as following one of five strategy types: no identifiable strategy, singleton, single-cue, intermediate, and optimal. At the end of Session 2, more subjects in the neutral condition were using an optimal strategy as compared to emotional control and phobic subjects. Additionally, there were more emotional controls and phobics using strategies not identified by the current analyses at the end of Session 2 than neutral subjects. Neutral and emotional control subjects employed differing types of simple strategies, with a greater number of neutral subjects using the singleton strategy and emotional control subjects preferring the single-cue strategy. Our study demonstrates that emotional outcomes alter strategy use in a probabilistic classification learning task.

C 125

TRAIT EMPATHY AND SENSITIVITY TO MORPHED EMOTIONAL FACES *Heidi S. Blocker, Orquidea Morales, Roque Mendez, Reiko Graham; Texas State University* – Facial expressions of emotion are important indicators of the emotional states of others. According to neurological studies, viewing a facial expression appears to activate the same brain areas involved in the personal experience of that emotion. This may be related to the construct of empathy: the notion of a participation in the thoughts and feelings of others, commonly measured using a questionnaire. We examined the relationship between trait empathy scores and the ability to detect and interpret morphed facial expressions of fear and anger. Subjects made judgments about morphed facial expressions while their response times and sensitivity to changes in emotional expression were measured. While there was no relationship between the ability to detect the presence or intensity of fear or anger alone, particular empathy subscales were significant predictors of how individuals interpreted blends of fear and anger. Greater empathic concern was associated with increased likelihood of endorsing an ambiguous blend as angry, while greater perspective taking in real and imagined situations was associated with an increased likelihood of endorsing a blend as fearful. We conclude that trait empathy can have an influence on how individuals decode facial expressions, most notably under conditions of emotional uncertainty. However, the ability to decode facial expressions is just one facet of the complex emotional and cognitive construct of empathy.

C 126

PERCEIVING WHOLE BODY EXPRESSIONS OF FEAR IN HIGH FUNCTIONING AUTISTIC AND ASPERGER SUBJECTS *Beatrice de Gelder[1], Bruno Wicker[2], Sylvie Berthoz[3], Julie Grezes[4]; [1]Donders Laboratory for Cognitive and Affective Neurosciences, Tilburg, The Netherlands and FC Donders Centre for cognitive brain-imaging, Nijmegen The Netherlands, [2]Institut de Neurosciences Cognitives de la Méditerranée, CNRS, Marseille, France, [3]Institut Mutualiste Montsouris, Paris, France, [4]CNRS - Collège de France, Paris, France* – Impaired use of multiple nonverbal behaviours is a core feature in autistic spectrum disorder. There are currently many lines of research on the possible origin of these problems in social communication and deficits in the processing of emotional information. Some authors think that the social deficit could be a consequence of amygdala dysfunction leading to functional abnormalities that impair the ability to detect socially relevant visual cues. Another model speculates that this impairment could be the consequence of a malfunctioning mirror system generating a deficit in the ability to represent the actions of others. Using event-related fMRI in humans, we investigate how fear signals from dynamic whole bodies are perceived. A factorial design allows us to investigate brain activity induced by viewing dynamic actions and bodily expressions of fear. Twelve adults with high-functioning autism or Asperger Syndrome (HFA/AS) and 12 matched controls are scanned. Our critical findings are threefold. First, we show that the motor mirror system (STS, parietal and premotor cortex) is activated both in controls and autistic subjects when viewing dynamic actions. Second, when perceiving fearful bodies, typical subjects show greater activations in the amygdala, temporal cortex, inferior frontal gyrus and premotor cortex, possibly reflecting the affective evaluation of the stimuli and preparation for motor responses related to defensive behaviors. These activations were absent in the HFA/AS, who show greater activation in the medial superior frontal cortex. Altogether, these results may suggest that in the HFA/AS, the motor mirror system, while functional, may be dissociated from socio-affective capabilities.

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CATEGORICAL PROCESSING OF AUDITORY EMOTIONS AS REVEALED BY THE MISMATCH NEGATIVITY *Katja N. Spreckelmeyer[1,2], Eckart Altenmüller[2], Thomas F. Münte[3]; [1]Aachen*

University, [2]Institute of Music Physiology and Musicians' Medicine, Hanover University of Music and Drama, [3]Magdeburg University – Specific acoustical patterns have been identified to reliably express prototypical emotions such as happiness and sadness in verbal and non-verbal expressions. However, the neural basis of auditory emotion recognition is still unclear. Given that the evaluation of emotionally expressive sounds typically happens fast and effortless, even cross-culturally, it has been suggested that it is based on pre-wired representations of emotion-specific acoustical cues. Since many different utterances may express the same emotion a number of different cue-combinations need to exist for each emotion-category. To test for a neural basis of such a schema-based processing of emotionally expressive non-verbal sounds event-related brain potentials (ERP) were recorded in a passive oddball paradigm in 16 participants (8 women). Three happy sounding tones of different perceptual structure were randomly presented as standard tones in condition one, three different sad tones in condition two. One of the standards in each condition also served as deviant in the respective other condition (25% probability of occurrence). Presenting a happy tone in a series of sad tones resulted in a mismatch negativity (MMN) that was larger in amplitude than the ERP to the same happy tone functioning as standard in the opposite condition. In contrast, no difference was found for the sad tone presented in a train of differing happy tones. The results indicate that the brain built a common sensory memory trace of the standard tones based on their emotional similarity despite the structural heterogeneity of the individual tones, though only for the sad tones.

C 128

EMOTION MODULATES EPISODIC RECALL THROUGH IMPLICIT PROCESSES *Magali Seassau[1], Richard Levy[2], Pascale Gisquet-Verrier[3]; [1]INSERM U610; CNRS UMR 8620, Paris, France, [2]INSERM U610, Paris, France, [3]CNRS UMR 8620, Orsay, France* – In a novel paradigm, we investigated whether emotion may exert a direct influence on the efficacy of memory retrieval. Thirty normal subjects were submitted to an unexpected recognition test of affective pictures (emotional and neutral) one week after an encoding phase during which these pictures were associated with neutral background pictures. At the recognition phase, the background pictures were used as primes under implicit or explicit condition. Each background picture can be the one associated with the target affective picture at the encoding phase or different (a novel background or a background associated with another affective picture at the encoding phase). Under implicit conditions, and in contrast to explicit conditions, reaction times were only reduced when the emotional picture was primed either by the associated background or by a background initially associated with an emotional picture sharing the same valence. This effect was restricted to backgrounds initially associated with emotional pictures. These results demonstrate that, in specific conditions, the valence of a given emotion associated to a relevant stimulus can be transferred to a neutral context, which may subsequently serve as an efficient cue for recalling the specific stimulus but may also reactivate, in a non-specific way, episodes sharing the same emotional valence. These results may open new ways to evaluate tools for memory assessment and to develop techniques to rehabilitate memory deficits using emotional content.

C 129

EMOTION PERCEPTION IN BORDERLINE PERSONALITY DISORDER *Miriam Dyck, Julia Slodczyk, Julia Schlummer, Volker Backes, Thilo Kellermann, Ute Habel, Frank Schneider, Martina Reske; RWTH Aachen University* – The ability to decode emotional information in the face is crucial for social interaction and communication. Individuals who meet the criteria for borderline personality disorder (BPD) demonstrate marked problems in interpersonal relationships and emotion regulation. Surprisingly, empirical research on facial emotion recognition in BPD is sparse until now and the few studies which have been published yielded inconsistent results. With a novel set of facial stimuli the present study investigated whether BPD patients in contrast to healthy subjects are impaired in the perception of emotional and neutral facial expressions. For this purpose 20 patients diagnosed with BPD and 20 healthy subjects completed two different tasks targeting emotion recognition. In both tasks subjects were asked to evaluate the emotional content of visually presented stimuli (emotional and neutral faces). The first task required a fast discrimination between negative and neutral facial expressions whereas in the second task a precise decision regarding default basic emotions (sadness, happiness, anger, fear) including neutral expressions had to be achieved. Results indicate significant differences between groups in the ability to discriminate negative and neutral facial expressions. In line with earlier findings, patients showed a negative bias in the evaluation of neutral facial expressions. The ability of BPD patients to recognize specific emotions within facial expressions was however not impaired. In summary, results point to a selective deficit of BPD patients in quick and direct discrimination of negative and neutral emotional expressions. Follow-up studies should investigate the underlying neuropathological mechanisms with functional magnetic resonance imaging.

C 130

INSULA ACTIVATION TO DISGUST FACIAL EXPRESSIONS AND PICTURES – A MAGNETOENCEPHALOGRAPHY (MEG) STUDY *Yu-Han Chen[1], Jürgen Dammers[2], Frank Boers[2], Katrin Amunts[2,1], Klaus Mathiak[1]; [1]RWTH Aachen University, University Hospital Aachen, [2]Institute of Medicine, Forschungszentrum Jülich* – Insular cortices have been reported as a key link between emotion and cognitive processes (Wager & Feldman Barrett, 2004). This study focused on investigating the dynamics of insula activation associated with the perception disgust. MEG was recorded to investigate brain activity in an emotional task using disgust facial expressions and pictures. Two presentation durations for faces (100ms and 1000ms) were used to separate early processes of emotional facial processing in the insula and other emotion-related cortical structures. Emotional faces/pictures (disgust, happy, neutral) were randomly presented in three blocks: (1) face stimuli presented for 1000ms, (2) face stimuli presented for 100ms, and (3) IAPS pictures presented for 1000ms. Participants were asked to response to the picture/face which displays the same emotional atmosphere/expression as the previous image (one back). After the MEG recordings a recognition task for facial expressions and valence/arousal rating of the pictures was performed. Magnetic Field Tomography (MFT) and MEG anatomy toolbox (Dammers et al., in press) were combined to objectively localize insular cortices. The results showed stronger activations for emotional compared to neutral faces and emotional pictures. Neuromagnetic signals of the processing of happy and disgust faces between 240-340ms after the stimulus onset were localized in accordance to insula activity. Interestingly, the time courses of insula activation differentiated between happy and disgust faces, and this underlies how important the analysis of the temporal aspects of brain activity is in gaining a comprehensive picture of emotional processing.

C 131

ATYPICAL PATTERNS OF CORTICAL ACTIVATION IN HEALTHY CHILDREN AND CHILDREN WITH ADHD WHILE VIEWING EMOTIONAL FACIAL EXPRESSIONS *Abigail Marsh[1], Elizabeth Finger[1], Derek Mitchell[2], Daniel Pine[1], RJR Blair[1]; [1]National Institute of Mental Health, [2]University of Western Ontario* – ADHD in children and adolescents is characterized by an impaired ability to modulate behavior appropriately in response to environmental cues. Accordingly, imaging studies in children with ADHD show atypical patterns of brain activation relative to healthy children in regions associated with executive control and behavior modulation, particularly prefrontal regions and cingulate cortex. Facial expressions of emotion are cues that serve to modulate the behavior of others. Anger expressions in particular modulate or inhibit inappropriate behavior. Prior evidence suggests children with ADHD to be impaired in processing emotional expressions, particularly anger expressions (Corbett & Glidden, 2000; Pelc et al, 2006). The goal of this study was to compare neural responses to anger expressions relative to fear and neutral expressions in healthy children and children with ADHD. All children were assessed using the K-SADS. Children were then scanned using event-related fMRI (1.5 Tesla) while viewing neutral, fear, and anger expressions. These expressions were morphed with neutral expressions such that they varied in intensity (50%, 100%, and 150%). Participants indicated with button-presses the gender of each face. Results indicated atypical patterns of activation in children with ADHD relative to healthy children in ventral prefrontal cortex, superior temporal gyrus, posterior cingulate cortex, fusiform gyrus, and caudate. In particular, children with ADHD showed dysfunctional BOLD responses to anger expressions in these regions relative to neutral expressions, and relative to healthy children. These results support the conclusion that children with ADHD are impaired in processing expressions that demand the modification of behavior.

C 132

TOP-DOWN ATTENTIONAL CONTROL UNDER THE INFLUENCE OF DISTRACTER EMOTIONALITY AND VISIBILITY: AN EVENT-RELATED FMRI STUDY *Qian Luo, Derek Mitchell, Meena Vythilingam, Krystal Mondillo, Niveen Kamel, James Blair; Mood and Anxiety Disorders Program, National Institute of Mental Health* – In the presence of a distracter, top-down attentional control is needed to suppress its influence and to ensure target processing. Here we investigated the effect of distracter emotionality and visibility on top-down control. In the study, subjects focused on the target that was either preceded by distracters (distracter types: subliminal-emotional, subliminal-neutral, supraliminal-emotional, supraliminal-neutral) or nothing (control condition). Behavioral data showed that the presence of distracters significantly interfered with target processing. FMRI results indicated that distracter valence and visibility had a similar interfering effect in fronto-parietal cortical attentional network. This suggests that the more emotionally or visually salient a distracter is, the more effort is needed to exert top-down control. Such effect can be explained the neural input from sensory and subcortical attentional/emotional area. In the visual area, visibility was found, which might contribute to the greater control need in cortical attentional network for visible distracters. In the subcortical attentional areas (thalamic pulvinar and superior colliculus, areas associated with bottom-up attention) and the amygdala (an area for emotional encoding and has reciprocal connections with subcortical attentional areas), only valence effect was obtained. Valence effect was also found in visual area. Presumably, the reason for valence effect in cortical attentional area might be a result of stronger input from subcortical attentional areas and visual area triggered by emotional versus neutral distracters. Interestingly, although interfering effect in the subliminal condition was greatly reduced relative to the supraliminal condition, it was still significant in the emotional condition (although not in the neutral condition).

C 133

NEURAL CORRELATES OF EMOTION & ATTENTION PROCESSING IN POSTTRAUMATIC STRESS DISORDER *Jasmeet Pannu-Hayes[1], Christopher M. Petty[1], Debra A. Cooper[2], Kevin S. LaBar[2], Gregory McCarthy[3,1], Rajendra A. Morey[2,1]; [1]Durham VA Medical Center/ MIRECC, [2]Duke University Medical Center/Brain Imaging & Analysis Center, [3]Yale University* – It has been well established that patients with PTSD preferentially allocate attentional resources to threatening stimuli (Vrana, Roodman, & Beckham, 1995). However, the neural pattern reflecting the influence of negative emotion on attention in PTSD has yet to be demonstrated. In the present study, subjects with PTSD symptomatology engaged in an emotional oddball task, which has previously shown that emotion and attention largely segregate into ventral (affective) and dorsal (cognitive-attention) streams (Yamasaki, LaBar, & McCarthy, 2002). Twenty-six subjects with a history of trauma were classified into a high PTSD symptomatology group (patients) or low PTSD symptomatology group (trauma control) based on their scores on the Davidson Trauma Scale. Subjects discriminated infrequently presented target stimuli (circles) from frequently presented standards (squares) while emotional and neutral distracters were intermittently presented. Results show that the patient group had greater neural activity than the trauma control group for emotional stimuli in the right middle frontal gyrus, as well as in ventral regions such as the fusiform gyrus. By contrast, the trauma control group showed greater activation in frontal regions during the attention task. Differences also emerged between groups in the cingulate cortex, a region implicated in the integration of the emotional and attentional processing streams. Finally, trauma control subjects showed greater medial temporal lobe activation than patients during viewing of neutral stimuli. These results provide evidence for emotional interference of attention in PTSD on a neural level.

C 134

GAZE FIXATION PREDICTS BRAIN ACTIVATION DURING THE VOLUNTARY REGULATION OF PICTURE-INDUCED NEGATIVE EMOTION *Carien van Reekum[1], Tom Johnstone[1], Heather L. Urry[1,2], Marchell E. Thurow[1], Hillary S. Schaefer[1], Andrew L. Alexander[1], Richard J. Davidson[1]; [1]University of Wisconsin-Madison, [2]Tufts University* – A number of studies have identified a distributed network of brain regions underlying emotion regulation in response to affective images, including parieto-temporal regions and lateral/medial regions of prefrontal cortex (PFC). Given the role of PFC in cognitive control, these areas are considered crucial in emotion regulation. However, a number of these commonly activated regions are thought to underlie visuospatial attention and oculomotor control. Indeed, people use attentional deployment as one of a number of strategies to regulate emotion. We predict that a significant portion of the observed variance in brain activation is due to differences in how participants visually scan the images while regulating their emotions. We recorded brain activation using fMRI and quantified patterns of gaze fixation while participants increased or decreased their affective response to a set of affective images. FMRI results replicated previous findings on emotion regulation. Our gaze fixation data revealed that when regulating, individuals changed their gaze patterns, and this variation in gaze fixation explains substantial amounts of variance in brain activation, to the extent that for the decrease condition little additional variance is left explained by any other regulation process. While a drop in the proportion of variance uniquely left explained by regulation for the increase condition is observed in similar brain regions, the magnitude of this drop is not as dramatic as for the decrease condition. These data point to the importance of gaze fixation as a regulatory strategy, and have important methodological consequences.

C 135

SOPHIE'S CHOICE: NOT A PERSONAL DILEMMA FOR PATIENTS WITH VENTROMEDIAL LESIONS *Giuseppe di Pellegrino[1,2], Elisa Ciaramelli[3], Michela Muccioli[2], Elisabetta Ladavas[1,2]; [1]Universita' di Bologna, Italy, [2]Centro Studi e Ricerche di Neuroscienze Cognitive, Cesena, Italy, [3]Rotman Research Institute, Toronto, Canada* – Recent fMRI evidence has detected increased medial prefrontal activation during contemplation of personal moral dilemmas compared to impersonal (Greene et al., 2001), which suggests that this brain area plays a role in personal moral judgment. However, it is not clear whether the medial prefrontal cortex would be essential to oppose personal moral violations or whether its activation would merely reflect processing of personal dilemmas. In the present study, we tested 7 patients with lesions in the ventromedial prefrontal cortex and 12 healthy individuals in personal moral dilemmas (e.g., the footbridge dilemma) and impersonal moral dilemmas (e.g., the trolley dilemma). Both types of dilemma require to judge whether it is appropriate to incur in a moral violation in order to maximize overall consequences. However, whereas personal moral violations involve causing bodily harm to an individual through one's own action, impersonal moral violations lack this sense of agency, and therefore may induce a less intense emotional experience in individuals (Greene et al., 2001). A set of dilemmas with no moral implication (i.e. nonmoral dilemmas) was also included for comparison purposes. Compared to normal controls, patients were more willing to judge personal moral violations as acceptable behaviours in personal moral dilemmas, and they did so more quickly. In contrast, their performance in impersonal and nonmoral dilemmas was comparable to the controls. These results provide evidence that the ventromedial prefrontal cortex is critical to oppose personal moral violations. This area might be implicated in forecasting the long-term emotional outcomes of choice options during decision-making.

C 136

THE COMBINATION OF REDUCED ACTIVITY IN VENTROMEDIAL AND DORSOMEDIAL PREFRONTAL CORTEX PREDICTS THE COMBINATION OF REDUCED REWARD RESPONSIVENESS AND ELEVATED ANHEDONIA *Sharee N. Light[1], Tom Johnstone[1], Ned H. Kalin[1], Heather L. Urry[2], Carien M. van Reekum[1], Richard J. Davidson[1]; [1]University of Wisconsin-Madison, [2]Tufts University* – Anhedonia, a reduced ability to experience pleasure, is a chief symptom of major depressive disorder (MDD). Functional magnetic resonance brain imaging was used to track prefrontal cortex (PFC) activity in 21 MDD patients (mean age 33, 8 males) compared to 18 age matched controls (7 males) as participants viewed a sequence of emotionally positive images taken from the International Affective Picture System. MDD patients had significantly lower ($p<.001$) "reward responsiveness" scores (Carver & White, 1994), and had significantly higher ($p<.001$) "anhedonia" scores (Watson et al., 1995) compared to controls. To determine whether PFC activity could account for these observed differences in reward responsivity and anhedonia, a general linear model was used to compare PFC activity exhibited by controls versus MDD patients. Controls showed greater activation in ventromedial (VMPFC; $p<.01$) and dorsomedial (DMPFC; $p<.001$) PFC as they viewed positive images compared to MDD patients. VMPFC activity correlated with DMPFC activity (.67; $p<.001$). Activity in each region predicted reward responsiveness/anhedonia level (p's<.05). To determine whether the combined activity of these two prefrontal regions constitute a PFC circuit that enables the experience of pleasure, VMPFC and DMPFC activity was mathematically combined with a principal components analysis (PCA). Reward responsiveness and anhedonia scores were also combined with a PCA. Variation in VMPFC/DMPFC activation accounted for 28% ($r=.52$, $p<.01$) of the variance in reward responsiveness/anhedonia level. In sum, MDD patients did not potently recruit VMPFC/DMPFC when presented with a positive stimulus, and this may be a neural marker of a reduced ability to generate pleasure.

C 137

BRAIN NETWORKS INVOLVED IN DIFFERENT TYPES OF EMOTIONAL APPRAISAL DURING MOVIE VIEWING *Kyung Hwa Lee[1], Walter Schneider[1,2], Maureen McHugo[2], Greg Siegle[1]; [1]Center for the Neural Basis of Cognition, University of Pittsburgh, [2]Learning Research and Development Center, University of Pittsburgh* – Several different types of emotional appraisal may occur in response to emotional stimuli such as evaluation of one's own emotions, evaluation of other people's emotions, or evaluation of the positivity or negativity of the stimulus more generally (emotion identification). Neuroimaging studies have examined neural substrates underlying emotional appraisal by instructing participants to engage in each of these types of appraisal. However, whether these different types of appraisal of emotion are associated with similar or different brain networks has not been examined. The present study investigated how brain activity correlated with three different types of appraisal of emotional information. We scanned 12 healthy participants while they watched movie clips passively using 3T fMRI. Subsequently, 14 healthy volunteers watched the same movie clips passively first, and then they were instructed to provide continuous retrospective appraisal ratings of emotion with three different appraisal instructions while repeatedly watching the same movie clips. Correlation analysis revealed the DMPFC, PCC, and amygdala as overlapping brain networks correlated with all three types of appraisal of emotion. Partial correlation analysis also elucidated distinct brain networks correlated with each individual appraisal type of emotion. For example, ratings of other people's emotion correlated with brain activity in the FFA and MTG whereas rating data of one's own emotion correlated with brain activity in the MPFC and ACC. These results suggest that different types of emotional appraisal may share some common brain networks, but may recruit different brain networks specialized for specific types of appraisal of emotion.

C 138

THE RELATIONSHIP BETWEEN CORTISOL AND MEMORY: PRELIMINARY ANALYSIS ON THE ROLE OF AFFECTIVE STATE AND THE AMYGDALA *Allison Jahn[1], Simone Kern[2], Richard Davidson[1], Jerry Halverson[1], Clemens Kirschbaum[2], Heather Abercrombie[1]; [1]University of Wisconsin, Madison, [2]Technical University of Dresdeny* – Research suggests that the beneficial effects of cortisol on memory depend on the emotional state of the individual (Okuda et al., 2004; Abercrombie et al., 2006). These studies suggest that negative emotional arousal plays a permissive role in the effects of cortisol on memory. Animal data suggests that amygdala activation, specifically noradrenergic activity in the basolateral amygdala, is necessary for the beneficial effects of cortisol on memory. We hypothesize that cortisol will interact with both amygdala activation and emotional state to predict memory performance. Participants served as their own controls. They received placebo or 15 mg hydrocortisone one hour before a self-referent encoding task (two separate fMRI scans; order counterbalanced). Participants completed recognition memory tests after the scanning sessions. Preliminary analyses ($n=14$) of event-related fMRI show increased brain activation in response to negative words vs. positive and neutral words in the left ventral amygdala after the administration of cortisol only in individuals with low positive affect ($n = 7$). Also, we found an interaction between emotional state and cortisol in predicting memory performance, such that only individuals with low positive affect show greater memory for negative words encoded during cortisol compared to placebo administration ($F(1,12) = 6.16$, $p < 0.05$). Our data are consistent with the hypothesis that the beneficial effects of cortisol on memory depend on emotional state and amygdala activation. With additional participants we will test whether amygdala activation predicts memory performance.

C 139

AMYGDALA, NUCLEUS ACCUMBENS, AND VENTRAL ACC ARE ENGAGED DURING ANTICIPATION OF SOCIAL FEEDBACK AND ARE MODULATED BY INDIVIDUAL DIFFERENCES IN SELF-ESTEEM AND ANXIETY *Leah Somerville, Todd Heatherton, William Kelley; Dartmouth College* – This study investigated the neural structures involved in social information processing while anticipating social feedback from others. During two fMRI studies, participants ($N=42$) viewed faces of strangers and formed a first impression (like/dislike) of each face (Study 1), or predicted whether the pictured individual would like the participant (Study 2). Following this decision period, subjects waited to receive fictitious feedback indicating whether the pictured individual accepted or rejected the participant. Of interest was the neural activity that accompanied the anticipation period. The anticipation period engaged bilateral regions of the nucleus accumbens and ventral amygdala significantly above baseline. After scanning, we assessed individuals' self-esteem, social anxiety, and rejection sensitivity using self-report measures. A factor analysis identified a predominant factor comprising higher anxiety and rejection sensitivity and lower self-esteem. Whole-brain regression analysis examining this putative rejection anxiety factor score identified positive correlations with nucleus accumbens and ventral anterior cingulate activity during the delay portions of trials. Although the amygdala responded during the anticipation period, amygdala activity was insensitive to individual differences in the rejection anxiety factor, suggesting a relatively stable engagement of this region in anticipation of social evaluation across subjects. These findings indicate that nucleus accumbens activity during reward anticipation can be extended to situations involving social evaluation, and suggest that the degree of this involvement varies based on individual differences.

C 140

CHOOSING THE LESSER OF TWO EVILS, THE BETTER OF TWO GOODS: THE ROLE OF 5-HTTLPR GENOTYPE AND TRYPTOPHAN DEPLETION STATE IN OBJECT CHOICE *Karina Blair[1], Elizabeth Finger[1], Abigail Marsh[1], John Morton[2], Beata Buzas[1], David Goldman[1], Wayne Drevets[1], National Institute of Mental Health, NIH, James Blair[1]; [1]National Institute of Mental Health, NIH, [2]Institute of Cognitive Neuroscience, University College London* – The serotonin (5-HT) system has been considered important for both reward- and punishment-related decision-making. However, work distinguishing its role in reward and punishment processing has only just begun. One aspect of decision-making that has received little attention is that making the right choice often translates to making the better choice. Thus, response choice often occurs in situations where both options are desirable (e.g. choosing between mousse au chocolat or crème caramel cheesecake from a menu), or alternatively in situations where both options are undesirable. Moreover, response choice is easier when the reinforcements associated with the objects are far apart, rather than close, in value. In this study, healthy volunteers underwent acute tryptophan depletion (ATD) or control procedures and genotyping of the 5-HTTLPR for long and short allele variants. We then examined the effects and interactions of ATD and the serotonin promoter polymorphism genotype on two aspects of decision-making: (a) decision form; i.e., choosing between two objects to gain the greater reward or lesser punishment; (b) between-object reinforcement distance; i.e., the difference in reinforcements associated with two objects. ATD and LL homozygosity had comparable interactions with decision form and between-object reinforcement distance. Specifically, both disrupted the effect of between-object reinforcement distance when deciding between objects both associated with punishment. Moreover, ATD and genotype interacted, with ATD disproportionately affecting the performance of the LL homozygous group. These results suggest that serotonin is particularly associated with punishment, rather than reward-related processing, and that individual sensitivity to punishment-related information, and tryptophan depletion varies.

C 141

EMOTION RECOGNITION EXPLORED THROUGH MUSIC IN CHILDREN WITH AUTISTIC SPECTRUM DISORDERS *Eve-Marie Quintin[1], Anjali K. Bhatara[2], Éric Fombonne[3], Hélène Poissant[1], Daniel J. Levitin[2]; [1]Université du Québec à Montréal, [2]McGill University, [3]Montreal Children's Hospital, McGill University Health Center* – Musical abilities are one of the strengths of individuals with autistic spectrum disorders (ASD). They exhibit a heightened interest in music (Levitin et al., 2004) and above average auditory processing abilities (Brown et al., 2003). Baron-Cohen and colleagues (2000) believe that hypo-functioning of the amygdala may explain the social and emotional deficits in autism such as a diminished sensitivity to fear. The observation of strong musical interest and abilities, coupled with impaired emotion processing, presents a paradox because the communication of emotion is generally regarded to be a primary purpose or effect of music (Juslin & Sloboda, 2001). Thus, we assessed recognition of happy, sad, scary and peaceful music in ASD. It was expected that happy and sad music would be identified as such by individuals with ASD (see Heaton et al., 1999) but that their recognition of scary and peaceful music would be impaired, as observed in patients with damage to the amygdala (Gosselin et al., 2005). Twenty adolescents (12-17 yrs.) with ASD and 20 typically developing children and adolescents (9-17 yrs.) participated in the study. Groups were matched for musical knowledge and aptitude using the SAMMI. Participants heard 20 musical clips and were asked to identify the emotion conveyed in the music: happy, sad, scary or peaceful. They also judged how intensely each emotion was conveyed and how confident they were that they had selected the correct emotion. (M)ANOVAs will be performed to test for main and interaction effects of diagnosis group and intended emotion.

C 142

PSYCHOPHYSIOLOGICAL STUDIES OF EMOTIONAL AROUSAL TO BILINGUAL SPEAKERS' FIRST AND SECOND LANGUAGES *Catherine Caldwell-Harris[1], Marianna Staroselsky, Nadya Vasilyeva[2], Victoria Rukovets[1]; [1]Boston University, [2]Northeastern University* – The importance of studying the emotional concomitants of cognitive abilities has become increasingly appreciated over the last decade, yet no systematic empirical study of emotion and language has been undertaken. The current study uses bilingualism as a method of obtaining reliable differences in emotional report. Second language users frequently report that concepts expressed in their first language have greater emotional resonance than concepts expressed in their second language. Electrodermal recording was used to verify this psychophysiologically in English speakers who had grown up with Russian as their first language, or who had acquired Russian as a foreign language in the teen years or later. Stimuli included insults, childhood reprimands (e.g., "Shame on you!"), and positive emotional expressions (compliments, endearments). Late learners of English showed stronger skin conductance responses (SCRs) to emotion words in their first language, Russian, while late learners of Russian showed stronger responses to English. Russian-Americans who grew up with both languages had more similar responses to the two languages. SCRs of English monolingual speakers varied for English phrases but not Russian, indicating that results are due to the meaning of the phrases and not their emotional tone. Participants' ratings of their emotional arousal to the endearments and reprimands were almost as high as to the insults, but SCRs were elevated only for insults. Reports of which language was generally experienced as more emotional was generally the language of highest proficiency, except that the bilingual-from-birth group varied in their report, suggesting that both proficiency and age-of-acqusition are important for determining emotional reactivity.

C 143

RECOGNITION AND PRODUCTION OF EMOTIONAL FACIAL EXPRESSIONS IN HUNTINGTON'S DISEASE *Iris Trinkler, Anne-Catherine Bachoud-Lévi; Ecole Normale Supérieure, et INSERM équipe* – It has been shown numerously that patients with Huntington's Disease (HD) present with a recognition deficit for emotional facial expressions (Sprengelmeyer et al 1997, 2006 ; Grey et al. 1997 ; Milders et al. 2003 ; Hennenlotter et al. 2004 ; Montagne et al. 2006). The impairment consistently involves disgust but often also other emotions (Sprengelmeyer et al. 1997; Milders et al. 2003; Montagne et al. 2006; De Gelder et al. subm). Our interest is to establish how the recognition deficit is correlated to a potential deficit in the production of emotional expressions, and how both are correlated with measures of motor deficits (UHDRS motor). 15 early HD and 15 control subjects, matched for years of education, sex, and age, take part in this experiment. Subjects perform a forced-choice recognition test of emotional facial expressions (anger, disgust, fear, joy, sadness, and surprise) using 60 images from the Karolinska Faces inventory (Lundqvist, D., et al. 1998) and the 60 Ekman faces (Ekman & Friesen 1976). Further, the subjects are filmed while they produce the six emotional facial expressions repeatedly. The most salient still image of each production is selected and given to two naïve rater(-neurologist)s as a forced-choice recognition test. Recognition and production scores are correlated and compared to aspects of the UHDRS motor. With this study, we will for the first time illuminate the relationship between action production and perception for emotional stimuli. This will advance our understanding of social cognition deficits in HD (Snowden et al. 2003).

C 144

"I'M DOWN BUT I'M HAPPY" REMAPPING THE RELATIONSHIP BETWEEN NEURAL SIMULATIONS OF DIRECTION AND VALENCE. *Adele Pacini, Phil Barnard; MRC Cognition and Brain Sciences Unit* – Lakoff & Johnson (1999) argue that understanding valenced concepts requires neural simulations of the sensori-motor system, whereby "happy is up" and "sad is down". Meier and Robinson (2004) find positive evaluations of words gave faster responses to spatial probes in an upper region of space compared to lower regions of space, and vice versa for negative evaluations. However, “She blew her top” or “He is falling for her” are both common metaphors despite reversing the basic mapping. Using Meier & Robinson’s paradigm, we generated “negative-up” and “positive-down” phrases. Data showed a cue location x phrase type interaction where upper cues were responded to faster when preceded by a negative-up phrase, and lower cues responded to faster when preceded by a positive-down phrase. A materials analysis was also carried out, providing RT’s for each phrase, and showing which phrases were contributing to the observed interaction. Phrases where the direction of the subject was central to it being positive or negative contributed to the interaction. For example “His blood pressure was elevated”. However, phrases where the direction was secondary to the phrase’s valence did not, for example “They fell about laughing”. These findings suggest firstly that the connections between sensori-motor simulations and valence are less rigid than Lakoff & Johnson (1999) propose. Secondly, that the extent to which we use sensori-motor simulations in our comprehension of metaphor depends not simply on the existence of a direction salient word, but how central that word is to understanding the meaning of the entire phrase.

C 145

AWARE AND UNAWARE MECHANISMS FOR ANXIETY RELATED THREAT BIAS: INSIGHTS FROM BINOCULAR RIVALRY *Talma Hendler[1], Neomi Singer[1], Rebecca Ebitz[2], Leslie Ungerleider[2], Christian Grillon[2]; [1]Tel Aviv University, [2]NIMH, NIH* – Anxious individuals are highly tuned for threat related content. It is yet unclear if this effect emerges from biased unaware selection or increased aware engagement with threat related stimuli. To address this issue we applied a binocular rivalry (BR) paradigm in which either a neutral or fearful face continuously competed for awareness with a house. We assumed periods of dominant face to reflect aware engagement while periods of suppressed face to represent unaware selection. Anxiety disorder patients (n=28) were compared to healthy individuals (n=17). The BR paradigm consisted of 40 sec epochs of overlaid images of face (fearful or neutral) and house presented to the subject via filtered glasses. Participants were asked to indicate whether they perceived a face (i.e. dominant face) or a house (i.e. suppressed face). Healthy subjects had longer periods of dominant than suppressed face more so when it was fearful than neutral ($p<0.01$). In contrast, anxiety disorder patients did not show this emotion related difference in dominant face periods. Further, in patients relative to healthy, the difference between fearful and neutral faces, was diminished for dominant face ($p<0.03$) and increased for the suppressed face ($p<0.02$). This effect was most evident among patients with the worst clinical state. Our finding suggests two possible mechanisms for the observed threat related bias among anxiety disorder patients: decreased differential aware engagement with threat versus non-threat signals, and excessive unaware selection processing of the threat signal. These mechanisms might differentially underlie clinical manifestations in anxiety disorder.

C 146

EARLY DIFFERENTIATION OF BRAIN RESPONSES TO DIRECT AND AVERTED GAZE DURING THE PERCEPTION OF EYE MOTION: AN ERP STUDY WITH SOURCE RECONSTRUCTION *Laurence Conty[1,2], Karim N'Diaye[1,3], Charles Tijus[2], Nathalie George[1]; [1]CNRS UPR 640/Université Pierre et Marie Curie, Paris, France, [2]Cognition et Usages, Université PARIS VIII, Saint-Denis, France, [3]University of Geneva, Switzerland* – Direct gaze or eye contact is a particular configuration of gaze direction. It is a strong signal to mutual social attention, which often precedes interindividual interactions and can have various meanings depending on the context. In order to examine the processing of gaze contact relative to averted gaze, we studied evoked potentials in response to the apparent motion of gaze in 14 human adults. Deviated and frontal faces were presented with a fixed gaze direction, followed by an apparent movement of the eyes either toward the subject or away from him/her. The results showed that the perception of direct relative to averted gaze evoked a greater, later and longer lasting N170, suggesting that gaze contact mobilized more resources than averted gaze in the early stage of gaze processing. Moreover, the direction of gaze motion influenced the mean ERP amplitude between 160-210 ms starting over centro-parietal electrodes and extending into occipito-temporal regions. These results were significant whatever the head orientation. Source reconstruction of the differential responses to gaze contact versus averted gaze in the 150-220 ms time window revealed a temporally and spatially structured brain network implicated in this early dissociation. The network began in the median prefrontal cortex regions and spread to the superior temporal sulcus and the orbitofrontal regions. These regions are known to be involved in biological motion perception and Theory-of-Mind processes. Altogether, our findings show that gaze contact as compared to other gaze directions recruits early specific processes in the social brain network.

C 147

DISSOCIATION IN THE INFLUENCE OF EMOTIONAL CONTENT AND PERSONALITY ON WORKING AND LONG-TERM RECOGNITION MEMORY *Raliza Stoyanova, Kirston Greenop; University of the Witwatersrand, South Africa* – The relationship between working and long-term recognition memory for emotional content and the extent to which individual differences in personality influence this relationship is poorly understood. To address these questions, we employed a delayed match-to-sample working memory task followed by a surprise remember/know picture recognition task. Working memory accuracy for arousal-matched positive and negative stimuli was lower than that for neutral images. Despite similar levels of accuracy, participants were slower to respond to negative than to positive stimuli suggesting that negative images were processed less efficiently. Higher degrees of Neuroticism tended to impede working memory accuracy for negative stimuli while higher degrees of Extraversion tended to improve performance. Using measures of recollection and familiarity to examine the types of awareness that underlie long-term recognition of emotional images, we found that overall, participants recalled the greatest number of negative images, followed by positive and then neutral images with no effect of valence on familiarity. However, individuals higher in Neuroticism were significantly more sensitive to differences in familiarity signals for negative stimuli. These results suggest that while working memory performance for emotional stimuli is worse than for neutral, negative stimuli are more readily recalled over the long term. Our results also indicate that differential effects of personality on emotional working memory may be revealed only under relatively more demanding conditions and that while higher levels of Neuroticism may impede negative working memory, they are also associated with greater sensitivity to previously studied as compared to unstudied negative items, over longer time intervals.

Poster Session D

Attentional Processes: Auditory

D 1

GETTING BACK ON TRACK IN AUDITORY ATTENTION *Sophia Barrett[1,2], Martin Duff[1,2], Hilary Gomes[2]; [1]Graduate School and University Center (CUNY), [2]City College of New York (CUNY)* – In recent years, there has been a growing interest in the reorienting of attention. We have been studying attention and distraction using an auditory distraction paradigm developed by Schröger and colleagues (1998; 2000) that embeds task relevant information into the same perceptual object as task irrelevant/distracting information. Participants have to discriminate between equiprobable long and short tones. Infrequent task-irrelevant frequency deviations have reliably caused behavioral distraction in the form of prolonged reaction times. However, a crucial question to be answered is the length of time it takes a person to get back on track after the occurrence of a distracting event. The aim of the present study was to investigate how much time was required after a distracting event to fully reorient to the primary task. Twenty undergraduate participants performed an auditory forced choice duration discrimination task in which the preceding ISI (1300, 1100, 1000, 900, 800, 700, 600, or 500) was varied from trial to trial. We compared performance measures (accuracy and reaction time) following each of the preceding ISIs to determine the time interval required to recover from the distracting event and return to performing at a predistraction level. Preliminary behavioral research indicates that most adults require 500 – 800 ms to reorient after the occurrence of a distracting auditory event. Establishing the time frame of reorientation has implications for fully understanding the impact of and recovery from distraction.

D 2

ERP PREDICTORS OF AUDITORY DEVIANCE AWARENESS *Merav Sabri, Michael Ellingson, Colin Humphries, Jeffrey Binder, Einat Liebenthal; Medical College of Wisconsin* – We used event-related potentials (ERPs) to study the differences between neural responses to detected and undetected auditory irregularities during a divided attention task. In one ear, participants (n=16) performed a difficult duration judgment task to a sequence of short (50 ms) and long (60 ms) sinusoidal tones (1000 Hz; ISI=1500 ms) of equal probability. In the other ear, participants monitored a second auditory sequence, indicating whether a frequency change (deviant) had occurred within a train of repetitive standard tones (1000 Hz, 110 ms; ISI=500 ms). The frequency change was determined individually and set to a value between 8 and 20 Hz that produced detection rates of approximately 50%. Group average performance on the primary task reached 80% accuracy, and the detection rate on the secondary task was 50% (SD=11%; false alarm rate=12%). ERP responses to deviants revealed a larger frontal positivity at 150 ms latency --the P2 component-- and a larger prolonged frontocentral negativity from 200 to 500 ms for detected compared with undetected change. The broad negativity may reflect a combination of the N2 component associated with increased attention and stimulus categorization, and the contingent negative variation (CNV) component implicated in preparation for active target detection and response, which in this study was delayed until the end of the tone sequences. The dissociation of responses to detected and undetected change as early as 150 ms latency, suggests that awareness of auditory irregularity is triggered and maintained within this time frame.

D 3

RESTING WITH INSTRUCTIONS: ACTIVELY IGNORING OR ATTENDING TO SCANNER BACKGROUND NOISE DURING REST PERIODS CAN ALTER DEFAULT MODE OF BRAIN FUNCTIONS *Nadine Gaab, Noa Ofen, John D.E. Gabrieli; Brain and Cognitive Science, MIT* – Many studies have identified specific brain regions that are activated during rest and deactivated during attention-demanding goal-directed tasks, the so called 'default mode of brain functions" (DMBF). We recently showed that the scanner background noise (SBN) can suppress the DMBF by adding an attentional component to the resting period (Gaab et al., HBM2006 abstract). However, at least one study reports no deactivation of the DMBF during passive stimulation. The goal of this study was to examine whether activation during the resting state can be altered by different attention modulating instructions during resting periods. During a baseline phase, 20 subjects were instructed to relax in the 3T MR scanner and to focus on a fixation cross. Following that, subjects were instructed to change their attention towards the SBN depending on a visual cue, either carefully attend to SBN or ignore SBN. Ignoring the noise relative to the uninstructed baseline led to activation of medial, middle and inferior frontal gyrus. Ignoring the noise, relative to attending to it revealed increased activation in various brain regions that have been frequently reported to be part of the DMBF, including medial frontal regions and anterior cingulate. Attending to SBN compared to ignoring SBN resulted in increased activation of bilateral primary and secondary auditory cortices. These results suggest that attention modulating instruction changes can lead to alterations of the resting state activation. Clear instructions on 'how to rest' seem to be crucial in studies that compare healthy fMRI-experienced controls and impaired subjects, children or naïve subjects.

D 4

INTENSE MEDITATION TRAINING ENHANCES THE EFFECTS OF SELECTIVE ATTENTION ON ELECTRICAL EVOKED POTENTIALS *Antoine Lutz, Heleen Slagter, Zachary Moran, Nancy Rawlings, Richard Davidson; Waisman Laboratory for Brain Imaging and Behavior, University of Wisconsin* – Previously, we reported electroencephalogram differences between expert meditators and novices, suggesting that meditation may, over time, lead to long-term changes in the brain and its functions. Here, for the first time, we explicitly tested this assumption by studying the changes in attentional processes before and after a 3 month intensive meditation training (~ 1000 hours total). A standard dichotic listening task was used to probe the impact of meditation training on sustained attention and attentional control. We collected data from seventeen participants, referred to as practitioners, (7 male; median age 41 years, range 22-64 years, median education = 18 years) and twenty-three matched controls, without prior meditation experience, referred to as novices. Novices took part in meditation training sessions and practiced daily for a week prior to the pre- and post-data collections (3 months apart). The practitioners' performance (reaction time, standard deviation of the reaction time, and sensitivity d) increased from pre- to post-time points and this increase was higher than that of the novices. Intensive meditation training also was shown to enhance the difference between attended and unattended event related potentials (ERP) as early as the early frontal positive component (40-55ms). This increase suggests attention training may enhance the early gating of auditory transmission. Finally, the P200 showed a strong time by group interaction in both the attended and unattended conditions (increase for the practitioners after the retreat). Together these results suggest that intensive meditation training affects attentional processes.

D 5

FUNCTION AND TOPOGRAPHY OF MISMATCH VS. LATE NEGATIVITY AND THE ROLE OF ATTENTION IN VOWEL PERCEPTION *Miwako Hisagi, Marcin Wroblewski, Carol Tessel, Hia Datta, Valerie Shafer; City University of New York (CUNY) - Graduate Center* – Attentional mechanisms are hypothesized to play an important role in second language processing (Strange and Shafer, 2006). To explore this, modulation of the Mismatch and Late Negativity (MMN/LN) discriminative components were examined in English listeners under different attentional conditions. The MMN is shown to be preattentive, although it can be modulated by attention (Woldorff & Hillyard, 1991). The functional significance of LN remains unclear but it has been related to discrimination and attentional processes (e.g., Shestakova 2003). We compared voltage and current source density (CSD) maps to determine whether these components might share underlying neural sources and whether attention influences the topography. Stimuli were /I/ (as non-target deviant) and /E/ (as non-target standard). The three tasks were: a) ignore stimuli and attend to a silent movie (Passive Task), b) press a button to the higher frequency of two tones (Tone Task) and, c) press a button to the /ba/ target (Speech Task). MMN showed a slightly right, fronto-central topography. In the Passive and Tone Tasks, inversion was greatest at the right mastoid whereas in the Speech Task inversion was greatest at the left mastoid. The LN showed more frontal topography than the MMN. At inferior sites inversion of the LN was largest at the right mastoid for the Passive and the left for the Speech, with no LN for the Tone Task. The topographical analysis suggests that MMN and LN do not have identical sources, and attention to different aspects of the auditory information leads to differences in topography.

D 6

UNILATERAL NEGLECT AND TASK-DEPENDENT MODULATION OF SPATIAL BIAS IN AUDITORY SEARCH *Ranmalee Eramudugolla[1], Jason Mattingley[1], Dexter Irvine[2]; [1]University of Melbourne, [2]Monash University* – Efficient detection of a target object in a cluttered visual display requires intact visuospatial attentional mechanisms. This is evident in individuals with unilateral spatial neglect. Neglect patients' lateralized bias in spatial attention leads to spatially asymmetric performance on visual search tasks, such that they are slower to, or fail to, detect targets located on the contralesional relative to ipsilesional side of space. This is consistent with recent reports that detection of visual targets embedded in arrays of multiple distracter stimuli relies predominantly on selective attention to spatial rather than object features of stimuli. As with vision, unilateral neglect can also result in a spatial bias in detecting lateralized auditory stimuli (e.g., auditory extinction). However, it is not clear whether spatial attention plays a role in guiding selective attention across auditory scenes composed of concurrent spatialized and spectro-temporally varying sound streams. If auditory and visual search both rely on spatial attention, we predicted that neglect patients would display a spatial bias in target detection on auditory as well as visual search tasks. The detection of contralesional visual or auditory stimuli in neglect can also be modulated by the stimulus properties to which the patients' attention is directed. In the present study, we also investigated whether neglect patients' auditory and visual search skills varied depending on the task required of them: target detection vs target localization. The findings have implications for current models of attentional modulation of spatial and object processing, and the similarity of auditory and visual systems in this regard.

Attentional Processes: Visual

D 7

AGING AND CULTURAL DIFFERENCES IN EYE-MOVEMENTS DURING COMPLEX PICTURE VIEWING *Joshua Goh[1], Michael Chee[2], Jiat Chow Tan[2], Denise Park[1]; [1]University of Illinois at Urbana-Champaign, [2]Singhealth Research* – East Asians have been shown to engage more holistic perceptual processing of visual information compared to Westerners. Recently, we found fMRI evidence (Goh et al., in press) that suggests aging might modulate these differences possibly due to prolonged experience in the cultural environment. In this study, we tracked eye movements to verify these imaging findings concerning cultural and age differences in visual attention. We evaluated how bottom-up salient changes in object and background information interact with top-down attention biases due to cultural influences. 61 subjects (15 young and 14 old East Asians; 16 young and 16 old Westerners) passively viewed naturalistic pictures of objects with background scenes in an identical manner to our previous fMRI study. Quartets of pictures were presented in each condition: a) 4 repeated objects and backgrounds, b) 4 repeated objects with changing backgrounds, c) 4 changing objects with repeated backgrounds, and d) 4 changing objects and backgrounds. Compared to young adults, older adults had longer peak latencies for proportion of object gazes over time per picture suggesting slower visual processing with age. Across all picture change conditions, East Asians spent more time fixating on backgrounds elements, had longer gaze distances per picture but shorter fixation durations compared to Westerners. In addition, older East Asians made the most number of fixations per picture. These data buttress prior neuroimaging findings and suggest that East Asians engage more holistic and context-based visual scanning strategies compared to an object-based strategy in Westerners.

D 8

ARE OLD ADULTS MORE CONTEXTUAL? AN EYE TRACKING STUDY *Wenjing Wang[1], Adrian Imfeld[2], Denise Park[1]; [1]University of Illinois at Urbana Champaign, [2]University of Zurich, Switzerland* – When viewing complex scenes, functional imaging data have suggested that older adults evidence robust activations in the parahippocampus, reflecting attention to the background scene, but that old adults show reduced activations compared to young in the lateral occipital complex, an area specialized for object recognition (Chee et al., 2006). In the present study, we investigated whether old adults spend more time viewing background compared to object areas in complex scenes using eye tracking technology to measure fixation time. We tested 19 young and 16 old subjects while they viewed naturalistic scenes at encoding and recognition. At encoding, all stimuli were comprised of a focal object presented against a complex, naturalistic background (e.g., moose grazing near a lake). At recognition, subjects judged their memory for the focal object in the picture which was presented in the context of either the same background at encoding or against a novel background. Results indicated that at encoding, young and older adults showed similar patterns of gaze to backgrounds and objects. However, during recognition, older adults showed more attention to the background compared to young adults. Moreover, when either the object or background of the recognition stimulus was novel, older adults spent disproportionally more time than young gazing at the background, suggesting context was more important for them in making a difficult recognition decision. Overall, these findings suggest that when making memory judgments older adults are more likely to rely on contextual information, whereas young adults have sufficient information based on the central object.

D 9

WHEN THE EYES LOSE FACE IN SOCIAL ATTENTION *Imran Ansari, Chris Blais, Derek Besner; University of Waterloo* – There are a number of reports that subjects are faster to respond to a target that appears at a location validly cued by the gaze direction of a schematic face than they are to a target that appears at an invalidly cued location.

The standard interpretation of this spatial cueing effect is that (a) it demonstrates a reflexive shift of attention driven by the social and/or biological significance of face, and (b) having attention at the right location speeds processing. However, most of these studies ignore the fact that the pupils of the schematic face appear as an abrupt onset, producing apparent motion. By hypothesis, apparent motion per se is sufficient to cue attention to a location. The present experiment distinguishes between these two hypotheses by pitting eye gaze direction against apparent motion of features other than the eyes. The results are consistent with the conclusion that apparent motion is sufficient to account for the spatial cueing effect observed with schematic faces in the context of this paradigm.

D 10

INATTENTIONAL BLINDNESS IS MEDIATED BY ATTENTIONAL INHIBITION UNDER HIGH TASK LOAD *Preston P. Thakral, Scott D. Slotnick; Boston College* – Salient stimuli presented at unattended locations are not always perceived, a phenomenon termed inattentional blindness (IB). We hypothesized that IB may be mediated through attentional inhibition. Studies investigating the spatial distribution of attention have shown that attentional inhibition has its maximal effect near the locus of attention. If our hypothesis is correct, IB effects should be maximal near an attended location. A central fixation cross was presented on a white background along with rapidly presented colored digits at an eccentric location (3.2° of visual angle from fixation). A black circle served as the unexpected critical stimulus. Participants were instructed to maintain central fixation and say each color/digit aloud, requiring focused attention at that location. In three groups of participants, the critical stimulus was presented at central fixation (control group), 1.5° of visual angle from the attended location, or 3° of visual angle from the attended location (distances were based on previous work showing maximal attentional inhibition effects at 1.5°). Results illustrated that IB effects mirrored attentional inhibition effects, maximal adjacent to the attended location. However, these effects were only observed when the task was sufficiently difficult (high task load/low accuracy), consistent with previous findings (Cartwright & Lavie, 2006). In a second experiment, we directly manipulated task load by varying the colored digit interstimulus interval. The results confirmed that IB effects only occur during high task load. Our evidence suggests that attentional inhibition mediates inattentional blindness, specifically under high task load conditions. The neural mechanisms underlying these effects are also considered.

D 11

AGE-RELATED CHANGES IN CEREBRAL WHITE MATTER INTEGRITY: FIBER TRACKING FROM DTI *Matthew C. Costello[1], David J. Madden[1], Leslie Crandell Dawes[1], Leonard E. White[1], Roberto Cabeza[2], James M. Provenzale[1], Scott Huettel[1]; [1]Duke University Medical Center, [2]Duke University* – Previous research has established an age-related decline in cerebral white matter integrity, especially in anterior brain regions. Yet it is unknown whether specific fiber tracks contribute differentially to this decline. We used diffusion tensor imaging (DTI) fiber tracking to investigate age-related differences in regions relevant to the frontoparietal cortical network: the genu and splenium of the corpus callosum, and the superior longitudinal fasciculus (SLF). Fiber tracks were derived from tensor images using target and seed regions defined on high resolution T1-weighted images. We divided splenium tracts into occipital and parietal components. We hypothesized that in addition to an expected age-related decline in fractional anisotropy (FA) for the genu, there would be decline in FA for posterior regions that support bottom-up sensory processing. We conducted 15-direction DTI at 3T, collecting 52 slices with voxel size of 1 x 1 x 2.4 mm. Analyses of 12 younger adults (18-27 years of age) and 12 older adults (64-85 years of age) indicated significant age-related decline in FA throughout each region of interest. Regression analyses indicated a highly linear ($r2 = .94$) relation between younger and older adults' FA values, yet with an overall decline in older subjects suggesting a general age-related decline in white matter integrity throughout the frontoparietal network. Only within the genu did the magnitude of decline significantly exceed the generalized effect. We conclude that although age-related decline in white matter integrity is differentially greater for the genu, decline occurs generally throughout the frontoparietal network, including posterior regions mediating sensory processing.

D 12

SENSORY COMPETITION AND RESPONSE COMPETITION: HOW THESE PROCESSES INFLUENCE THE FILTERING OF IRRELEVANT INFORMATION *Ana Torralbo[1,2], Paige Scalf[2], Diane Beck[2], Arthur Kramer[2]; [1]Universidad Autonóma of Madrid, Spain, [2]Beckman Institute, University of Illinois at Urbana-Champaign* – Stimuli presented simultaneously in the visual field are not processed independently, but instead interact in a mutually suppressive way that suggests a competition for neural representation in early stages of processing at the level of visual cortex. It has also been shown that interference due to competing response tendencies produces conflict at later stages of processing, closely related to adjustments in cognitive control to prevent subsequent conflict. We are interested in how these two systems of competing tendencies interact. We manipulated a flanker design where the flanker can be response compatible or incompatible with respect to the target. At the same time, the flankers were either surrounded by irrelevant letters (i.e. the sensory competition condition) or not. Our preliminary results show that flanker interference effects (incompatible – compatible RTs) can be modulated by sensory competition in peripheral locations. Results are discussed in terms of attenuated representation of target and distractors due to sensory competition.

D 13

AN INDEPENDENT RESOURCE OF EACH HEMISPHERE MODULATES SELECTIVE ATTENTION *Kazuhito Yoshizaki, Ritsuko Nishimura; Aichi Shukutoku University* – The aim of this study was to investigate the relationship between selective attention and interhemispheric interaction. Based on both the load theory (Lavie, 1995, 2005) and the assumption in which each hemisphere has an independent attentional resource, we examined the effects of perceptual load in each hemisphere on compatibility effects. In the present experiments, two letter-strings (target "X" or "N", and noise stimuli) as the task-relevant stimuli were briefly presented to left and right visual-fields in parallel with a distracter ("X", "N"), which was presented on the center of the screen. Right-handed participants were asked to identify the target among the two letter-strings during ignoring the distracter. In Experiment 1, the perceptual load ("HIGH" or "LOW") of the letter-string without a target was manipulated and the perceptual load with a target was invariant. The results showed that the size of the compatibility effects was larger in the LOW condition than in the HIGH condition. In Experiment 2, the task-relevant stimuli consisted of the high and low perceptual load-strings. The target was included in either letter-string. The results showed that the size of compatibility effects was larger when the target was not included in the LOW perceptual load-string. These the consistent results of the two experiments were due to that the more residual resource of the hemisphere where the target was not projected would facilitate processing the distracter. Our findings suggested that selective attention would be modulated by an independent resource of each hemisphere.

D 14

TIME-SPACE SYNESTHESIA: AN EVENT-RELATED BRAIN POTENTIAL (ERP) STUDY *Ursina Teuscher, David Brang, Lee Edwards, Marguerite McQuire, Seana Coulson; Cognitive Science Department, University of California, San Diego* – In one type of synesthesia, people report that they associate time events, such as months of the year, with specific spatial locations. The present study assessed the extent to which time-space associations in synesthesia impact visuospatial attention via a symbolic cuing paradigm. Cues consisted of arrows pointing left or right, direction words "left" or "right", and the names of months that were on either the left or the right side of the synesthete's mental calendar (e.g., "October" and "May"). After each cue, a probe stimulus appeared in the correctly cued location 75% of the time, and in the uncued location 25%. Half of the probes required a response (targets), and half did not (non-targets). ERPs were recorded from 3 time-space synesthetes and 6 age-matched control subjects as they performed this target detection task. In the time-space synesthetes, a comparison of ERPs to probes cued by months revealed effects of cue validity on the P2 component (larger for valid probes) and the late positive complex (LPC) observed 400-1000ms post-onset (larger for invalid probes). In the control subjects, effects of cue validity were apparent on ERPs to probes cued by arrows and direction words, but not on ERPs to probes cued by months. These data suggest that relative to age-matched controls, time-space synesthetes can more effectively utilize words referring to temporal events to direct their attention in space.

D 15

DISTRACTIBILITY IN THE AGING AND PARKINSONIAN BRAIN *Liana Machado, Amy Devine, Natalie Wyatt; University of Otago* – Using a modified flanker task in young adults, we previously found that when a distractor and a target appear in close temporal proximity, response latencies are faster when the two stimuli are associated with the same response compared to different responses (i.e., a positive compatibility effect). In contrast, when a distractor precedes a target by more than a few hundred milliseconds, responses are delayed when the two stimuli are associated with the same response (i.e., a negative compatibility effect). We interpreted the negative compatibility effect that emerged at longer distractor-target stimulus onset asynchronies (SOAs) as reflecting inhibition of the neural representation of the distractor, which may function to prevent unwarranted action plans from being executed inadvertently. The current research investigated the impact of aging and Parkinson's disease on distractibility and the use of inhibition to minimize distraction. Compared to young adults, elderly adults showed substantially larger positive compatibility effects at the shorter SOAs and reduced or absent negative compatibility effects at the longer SOAs. These findings suggest that the neural changes that occur with normal aging lead to both increased distractibility and a faulty inhibitory mechanism of selective attention. Removing the distractor prior to the appearance of the target attenuated these effects of aging. Parkinson's disease further disrupted the function of the inhibitory mechanism that reduces the positive compatibility effect as the SOA increases. Interestingly, decreased distractor inhibition was not necessarily accompanied by increased distractibility, suggesting that the two effects may have resulted from the disruption of two separate mechanisms.

D 16

EXAMINATION OF THE CONTINUUM OF ENGAGEMENT AND ADDICTION TO GAMBLING, COMPUTER/VIDEO GAMES AND THE INTERNET AS INDEXED BY P300 *Naomi Thomas, Frances Martin; School of Psychology, University of Tasmania* – Recent advances in the field of addiction have given greater emphasis to subjective experience and compulsive behaviour, signifying a paradigmatic shift to conceptualise behavioural addiction as sharing similarities with substance dependency. Research suggests addiction and engagement in behaviours exist on a continuum of severity. This study was the first to employ a psychophysiological measure, the P300 event-related potential, to examine whether engagement and addiction to behaviours exists along a continuum ranging from non-disordered engagement to addiction, characterised by neuronal adaptation and negative psychological and social consequences. Eighty participants aged 17-28 were classified according to their involvement in gambling, computer games, video-arcade games and the Internet. The P3b component was elicited while subjects responded to a visual three-stimulus oddball task. Three continuum hypotheses were investigated; progression of engagement to addiction, progression of engagement and addictive symptoms, and continuum of addictive experience from no clinical symptoms to addiction. It was hypothesised that P3b amplitude, which indexes the cognitive resources used to process a task, would be sequentially reduced in participants with progressively greater engagement and addictive symptoms. Findings indicate that P3b amplitude discriminated between levels of engagement, progression of addictive symptoms and engagement, and continuum of addictive symptoms, particularly at midline sites. Consistent with reduced cognitive processing reported for substance dependency, the current findings suggest that participants with lower levels of engagement in these behaviours and no addictive symptoms had more resources available to perform the task than subjects with either a subclinical level of addictive symptoms or a diagnosis of addiction.

D 17

THE NUMBER DISTANCE EFFECT IS ENHANCED IN THE ATTENTIONAL BLINK PERIOD *Tsu-Yu Hsu[1,2], Jiun-Liang Chyan[2,3], Shih-Kuen Cheng[1,2], Daisy L. Hung[1,2], Ovid J.- L. Tzeng[1,2], Chi-Hung Juan[1,2]; [1]Institute of Cognitive Neuroscience, National Central university, [2]National Yang-Ming university, [3]Computer Science and Information Engineering National Central university* – The number distance effect indicates that the mental number line is accessed in a number comparison task. However, the relationship between the number distance effect and visual attention remains unclear. In this study, we use a rapid serial visual presentation (RSVP) task to probe the fate of the number distance effect in the attentional blink (AB) period. In the RSVP task, twenty-one subjects were required to identify a double-digits number (served as T1) then compared whether the second double-digits number (served as T2) was larger or smaller than T1. The numerical distance between T1 and T2 were systematically manipulated in the task. The behavioral data indicated that the phenomenon of attentional blink was seen in the numerical task. Subjects' performance was poor when T2 was presented 160~240 ms after the display of T1. Intriguingly, their performance was deteriorated with the decrement of the numerical distance between T1 and T2 in the attentional blink period. The pattern of the data suggests that the judgment of magnitude is highly affected by the resources of attention. Accordingly, it also suggests that AB is not an all-or-none effect and it can be modulated by the context set by the T1. We are currently using ERPs to explore whether the number distance effect can be reflected by ERPs waveforms (e.g. Dehaene, 1996) despite that they cannot be correctly reported in the attentional blink period. Together with Luck et al's finding (1996) that semantic information can be processed and be reflected with N400 components in the AB period. Our study may shed some light on the debate whether an asemantic route exists in the numerical processing (e.g. Fias, 2001).

D 18

DISSOCIATING VISUAL SELECTION AND SACCADE PROGRAMMING IN TIME *Wen-Yen Hsu[1,2], Jia-Rong Liu[1,2], Daisy L. Hung[1,2,3], Ovid J.- L. Tzeng[1,2], Chi-Hung Juan[1,2]; [1]Institute of Cognitive Neuroscience, National Central university, National Yang-Ming university, [3]Institute of Neuroscience, National Yang-Ming university* – The relationship between covert attention and saccadic eye movement has been the long-standing issue in attentional research. The premotor theory of attention proposes that "the mechanisms responsible for spatial attention and the mechanisms involved in programming ocular saccades are basically the same" (Sheliga et al. 1994). Juan et al. (2004) challenged this prevailed theory by showing the allocation of visual attention and saccade programming can be dissociated in time. (see also Hunt and Kingstone, 2003). In this study, following the same logic in Juan et al's study, we used the abrupt onset paradigm (e.g.Theeuwes et al.1998) and manipulated the onset time of abrupt onset in visual search task to probe the functional dissociability of the oculomotor and the attentional systems in human. Eye movement data were collected while subjects performed a pro-saccade task. Subjects' saccade latency and saccade curvature were measured. In the trials with early AO onset time (SOA: 0, 100 ms), the AO prolonged saccade latency significantly but saccade curvatures were not affected. However, when AO was presented on late onset time points

(SOA: 200, 300 ms), the trajectories of saccades curve away from abrupt onset location significantly but saccade latencies were not changed. In other words, AO can differently affect the length of saccade latency and the amplitude of saccade curvature with different AO onset time points. The pattern of results may indicate that the mechanisms underlying visual attention (measured by saccade latency) and saccade programming (measured by saccade curvature) can be dissociated in time.

D 19

PROBING THE FUNCTIONAL ROLES OF THE FRONTAL EYE FIELDS AND THE TEMPOROPARIETAL JUNCTION IN THE INTERPLAY BETWEEN VOLUNTARY AND STIMULUS-DRIVEN ATTENTION WITH TMS *Chi-Fu Chang[1], Hui-Yuan Shiao[2], Yi-Chin Lin[1], Daisy L. Hung[3], Ovid J.- L. Tzeng[2], Chi-Hung Juan[1]; [1]Institute of Cognitive Neuroscience, National Central university, [2]National Yang-Ming university, [3]Institute of Neuroscience, National Yang-Ming university* — The interaction between goal-directed and stimulus-driven attentional control is vital for the deployment of visual attention. Serences and colleagues (2005) have demonstrated that the temporoparietal junction (TPJ) and ventral frontal cortex may serve the function for the transition between two modes of the attentional processes. It has also been shown that the frontal eye fields (FEF) play a critical role on the voluntary deployment of visual attention (e.g. Schall., 2002; Muggleton et al., 2003; Juan et al., 2004). In the present study, we used the contingent attentional capture task (e.g. Folk et al., 1992) and repetitive transcranial magnetic stimulation (rTMS) to investigate the causal roles of FEF and TPJ in these attentional processes. rTMS (10Hz, 300ms) was applied over FEF and TPJ either 300ms before or simultaneously with the onset of the visual search array. Our preliminary data indicate that the attentional capture effects caused by the task were both affected by the application of FEF-rTMS and TPJ-rTMS. However, the functional involvement of FEF in the processes seems earlier than that of TPJ. The pattern of data suggests that FEF may engage in monitoring and in maintaining the attentional settings and TPJ may involve in redeploying attention to accommodate changes of the settings.

D 20

SPATIAL ATTENTION AND REPETITION PRIMING IN FACE RECOGNITION: BEHAVIOURAL AND ERP RESULTS *Markus F. Neumann[1], Stefan R. Schweinberger[1], Holger Wiese[1], A. Mike Burton[2]; [1]Friedrich-Schiller University of Jena, Germany, [2]University of Glasgow, UK* — Several studies suggest that faces capture attention and are particularly difficult to ignore. While task-irrelevant distractor faces seem to be processed to a certain extent when observers attend to another visual object, distractor face processing is extinguished when observers attend to another face. Capacity limits for faces have recently been proposed, allowing processing of only one face at a time (Bindemann, Burton, & Jenkins, 2005, Cognition). We investigated repetition priming by attended faces or unattended distractor faces, assessing reaction times (RTs) and event related potentials (ERPs). In a priming phase, participants performed speeded gender judgements for central famous faces or symbols which were flanked by famous distractor faces. During subsequent testing, participants performed speeded fame decisions for primed or new faces. In Experiment 1, RTs revealed priming for target faces primed by attended central faces, but no priming from distractor faces irrespective of central item type (symbol/face). Relative to an unprimed condition, ERPs revealed a larger parietal positivity (450-600 ms) for target faces primed by attended faces, but no evidence for priming by distractor faces. In Experiment 2, we equated the difficulty of face and symbol gender judgements and reduced the time interval between priming and test. We replicated the results for attended primes. While RT priming from distractor faces remained absent, ERPs provided tentative evidence for distractor priming. Results suggest that although ERP correlates of priming may be found, distractor faces outside the focus of spatial attention were not processed sufficiently to cause behavioural repetition priming.

D 21

VISUAL PERCEPTUAL LEARNING IN DOUBLE-FEATURE CONJUNCTION SEARCH *Yulong Ding, Department of Psychology, Zhe Qu, Yunpeng Lai; Wei Tan, Sun Yet-Sen University* — The present study aimed to investigate the mechanism of fast perceptual learning in double-feature conjunction search. Adult subjects with normal vision participated in this study. Each subject was given 480 trails' training in color-shape conjunction search task within 1 hour. In order to measure the learning effect and its specificity, the training task and 1~2 transfer tasks were tested just before and after training. In transfer tasks, the target was different in one or both features while the distractors remained same as those in the training task. The results showed that training of color-shape conjunction search induced significant improvement in response accuracy. Such improvement could "not" transfer to target with different color and different shape, as well as to that with same shape but different color. However, the learning effect could "partly" transfer to target with same color but different shape. These results indicated that short-term training of color-shape conjunction search could induce learning of "color-shape" conjunction and "color" feature, but not "shape" feature. We suggested that the different learning effects of color and shape features may be due to the asymmetry in processing of the two features; learning of color-shape conjunction may involve activation of conjunctively tuned channels, and/or enhancement of temporal synchrony in the processing of color and shape features.

D 22

NETWORKS FOR SPATIAL ATTENTION IN THE HUMAN LEFT HEMISPHERE: EVIDENCE FROM INTRAOPERATIVE STIMULATION *Michel Thiebaut de Schotten, Marika Urbanski, Hugues Duffau, Emanuelle Volle, Bruno Dubois, Richard Levy, Paolo Bartolomeo; INSERM, Paris* — Right-sided neglect is less frequent, severe and persistent than left neglect. The frequent association with language impairments makes right neglect difficult to explore, and its lesional correlates within the left hemisphere are poorly known (Beis & al, Neurology 63: 1600-05, 2004). Intra-operative electrical stimulation, which temporarily inactivates small brain regions, has better spatio-temporal resolution than lesion overlapping methods. Previous results using this technique in the right hemisphere have identified the caudal portion of the superior temporal gyrus (STG), the supra-marginal gyrus (SMG) and the second branch of the superior longitudinal fasciculus as crucial regions whose inactivation leads to rightwards shifts in line bisection. Does the left hemisphere contain mirror-image networks for spatial processing? Two right-handed patients with low-grade gliomas in the left temporo-parietal region bisected with their right, dominant hand 20-cm horizontal lines during direct cortical and subcortical electrical stimulation. Stimulation of the caudal STG, but neither of its middle/rostral portions, nor of the SMG, determined leftwards deviations on line bisection. However, the most dramatic shifts occurred with subcortical stimulation. Using fiber-tracking on post-operative magnetic resonance imaging scans, we identified the subcortical stimulated site as the posterior segment of the arcuate fasciculus, linking the caudal STG to the inferior parietal lobule. Left-hemisphere networks for spatial processing are similar, but not identical to right-hemisphere ones.

D 23

MIXED SIGNALS: STIMULUS-RESPONSE COMPATIBILITY IN THE REAL WORLD *Andrew Bayliss, Steven Tipper; School of Psychology, University of Wales, Bangor, UK* — It is often important to apply the findings of cognitive psychology to meaningful scenarios in the real world. For example, the amber indicator lights on cars are designed to enable road users to efficiently predict the driver's next manoeuvre. Among other factors (e.g. luminance), the spatial configuration of these lights facilitates their interpretation (e.g. the _right_ indicator flashes for _right_ turns). However, several modern models of car confound this intuitive relationship by placing indicators medially relative to the headlights. Hence, the left indicator is placed to the right of the left headlight, for example. In two experiments, the object-based incompatibility that arises from this latter configuration resulted in slower, more erroneous responses to the indicated direction than for the standard configuration. These data act as a reminder to car designers that indicators, which are inherently a safety feature, should be designed with the fundamental properties of the human visual system in mind, and not just for aesthetic appeal. Furthermore, this is a demonstration of how an oft-studied paradigm in visual cognitive science can have a real-world application.

D 24

EFFECT OF CHOLINESTERASE INHIBITORS ON PARIETAL LOBE ACTIVATION DURING A SPATIAL ATTENTION TASK IN MCI *Ananth Narayanan[1], Catherine White[1], Namhee Kim[1], Madalina Tivarus[2], Ashleigh Hillier[3], Petra Schmalbrock[1], Maria Kataki[1], Doug Scharre[1], David Beversdorf[1]; [1]The Ohio State University, [2]University of Rochester, [3]University of Massachusetts-Lowell* — Recent fMRI studies have demonstrated increased activation in MCI patients on memory tasks with cholinesterase inhibitor treatment. However, as memory is impaired in MCI, the question remains as to how these drugs affect activation for tasks that are relatively preserved in MCI. Therefore, we examined the effect of cholinesterase inhibitor treatment on a spatial attention task for which cholinergic function is known to be critical. MCI patients were imaged twice. The first prior to initiation of treatment, and the second 3 months after initiation of treatment. As expected, performance remained at ceiling for both sessions. However, parietal lobe activation significantly decreased after initiation of the drug. Unlike what is observed for memory, where treatment increases activation in fMRI, a decrease is observed for visuospatial attention tasks. Whereas memory is impaired in MCI, performance on this attentional task is preserved. As no impairment is present with this task, this imaging result may represent improved efficiency of neural processing in order to carry out this task with cholinesterase inhibitor treatment.

D 25

EARLY EVOKED GAMMA BAND RESPONSES IN THE VISUAL ODDBALL TASK OF HEALTHY MALE ADULT SUBJECTS. *Niklas Manz, Madhavi Rangaswami, Chella Kamarajan, David B. Chorlian, Bernice Porjesz; SUNY Downstate Medical Center, Henri Begleiter Neurodynamics Laboratory, Brooklyn, NY* — We report new results of early evoked gamma band activity during a visual oddball task with target, non-target, and novel stimuli with a focus on the latter case. The sample consisted of 104 healthy, right-handed, substance-abuse free males with an age range of 20-40 years (24.91 ± 4.59 yr). Gamma rhythms are important functional building blocks of brain electrical activity. In humans, gamma band activity has been observed in a variety of cognitive tasks. Event related oscillations in the gamma band can be found as phase-locked (evoked) or non-phase locked (induced) responses to the onset of the experimental stimuli. Studies with novel stimuli have shown that they evoke frontal responses. Using S-Transform analysis, a time-frequency representation method was applied to EEG data and was analyzed in order to obtain stimulus related early evoked gamma band activity (29-45 Hz) and was analyzed within the first 150 ms after stimulus. Target and novel stimuli evoke significantly higher gamma responses than the non-target. The topography of these case differences will be demonstrated. The findings will be discussed in the context of early cognitive and attentional processes.

D 26

RESPONSE INHIBITION IN ADULTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER: AN ERP STUDY *Robert Melara[1,2], Huijun Wang[3]; [1]City College, [2]City University of New York, [3]Purdue University* — Aims: The present study used event-related potentials to examine the temporal course of deficient response inhibition associated with adult ADHD, either with (Experiment 2) or without (Experiment 1) the added requirement of interference control. Method: Two experiments recruited different adult ADHD and control groups. A stop task and a simple choice reaction time task constituted Experiment 1; a stop task and a more difficult flanker task constituted Experiment 2. Results: First, a consistent ERP pattern of response inhibition was demonstrated across the two experiments during successful inhibition trials, consisting of an earlier N1, greater P2, smaller N2, greater and earlier P3. Second, in both experiments adults with ADHD performed worse than controls in response inhibition, as evidenced by a delayed SSRT. This delay was accompanied by an ERP pattern of poor response inhibition, which consisted of a smaller N1, delayed N2, smaller and delayed P3 in Experiment 1 and of a delayed N1, P2, N2, and P3 in Experiment 2. Third, ADHD adults showed no additional difficulties in response inhibition as interference control was introduced as the primary response execution task. Conclusions: Response inhibition is revealed at multiple temporal points of processing. Adults with ADHD display inferior inhibitory processing of responses at each of these processing stages. However, their poor response inhibition is not further deteriorated by the added requirement of interference control, a finding that may have important clinical implications.

D 27

SUSTAINED SELECTIVE VISUAL ATTENTION TO FEATURE CONJUNCTIONS IN HUMAN EEG *Søren Andersen, Matthias M. Müller; University of Leipzig* — We used an electrophysiological measure of selective stimulus processing (the steady-state visual evoked potential, SSVEP) to investigate concurrent attentional selection of two features. Participants viewed a display consisting of 300 spatially intermingled bars that continually shifted their positions at random. Four different types of bars were presented, each corresponding to a specific conjunction of color (blue/red) and orientation (horizontal/vertical). Each type of bar flickered at a specific frequency, thereby eliciting distinguishable SSVEP signals. Participants were instructed to detect short intervals of coherent motion of a cued bar-type, while ignoring similar coherent motion of the unattended other three bar-types. The analysis of SSVEP amplitudes showed that 1) attending the bars of one type enhanced the amplitude of their frequency-tagged SSVEP. 2) bar-types sharing one feature (either color or orientation) with the attended bar-type elicited higher SSVEP-amplitudes compared to the bar-type which differed on both dimensions and 3) there was no interaction between the attentional effects of color and orientation. Theses findings are in accordance with the feature-similarity gain model. The observed signal amplification provides a neurophysiological basis for the rapid identification of feature conjunctions during visual search, as proposed by "guided search" models.

D 28

FIXATION ON EYES IS REDUCED IN A CASE WITH RIGHT SUPERIOR TEMPORAL GYRUS LESION *Tomoko Akiyama[1], Motoichiro Kato[2], Fumie Saito[2], Haruo Kashima[2]; [1]Komagino Hospital, [2]Keio University School of Medicine* — Disorders with social impairments, such as autism and schizophrenia, have been demonstrated with reduced fixation on the eye region when viewing faces. Interestingly, a similar decrease in fixation on eyes has been recently reported in a case with lesions to the bilateral amygdala, a most prominent social brain component. Another notable component of the social brain is the superior temporal sulcus (STS) region, which is known to be involved in processing biological motion. In this report, we have studied the visual scanning pattern when viewing faces, in a case with a lesion confined to the right superior temporal gyrus (which covers the upper half of the STS region). Compared to age-matched normal controls, this case fixated the eye region in an extremely small proportion (2.2% of total fixation, compared to the controls' 32.7%), and fixated off -face in an extremely large proportion (24.4% compared to 4.3%). Results show a robust decrease of fixation on eyes in this STS-lesion case, similar to that reported previously for the amygdala-lesion case. These findings implicate that social brain components such as the amygdala and the STS might work in concert to realize normal gaze behavior such as eye-contact, a critical social function. Additionally, these findings offer implications for the neural basis of disorders such as autism and schizophrenia, whose lack of eye-contact is one of the cardinal manifestations.

D 29

POINT PROCESS MODELING OF EYE-MOVEMENTS *Christopher Kovach[1], Hiroto Kawasaki[2], Ralph Adolphs[3]; [1]University of Iowa, [2]University of Iowa Hospitals and Clinics, [3]California Institute of Technology* — The probability of fixing gaze on any region in a scene is governed by multiple simultaneous influences including low level visual information, top-down effects, and inhibition of return. Common techniques for testing hypotheses on the distribution of fixations rely on the frequency with which regions are fixed. Tests on raw fixation frequency, however, may not reliably or efficiently distinguish the independent contributions of multiple effects and otherwise depend on the invalid assumption that the modeled events are statistically independent of each other. Such tests are likely to miss important effects in some cases and produce false significance in others. We demonstrate an approach to modeling eye-movements using generalized linear multiple regression for point process data. Estimates of regression coefficients, representing the influence of some scene related measure on the log odds of fixation, permit a statistically well founded operationalization of the concept of visual salience. Violations of the assumption of independent sampling, which invalidate tests on raw fixation frequency, can be accommodated within nuisance parameters. The approach may serve as a highly adaptable basis for testing hypotheses on fixation probability, constructing parametric as well as non-parametric empirical salience maps, and predicting and simulating visual scanpaths. Its application is demonstrated with data on the scanning of faces and in visual search for upright and inverted faces.

D 30

POSTERIOR PARIETAL CORTEX RESPONDS TO SET SIZE IN PERCEPTUAL AS WELL AS WORKING MEMORY TASKS. *Daniel Mitchell, Rhodri Cusack; MRC Cognition and Brain Sciences Unit* — It has recently been shown using fMRI that activity in the posterior parietal cortex (PPC) correlates with the limited number of objects that can be held in visual short term memory (VSTM) (Todd & Marois, 2004; Todd & Marois 2005; Xu & Chun, 2006). Here we replicate this finding (using set sizes of 1, 4 and 8 objects) and extend it to three other tasks that use a similar stimulus set but have no explicit memory requirement. The tasks were designed to manipulate attentional demands across space and time. In PPC we find a capacity-limited set-size effect in the VSTM task, but also in two of three other tasks which do not tax VSTM. In an anterior cingulate region we find a similar effect but only in the memory task. In occipital regions, a capacity-limited effect is again seen in the VSTM task and one of the perceptual tasks, along with a linear effect of set-size in some of the perceptual tasks. These findings cannot easily be explained by behavioural performance measures or memory demands alone, and suggest a possible role of the PPC in segregating and maintaining distinct, task-relevant object representations, whether in short-term memory or the current perceptual scene. This is consistent with the idea that working memory is an emergent property of attention being flexibly allocated to internal representations (Postle, 2006).

D 31

TIME COURSE OF AFFECTIVE BIAS IN VISUAL ATTENTION: CONVERGENT EVIDENCE FROM STEADY-STATE VISUAL EVOKED POTENTIALS AND BEHAVIORAL DATA *Catherine Hindi Attar, Søren Andersen, Matthias M. Müller; University of Leipzig* — Recent studies emphasize the competitive interaction of attention and emotion in early visual cortex. It remains however unclear to what extent the processing of affective stimuli are dependent on attentional resources. The present study investigated the impact of task-irrelevant affective stimuli (pleasant, unpleasant and neutral pictures) on the concurrent processing of an attentionally demanding foreground task. In order to trace the time course of this competition, steady-state visual evoked potentials (SSVEPs) to a flickering display of moving random dots were recorded. These dots were superimposed upon pictures from the International Affective Picture System. Subjects were required to attend the dots and to detect short intervals of coherent motions while ignoring the background pictures. Presenting highly arousing pictures (pleasant and unpleasant) in the background induced stronger competition with the foreground task compared to neutral pictures, as reflected in reduced SSVEP amplitudes at central occipital sites. This effect extended over several hundred miliseconds and was strongest for unpleasant pictures. In close temporal relationship with the electrocortical responses, target detection rates showed a stronger decrease when highly arousing pictures were presented in the background. These results clearly indicate that affective stimuli modulate the early stages of attentional processing even though attentional resources are sparse.

D 32

A PERCEPTUAL SHORTCUT: RESPONSE DEMANDS MODULATE EARLY VISUAL PROCESSING *Ingo Fründ[1], INiko A. Busch[1], Jeanette Schadow[1], Thomas Gruber[2], Ursula Körner[3], Christoph S. Herrmann[1]; [1]Institute of Psychology, Otto-von-Guericke University, Magdeburg, Germany, [2]Institute of Psychology I, University of Leipzig, Germany, [3]Honda Research Institute Europe, Offenbach, Germany* — The present study investigated, whether physiological markers of early visual perception are influenced by response demands. Seventeen healthy volunteers watched images of known objects and unknown object-like patterns under two response demands: In the first case participants classified known and unknown objects by a speeded button press, in the second case participants performed the same classification task, but did not have time pressure in performing the button press. This task was performed with abstract line drawings as well as colored natural images with a broad range of spatial frequencies. Early, stimulus locked gamma oscillations discriminated known from unknown objects only for speeded responses irrespective of the complexity of the stimulus set. Later, induced gamma oscillations discriminated known from unknown objects only for natural images, irrespective of response demands. These results suggest that evoked gamma oscillations might be relevant to quickly transform visual stimuli into motor responses, while induced gamma oscillations might be relevant for more detailed analyses.

D 33

ADAPTIVE VISUAL ATTENTION MECHANISMS REDUCE SENSORY CONFLICT EFFECTS WITH INCREASING TASK DEMANDS: AN ERP-STUDY *Stefanie Kehrer[1,2], Antje Kra[1,2], Kerstin Irlbacher[1], Stefan P. Koch[1], Herbert Hagendorf[2], Norbert Kathmann[2], Stephan A. Brandt[1]; [1]Charité, Berlin, [2]Institute of Psychology, Humboldt University, Berlin* — Recent studies provide evidence for the concept that attentional resources are focused on task-relevant stimuli to resolve conflicts from distracting events (Weissman 2004). We hypothesize that more difficult target selection conditions lead to stronger attentional top-down control reducing the effects of arising conflicts. We investigated the role of these mechanisms on the location negative priming (NP) effect with event-related potentials (ERP). Selection difficulty was manipulated by comparing an easy and a difficult task as described by Tipper (1990) and by Vink (2005). For each subject (N=27) ERPs were recorded from 64 electrodes. A significantly delayed reaction time (RT) for NP- as compared to control-trials, i.e. NP-effect, was only evident in the easy task. However, ERP analysis revealed a reduced parieto-occipital N1-amplitude of NP-trials compared to control-trials, both in the easy and the difficult task. In contradistinction, differences between the easy and difficult task were found in the P3-latency, which was significantly delayed for NP-trials only in the easy task. We suggest that the RT and N1-effect for NP-trials in the easy task reflect an inhibitory mechanism modulation early sensory processing associated with a slowing of stimulus evaluation. Since the NP-effect was found in the difficult task for the N1-amplitude but not in the RT, we assume that early sensory inhibition occurs also in the difficult task. However, the P3-latency results indicate that additional attention mechanisms are involved in processing of the complex task, suggesting that the NP-effect on the early sensory stage is abolished at a later stimulus evaluation stage.

D 34

CONTRASTING ERP PATTERNS LINKED TO FACE PROCESSING AND RECOGNITION IN WILLIAMS SYNDROME AND AUTISM *Anna Yam[1], Debra Mills[2], Alan Lincoln[3], Debbie Rull[3], Allan Reiss[4], Albert Galaburda[5], Julie Korenberg[6], Ursula Bellugi[1]; [1]The Salk Institute for Biological Studies, [2]Emory University, [3]Alliant International University, [4]Stanford University, [3]Alliant International University, [5]Beth Israel Deaconess Medical Center, [6]Cedars-Sinai Medical Center* – Individuals with Williams syndrome (WS) frequently display heightened attention to faces while individuals with Autism are socially avoidant and avoid looking at faces. The current study compared ERP effects to face stimuli across three groups of participants: WS, Autism and typical controls (TC). It was hypothesized that ERP patterns of activation would reflect social attentional tendencies in these groups. Participants, 10 adults from each group, viewed 38 photographic pairs of upright or inverted faces and indicated if the second face matched or did not match the first. Results indicated that the amplitude of the N100 was significantly smaller for the WS group compared to individuals with Autism and TC. The N200 amplitude in WS was significantly larger than the other groups. For both upright and inverted faces, a larger negative amplitude to the mismatch was observed at 320 ms post stimulus for the WS group but not for Autism. This mismatch pattern in WS was similar to the TC pattern for upright faces. The Autism group showed a mismatch positivity which resembled the TC pattern for inverted faces. The smaller N100 in WS relative to other groups may be indicative of lower efficiency in early visual processing. The N200 amplitudes possibly reflect contrasting attention patterns to human faces in these groups. The presence or absence of a 320 ms mismatch may be related to group-specific processing strategies and proficiencies. Activation patterns suggest that individuals with AD and WS process faces in a qualitatively different manner which may be expressed behaviorally.

D 35

BEYOND THE CONTROL OF VISUAL ATTENTION: NEW INSIGHTS FROM THE SPATIAL CUEING PARADIGM *Evan F. Risko, Chris Blais, Jennifer A. Stolz, Derek Besner; University of Waterloo* – In the context of the spatial cueing paradigm, an increase in the proportion of valid trials is associated with an increase in the magnitude of the spatial cueing effect. This proportion valid effect is widely understood as reflecting a form of control. Indeed, numerous researchers have used the proportion valid effect in special populations (e.g., schizophrenic, Alzheimer's and neglect patients) to index the endogenous control of visual attention. The present experiment identifies a component of the proportion valid effect that has nothing to do with “control.” A new framework is discussed that is able to accommodate these results. Discussion focuses on this new framework and the implications of it and the present results for existing work on the control of visual attention.

D 36

REMAPPING OF SPATIAL POSITION ACROSS SACCADES IN PATIENTS SUFFERING FROM CONSTRUCTIONAL APRAXIA AFTER RIGHT PARIETAL INJURY *Charlotte Russell[1], Cristiana Deidda[1], Paresh Malhotra[2], Masud Husain[2]; [1]Fondazione Santa Lucia, IRCCS, Rome, Italy, [2]Institute of Cognitive Neuroscience, Institute of Neurology, University College London, London, UK* – Constructional Apraxia (CA) is revealed through the inability of patients to complete accurate copies of drawings or three-dimensional constructions. Striking characteristics of their copying performance are a lack of accurate spatial relations among parts of objects and a ‘piecemeal’ quality to the copy. This is a common apraxia after right parietal stroke, often remaining after initial problems such as visuo-spatial neglect have resolved. To investigate the underlying malfunction, we examined whether a central problem might be failure to correctly integrate visual information from one fixation to the next. More specifically, whether this difficulty predominantly concerns remapping of spatial information as the right parietal lobe has an important role in the maintenance of a stable representation of locations across saccades. The experiment compared a group of patients suffering from CA, a group of patients without constructional problems and a group of neurologically healthy controls. Participants were required to judge whether a pattern changed in form (non-spatial information) or whether it shifted position (spatial information) either with an intervening two-saccade sequence or with a pause. Results revealed that the CA patients, in contrast to the other groups, were specifically impaired when judging whether the pattern had shifted position in the saccade condition. Furthermore, the direction of the two-saccade sequence was important, as performance was greatly inferior when the first saccade of the two-saccade sequence was to the right. The results suggest a role for trans-saccadic spatial remapping deficits in Constructional Apraxia following right parietal damage.

D 37

HOW MUSIC DECREASES THE ATTENTIONAL BLINK: AN EEG STUDY *Merel M. Pannebakker[1], Guido P. H. Band[1], K. Richard Ridderinkhof[2], Bernhard Hommel[1]; [1]Leiden University, Leiden, the Netherlands, [2]Acacia, University of Amsterdam, Amsterdam, the Netherlands* – In a behavioral experiment, Olivers and Nieuwenhuis (2005) have shown that concurrent task-irrelevant mental activity like listening to music reduced the Attentional Blink (AB). They argued that this improved performance may be caused by diffused attention or an altered mental state during music. These changes may be related to the Locus Coeruleus - NorEpinephrine (LC-NE) system responsivity, important for the regulation of cognitive performance. Furthermore, during the music condition relative to the control condition, less attention may be allocated to processing the first target (T1), which makes it easier to subsequently allocate attention to the second target (T2). The question is therefore whether music has an overall beneficial effect on attention, or affects the allocation policy. In this experiment, we elaborated the influence of listening to music on T1- as well as T2-performance using electrophysiological measurements. Our behavioral results showed improved performance (less blink) in the music condition compared to the control condition. Our ERP-data focused on P3 as an index of phasic LC-NE activity. As expected, attenuated P3 activation was measured for T2 in blink trials compared to no-blink trials. Furthermore, the P3 on T2 was higher in the music condition showing the increased attention available for T2. No difference between P3 peaks on T1 was found suggesting that improved allocation of attention to T2 is not the result of allocating less attention to T1. Instead, music seems to benefit the recovery of attention after processing T1.

D 38

DISSOCIABLE EFFECTS OF UNILATERAL DAMAGE TO THE HUMAN RIGHT SUPERIOR COLLICULUS ON VISUO-SPATIAL PROCESSING *Nadia Lucas[1], Gilles Pourtois[2], Sophie Schwartz[2], Patrik Vuilleumier[1]; [1]Dept. of Neurology (HUG) & Neuroscience (CMU), Geneva, [2]Dept. of Neuroscience (CMU), Geneva* – Neurophysiological studies suggest a critical role of the superior colliculus (SC) in different aspects of visuo-spatial attention, but few data exist in humans. We investigated a unique patient (45 year-old right-handed male) with a unilateral ischemic lesion restricted to the right SC. The patient showed transient visual symptoms but no persistent clinical neurological deficits in the chronic stage. However, tests of visuo-spatial functions classically imputed to SC revealed selective deficits in his contralesional left hemifield. In a Posner spatial cueing task, the patient showed slower responses to left than right visual targets, with inhibition of return (IOR) found on the right but not left side. These data support a role of the SC in generating contralateral IOR, consistent with similar observations by Sapir et al. 99. In a redundant target detection task, the patient showed faster responses to double targets presented across both hemifields, relative to single targets, with evidence for neural rather than probabilistic summation effects. However, he showed redundancy gain for double targets within the right/ipsilesional field but not left/contralesional field. These data do not support a role of the SC in target redundancy effects across, but rather within hemifields. Taken together, these findings reveal selective effects of unilateral damage to the superior colliculus in humans.

Perceptual Processes: Auditory Processing

D 39

HEMISPHERIC ASYMMETRIES IN SPEECH PERCEPTION: STIMULUS-DRIVEN VERSUS TASK-SPECIFIC EFFECTS *Paul T. Fillmore, Kenneth I. Vaden, A. Lisette Isenberg, Nicole M. Gage, Gregory S. Hickok; University of California, Irvine* – Several recent neuroimaging studies have found a left-hemisphere bias for activations in speech perception tasks when compared with non-speech stimuli. A prevalent hypothesis regarding the basis of this asymmetry is that the left auditory cortex is relatively specialized for the perception of fast temporal transitions, which are common in speech (e.g. formant transitions in stop consonants). However, lesion data exist which suggest that lateralization patterns in speech perception can be task dependent: left hemisphere lesion patients who are greatly impaired in sublexical speech perception tasks (i.e. phoneme discrimination) can perform speech comprehension tasks (which require correct phonemic perception) fairly well. In the present study, we investigate this task dependence further. Using functional MRI, we compared words with and without stop consonants to examine stimulus-based effects, across both sublexical and comprehension-level tasks. We expected that any existing left hemisphere bias towards fast temporal processing would manifest itself in both tasks, but that if task type modulates hemispheric asymmetry, such a bias might only show up in a sublexical task, with a comprehension-level task showing activation more bilaterally. We found regions in the superior temporal gyrus, bilaterally, that were activated to a greater extent by words containing stop consonants, with slightly higher levels of activation in the left hemisphere. Task-specific effects were greater for words containing stops, and seemed to be greater in the left hemisphere. Thus it appears that hemispheric biases, while present, may be more subtle than is often assumed, and that task may play a role in their modulation.

D 40

PITCH MEMORY FOR MUSIC PLAYED BACKWARD: A PERCEPTUAL LEARNING STUDY *Nestor Matthews, Kristin Cox, Megan Loveland; Denison University* – We investigated pitch memory for music played forward and backward in three experiments. Experiment one indicated significantly greater pitch memory for forward than for backward excerpts of popular songs. Nevertheless, pitch memory significantly exceeded chance even for backward excerpts that were pitch-shifted by just one or two semitones. Experiment 2 indicated that pitch memory was comparable for forward and backward recordings of single piano notes –a finding that contradicts a sensory explanation of the forward superiority effect for popular songs. In experiment 3 we explored the acquisition of pitch memory using a perceptual learning procedure and novel piano melodies. Participants learned to reliably distinguish the original keys of two melodies that differed from each other by just a single note. Additionally, an acoustical backward superiority effect followed training on backward versions of the melodies, despite their ecological atypicality. Overall, the data reveal remarkable precision and flexibility in human pitch memory.

D 41

N1, P2 COMPONENTS, AND REPETITION POSITIVITY IN THE AUDITORY EVENT-RELATED POTENTIAL OF YOUNG AND OLDER ADULTS *Rowena Cooper, Pat Michie, Juanita Todd; University of Newcastle* – In a previous event-related potential (ERP) study (Cooper, Todd, McGill, & Michie, 2006), we reported amplitude differences in the auditory N1 and P2 components between a young and older group that could have contributed to the between group difference seen in mismatch negativity (MMN) amplitude. In the present study we examined the recovery cycle of the N1 and P2 components in young (mean age = 20.7 years) and older (mean age = 64.8 years) adults by delivering pure tones (800 Hz, 50 ms, 55 dB above threshold) at five different stimulus onset asynchronies (SOAs): 500 ms, 1 s, 3 s, 6 s, and 9 s. We found a Group x SOA interaction ($p<.05$) in peak and mean amplitude measures of the N1 component at Cz. The older group tended to show larger N1 amplitude than the young group at the shorter SOAs and smaller amplitude than the young at the longer SOAs. There was also a significant Group x SOA interaction ($p<.05$) at Cz in peak P2 amplitude with the older group showing a tendency for reduced amplitude relative to the young especially at the longer SOAs. The study shows that there are age-associated changes in sound processing that are dependent on the interval at which sounds are delivered. We will also present findings from an ongoing aging study examining the repetition positivity (RP). The RP is a relatively newly described auditory ERP that overlaps the latency period of N1 and P2 components in MMN paradigms with a roving standard.

D 42

IMPACT OF TASK REQUIREMENT AND STIMULUS TYPE IN HEMISPHERIC INTERACTION. *Teow-Chong Sim, Carolyn Martinez; Sam Houston State University* – Two experiments investigated interhemispheric interaction in processing dichotic signals. In Experiment 1, 60 right-handed participants listened to 12 blocks of dichotic stimuli consisting of environmental sounds on one ear and a verbal descriptor on the other ear. Verbal descriptors on one ear were congruent or incongruent with the environmental sounds on the other ear. They were instructed to judge if the verbal descriptor on one ear corresponded to the environmental sound on the other ear. There was a right ear advantage (REA) in judging the accuracy of the verbal descriptor – the mean reaction time was significantly faster when the verbal descriptor was on the right ear, and corresponded to the environmental sound. The results show a lateralization effect and a Stroop-like interference. In Experiment 2, 60 participants listened to dichotic signals that consist of dissimilar environmental sounds in each ear. Each dichotic pair was synchronized with the onset of a verbal descriptor that was presented on a monitor, and the subject was instructed to press a key if the verbal descriptor corresponded to a stimulus in the dichotic pair. The subject was instructed to press a different key if there was no correspondence to either stimulus in the dichotic pair. A left ear advantage (LEA) was observed. Reaction times were faster, and there were more hits for stimuli presented to the left ear. An understanding of interhemispheric interaction must take into account the type of stimulus present and the task required of the perceiver.

D 43

THE CONTINUITY ILLUSION AND VOWEL PERCEPTION: AN FMRI STUDY *Antje Heinrich[1,2], Robert P. Carlyon[2], Matthew H. Davis[2], Ingrid S. Johnsrude[1]; [1]Queen's University, Kingston, Canada, [2]MRC-CBU, Cambridge, UK* – Intermittent sounds can be perceived as continuous if the silent gaps between them are filled with a masking sound. This "Continuity Illusion" (CI) is one example of closure, a principle of auditory perceptual organization that is critical for speech perception. The neural bases of auditory perceptual closure are largely unknown. We used fMRI to study CI in speech perception. We used two-formant vowels in which the formants alternated in time, and where the silent gaps in each formant frequency region were filled with noise. In the "Illusion" condition, the formant level, relative to that of the noise, was low enough for the formants to be perceived as continuous, and subjects heard the stimuli as vowels. When the formant levels were increased and the noise levels decreased so that the noise bursts were ineffective maskers, the CI broke down, and stimuli were perceived as less speechlike (Illusion-Break condition). We collected whole-brain echo-planar imaging data from 19 listeners using sparse imaging (Hall et al., 1999) with 8.4 sec stimulus sequences and 2-second data-acquisition periods (TR=11 seconds). Compared to Illusion-Break, the Illusion stimuli elicited activation in left posterior middle temporal gyrus, demonstrating one neural correlate of CI, possibly related to the speechlikeness of the resultant percept; this region was also preferentially activated by intact vowels compared to non-speech stimuli (alternating formants with no noise, and noise alone). In contrast, Illusion-Break stimuli produced greater activation in areas close to primary auditory cortex, possibly as a result of the increased number of perceived onsets in these stimuli.

D 44

NEURAL CORRELATES OF AUDIO-VOCAL FEEDBACK *Akira Toyomura[1], Sachiko Koyama[2], Tamaki Miyamoto[3], Shinya Kuriki[2]; [1]Japan Science and Technology Agency/Research Institute for Electronic Science, Hokkaido University, [2]Research Institute for Electronic Science, Hokkaido University, [3]Hokkaido University Graduate School of Medicine* – Perception of one's own speech plays an important role in fluent speech production. In this study, we conducted a functional magnetic resonance imaging (fMRI) experiments to delineate the neural mechanism for auditory feedback control of pitch, using a transformed auditory feedback (TAF). Right handed subjects were required to vocalize /a/ for 5 s while hearing their own voice through headphones. In the TAF condition, the feedback voice pitch was shifted up or down from the original pitch two or three times in each period. The subjects were required to hold the pitch of the feedback voice constant by changing the pitch of the original voice. In the non-TAF condition, the pitch of feedback voice was not modulated and the subjects merely vocalized /a/ continuously. In the first experiment (n=12), the pitch of feedback voice was randomly shifted up or down within the range of 2-halftones in the TAF condition. The supramarginal gyrus, the prefrontal area, the anterior insula, the superior temporal gyrus and the intraparietal sulcus showed significantly stronger activation in the right hemisphere for TAF than for non-TAF condition. In the second experiment (n=10), an amount of the pitch shift (one, two and four halftones) was fixed in the TAF condition. The activation of the left insula increased as an amount of pitch shift increased. Previous studies have shown that the insula is related to speech production (Dronkers, 1996). Thus these findings conceivably suggested that the left and the right insula play different roles for pitch control of vocalization.

D 45

AUDITORY PERCEPTION OF SPECTRAL AND TEMPORAL VARIATIONS IN SPEECH AND NONSPEECH SOUNDS - A SPARSE-FMRI STUDY *Tino Zaehle[1], Lutz Jancke[1], Martin Meyer[2]; [1]University of Zurich, Switzerland, [2]Institute of Neuroradiology, University Hospital of Zurich, Switzerland* – In the present study we investigated the neurofunctional organisation of sub-lexical auditory perception with specific emphasis on auditory spectro-temporal processing in speech and nonspeech sounds. We presented participants with verbal and nonverbal auditory stimuli with systematic variations of the spectral or temporal acoustic characteristics in the context of a sparse event-related functional magnetic resonance imaging (fMRI) study. Based on models of lateralized hemispheric processing we hypothesized a left hemispheric dominance for the processing of rapid changing temporal characteristics and a right hemispheric dominance for spectral modulations of the auditory signal for both, speech and nonspeech stimuli. In agreement with our hypothesis results show a left hemisphere involvement during the processing of rapidly changing temporal characteristics regardless of the speechness of the sounds. In particular, when participants had to attend to subtle temporal modulations within speech and nonspeech stimuli we observed significant responses in the parietal operculum and the inferior frontal gyrus on the left hemisphere. In contrast, we revealed no lateralisation effects for spectral processing. When participants listened to changes in the frequency content of speech and nonspeech stimuli, we observed activations of the medial temporal gyrus und superior temporal sulcus bilaterally. The present data support the assumption of an asymmetric functional organisation within the auditory domain with the left hemisphere being more specialized for the processing of rapidly changing acoustic information within both speech and nonspeech signals.

D 46

THE BRAIN AUTOMATICALLY DIFFERENTIATES BETWEEN VOCAL AND NON VOCAL STIMULI *Maude Beauchemin[1,2], Isabelle Pelletier[1,2], Maryse Lassonde[1,2], Pascal Belin[3,2]; [1]Centre de Recherche, CHU Sainte-Justine, [2]Neuropsychologie et Cognition (CERNEC), Université de Montréal, [3]University of Glasgow* – Humans are remarkably social beings, but the underlying neural mechanisms that permit such socialization are still not well-known. Neuroimaging studies have provided evidence for localized processing specificity for human voice stimuli, paralleling the specificity for human faces (Belin et al., 2000). Using ERPs, Levy and collaborators (2001) reported that human voices evoked a positive event-related potential at 320 ms, distinctive from that elicited by instrumental tones, which they termed the Voice Specific Response (VSR). The present study investigated if voice selectivity could be observed at a pre-attentive level. ERPs were measured during an oddball paradigm in which the standard stimulus was a pure tone (85% occurrence) and two infrequent stimuli with natural timbre were either a human voice (7.5%) or a non-vocal piano tone (7.5%). All stimuli were matched for their fundamental frequency. The mismatch negativity elicited by the vocal deviants was found to differ from the one elicited by the piano tone as early as 122 msec after onset, both at electrode sites AFz ($F = 8.042$, $p = 0.013$) and Fz ($F = 8.205$, $p = 0.012$). To confirm that this effect was not specific to the voice and instrument timbre used, a second study was conducted in which several exemplars of each timbre category were used. Preliminary data corroborate the observed trend. These results provide the first evidence that the brain can differentiate voice from non-voice auditory stimuli much earlier (122 msec) than previously reported (320 msec) suggesting a time course similar to that of face processing.

D 47

CONTRALATERAL DOMINANCE VS. RIGHT HEMISPHERE PREDOMINANCE FOR SOUND LOCATION PROCESSING IN THE HUMAN BRAIN: AN EEG-STUDY IN FREE-FIELD *Nicole Richter[1], Sandra Hasse[1], Erich Schröger[2], Rudolf Rübsamen[1]; [1]Institute of Biology II, University of Leipzig, Germany, [2]Institute of Psychology I, University of Leipzig, Germany* – The aim of the present electroencephalographic (EEG) study was to test the putative contralateral and/or right hemisphere dominance in spatial auditory processing in a realistic spatial environment. A semi-natural acoustic environment was achieved by presenting stimuli through a circular array of loudspeakers situated around the subject. Using different stimulation designs with systematic changes of the laterality of sound sources we measured the N1 and the mismatch negativity (MMN). The N1 was elicited by stationary sound sources as well as by moving sound sources (simulated by successive pulsed acoustic emissions from five loudspeakers spanning 20° in azimuth). By use of an oddball paradigm, the location MMN was evoked by different standard and deviant stimuli from varying sound sources. For stationary and moving sound sources, the N1-amplitudes were more prominent over the hemisphere contralateral to the stimulation side; for centered stimulation, left- and right-hemispheric N1-amplitudes were equal. MMN-amplitudes were generally higher over the right rather than over the left hemisphere, irrespective of ipsi- or contralateral stimulation side. Furthermore, the modulation of the MMN-amplitude, which indicates differences in the processing of distinct spatial information, was more pronounced in the right than in the left hemisphere. These results provide evidence for both contralateral and right-hemisphere dominance in cortical processing of auditory space. At the level of the N1-component, the spatial information of stationary as well as of moving sound sources are processed primarily in the contralateral hemisphere. At the level of preattentive discrimination (MMN) there is a right hemisphere predominance in auditory spatial processing.

D 48

JUDGMENT OF TEMPORAL ORDER IN PATIENTS WITH AQUIRED UNILATERAL BRAIN LESIONS SUFFERING FROM AUDITORY EXTINCTION: A FREE-FIELD STUDY. *Claudia Schubert[1], Manon Grube[1,2], D. Yves von Cramon[3], Rudolf Rübsamen[1]; [1]Institute of Biology II, University of Leipzig, Germany, [2]Auditory Group, Medical School, University of Newcastle upon Tyne, United Kingdom, [3]Day Clinic of Cognitive Neurology, University of Leipzig, German* – Central auditory space processing and representation in the human brain is far from being understood. Studies with patients suffering from auditory extinction, a specific deficit in auditory space processing can help to shed light on this topic. The present free-field study specifically examined how extinction is modified by presenting bilateral stimuli in the right and left acoustic hemifield with a temporal onset asynchrony. Patients with lesions in the left or right hemisphere (LH, RH, each group 17 subjects) were studied. All had participated in a previous study investigating auditory extinction (Grube et al. in prep). Bilateral recognition was impaired in both patient groups, but more frequent in RH (n=13) than in LH patients (n=6). A systematic reduction of extinction was achieved with increasing temporal onset of the stimulus on either side. Still, for patient in both groups showing extinction, a higher incidence of failures were observed with the leading stimulus coming from the ipsilesional hemifield. Additionally, the ability to recognize the temporal order of the successive onset of the stimuli was tested. For that, LH patients more often showed misjudgements though without a clear bias towards either of the two hemifields. In RH patients there is a shift in the representation of acoustic space towards the contralesional side. The results support the notion of extinction being an impairment of the perception of stimuli in the contralesional acoustic space. In LH patients, the impaired perception of temporal order can be linked to the putative role of the left-hemisphere in temporal processing.

D 49

AGING AND MUSICAL EXPERTISE ON MELODIC ENCODING IN AUDITORY CORTEX *Takako Fujioka[1], Laurel Trainor[2,1], Terence Picton[1], Bernhard Ross[1]; [1]Rotman Research Institute, Baycrest, University of Toronto, Canada, [2]McMaster University, Hamilton, Canada* – Our recent studies recording the mismatch negativity (MMN) and its magnetic counterparts, MMNm, demonstrated that young adults with no formal music education process the interval information of melodies in the auditory cortex automatically, and that musical experience enhances this melodic encoding mechanism. In general, age-related declines of auditory encoding capability have been reported in MMN literature. The present research addressed the question of how the enhancement seen in younger musicians holds as they get older while continuing musical practice. The MMNm response from musicians over 60 years of age was obtained using two stimulus paradigms from our previous MEG studies of young musicians. The Interval paradigm contained one five-note standard melody transposed to eight keys from trial to trial and another deviant melody similarly transposed, but with the last note raised to another pitch (presented on 20% of the trials). The Control paradigm consisted with a standard and a deviant tone (990.7 and 1111.0 Hz). The MMNm response to the interval change was significantly present bilaterally in the older musicians. Although the amplitude of the MMNm was smaller than in young musicians, it was larger than in young non-musicians, suggesting that the superior automatic encoding system in musicians sustains over their later life if they keep musically active. MMNm in the control paradigm in older musicians was also smaller than in young musicians. MMNm in the left hemisphere was larger than in the right in older musicians, indicating that they may recruit more analytic strategies for encoding.

D 50

IS P50 SENSORY GATING ASSOCIATED WITH BEHAVIORAL MEASURES OF INHIBITION? *Carly A. Yadon[1], Julie M. Bugg[2], Kathleen M. K[1], Aubrey J. Anthony[1], Michael A. Kisley[3], Deana B. Davalos[1]; [1]Colorado State University, [2]Washington University, [3]University of Colorado at Colorado Springs* – The P50 auditory event-related potential (ERP) component is conceptualized as a measure of inhibition and represents the ability to suppress the neuronal response to an auditory stimulus presented just after an identical stimulus. This type of sensory gating is of particular interest because many clinical populations (such as schizophrenia) are impaired on this measure. P50 deficits in individuals with schizophrenia have been replicated numerous times and have also been found in first-degree relatives and in related psychotic disorders. Although the P50 component has been the focus of many studies, the behavioral correlates remain understudied and thus relatively unknown. In the present study we investigated whether the P50 ERP component was related to a battery of common measures of behavioral inhibition. To test this question, ERPs were recorded (Cz) from introductory psychology students who also completed the behavioral section of the experiment in a within subjects, counterbalanced design. Partial correlations controlling for baseline measures of processing speed, indicate a relationship between P50 suppression and behavioral inhibition. The findings suggest that while there may be common mechanisms involved in both neurophysiological inhibition and behavioral indices of inhibition, only select types of inhibitory tasks reveal this relationship. Further results and implications will be discussed.

D 51

AGE-RELATED INCREASED IN AUDITORY EVOKED FIELDS: A CENTRAL OR PERIPHERAL PROBLEM? *Jessica Quan, Claude Alain; Rotman Research Institute, Baycrest Centre Geriatric Care, Toronto, Canada* – Neuroelectric and neuromagnetic studies have revealed age-related increases in the amplitude of auditory evoked responses. These findings are thought to reflect deficits in inhibitory control mediated by the prefrontal cortex. Alternatively, age-related changes in the peripheral system and/ or ascending auditory pathways (e.g., loudness recruitment, frequency selectivity) could also account for increases in sensory evoked responses in older adults. We tested this hypothesis by presenting young and older adults with low and high frequency sounds against no, low or high background white noise while auditory evoked fields (AEFs) were recorded using a whole head MEG system. During the recordings, participants were asked to ignore the stimuli and watch a muted subtitled movie of their choice. For each participant, the AEFs were modeled with a pair of dipoles in the superior temporal plane and the effects of noise and age on the amplitude and latency of the resulting source waveforms were examined. We found a significant interaction between age and noise on the P1 amplitude, with the effect of age decreasing as the intensity of the background noise increased. The effects of broadband masking noise on the age-related difference in P1 amplitude may be related to changes in frequency selectivity and thus appear more consistent with a peripheral origin. Moreover, there was a significant decreased in P1 latency and an increased in N1 amplitude when the stimuli were presented against low background noise relative either the no or high noise conditions. This suggests that low-level noise can be beneficial in sensory processing.

D 52

EFFECTS OF LONG-TERM TRAINING ON TEMPORAL AUDITORY PERCEPTION AS EVIDENCED BY ELECTROPHYSIOLOGICAL RECORDINGS *Eveline Geiser[1], Lutz Jancke[1], Martin Meyer[2,3]; [1]University of Zurich, Switzerland, [2]University Hospital of Zurich, [3]Institute of Neuroradiology* – The present experiment aimed to detect long-term plasticity effects in the auditory system by investigating the electrophysiological correlate of auditory meter and rhythm processing in music perception with a focus on unattended processing. In an event-related brain potential study an auditory rhythm on one tone was presented repetitively to subjects. The stimulus material included metrical and rhythmical changes as well as pitch changes. Subjects were to detect and categorize either temporal changes (attended condition) or pitch changes (unattended condition). Furthermore, a group of trained subjects (musicians) was compared to a group of untrained subjects.As expected, trained subjects performed significantly better than untrained subjects. And within the untrained group subjects performed worse on the meter as compared to the rhythm detection. These behavioral results were well reflected by the amplitude of the auditory N1 component. Furthermore, in untrained subjects the N1 amplitude differed between attended and unattended processing conditions for meter and rhythm changes, showing enhanced amplitudes in the attended condition. In contrast, trained subjects showed similar amplitude differences between the attended and unattended processing for the meter changes only, while rhythm changes did not elicit different amplitudes in the two conditions. Our data provide evidence for training-dependent changes in auditory temporal processing as reflected by the N1 in unattended processing conditions and more specifically, this effect is evident in rhythmic changes.

Perceptual Processes: Multisensory Processing

D 53

AUDITORY STIMULI ALTER SOMATOSENSORY DEVIANT-DETECTION: AN EVENT-RELATED POTENTIAL STUDY *Kirsten Hoetting, Claudia K. Friedrich, Brigitte Roeder; Biological Psychology and Neuropsychology, University of Hamburg* – When a single tactile stimulus is presented together with two tones, participants often report perceiving two touches. It is a matter of debate whether this crossmodal effect of audition on touch reflects an interaction between modalities at early perceptual or at later integration stages. The present study used an oddball paradigm together with event-related brain potential (ERP) recordings to investigate the neuronal correlates of this multisensory illusion. Tactile double stimuli accompanied by two tones were presented as frequent standard stimuli. Rare single tactile stimuli accompanied by one or two tones were interspersed. Although participants were instructed to ignore the tones, they often failed to detect single tactile stimuli as deviants when they were presented together with two tones (“illusory standards”). ERP differences between "illusory standards" and "real standards" were calculated to test whether illusory trials were processed by the brain as standard or as deviant stimuli. Results were compared to the difference between ERPs to one vs. two touches presented without tones ("real deviants" vs. "real standards"). A mismatch negativity was observed between 100 and 200 ms for "real deviants" in the unimodal, but not for "illusory standards" in the multimodal condition. Therefore, pre-attentive, deviant-detection mechanisms of the somatosensory system seem to be influenced by auditory stimuli. Nevertheless, ERPs to “illusory standards” differed from ERPs to "real standards" in an enhanced negativity starting around 250 ms that continued for several hundred milliseconds at frontal leads. We speculate that this negativity reflects the subliminally detection of incongruent multimodal input.

D 54

AUDITORY AREAS ARE ACTIVATED DURING A VISUO-MOTOR TASK *Roberto Martuzzi[1,2], Micah Murray[1,3], Philippe Maeder[1], Eleonora Fornari[1], Jean-Philippe Thiran[2], Stephanie Clarke[3], Christoph Michel[3], Reto Meuli[1]; [1]Radiology Service, University Hospital, Lausanne, Switzerland, [2]Signal Processing Institute, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3]University of Geneva, Geneva, Switzerland* – Evidence is accumulating that brain regions traditionally considered as unisensory contribute to multisensory interactions. In this study, we investigated the BOLD response within auditory areas during a visuo-motor task. Subjects performed a simple reaction-time task in response to lateralized visual stimuli. Stimuli were randomly presented either at the right or at the left visual field, and subjects were asked to respond upon simple detection, irrespectively of the visual field stimulated. Stimuli were presented for 125ms with and inter-trial interval varying from 14.125 to 17.875s in steps of 125ms. In addition to activations within visual- and motor- related areas, we identified frank bilateral activations within auditory areas, with a clear predominance (both in size and in intensity) on the side contralateral to the responding hand. These results suggest that the signal intensity is primarily modulated by the responding hand and/or by the somatosensory stimulation generated during the motor response, while the visual field stimulated did not demonstrably affect the response laterality or its intensity and/or size within auditory cortices. The collective findings raise the possibility that activations in auditory cortices during visuo-motor tasks may receive an important contribution from auditory-somatosensory interactions and that such effects must be accounted for in experimental designs investigating multisensory phenomena.

D 55

THE TIMING OF LOC INVOLVEMENT IN TACTILE OBJECT RECOGNITION: AN EEG STUDY *Joshua Lucan[1], John Fo[1], Valerie Weisser[2], Krish Sathian[2], Sophie Molholm[3]; [1]City College of New York, [2]Emory University School of Medicine, [3]Nathan Kline Institute* – Recently, human functional neuroimaging studies have identified activity in the occipital lobes during touch perception. In particular, the recruitment of the lateral occipital complex has been demonstrated during tactile shape discrimination tasks. Further elaboration of the timing of this activation, however, is needed to establish whether it reflects early sensory and perceptual processing or later postperceptual events such as imagery. To this end we recorded high density EEG and examined the timing of activity over posterior scalp regions, comparing evoked potentials from a tactile shape discrimination task to a control condition. Participants (N=11) were blindfolded while either an inverted “T” or “V” shape was presented to their right finger pad. They were asked to discriminate between “shape 1” and “shape 2” or to sit passively while receiving the same stimuli. Results showed differences over posterior scalp regions beginning at ~230ms. LAURA based modeling attributed these changes to increased activity in occipital and temporal regions with activity in the lateral occipital complex peaking at ~330ms. Differential processing in the lateral occipital complex at this latency may reflect tactile object recognition processes in areas traditionally associated with visual object processing.

D 56

THE NEUROPHYSIOLOGY OF MULTISENSORY INTEGRATION IN OLDER AND YOUNGER TYPICALLY DEVELOPING CHILDREN. *Alice Brown; Queens College of the City, University of New York* – Multisensory integration is fundamental to basic perceptions (such as orienting) as well as to complex behaviors (such as learning language or driving a car). For some clinical populations, it is thought that the apparently natural, effortless ability to integrate sensory information is deficient. Yet neurophysiological support for such multisensory deficits has yet to be demonstrated. Moreover, little is known about where and when the integration of multisensory information occurs in the brain of typically-developing children. As a first step, in a high-density electrical mapping study, we investigated how the brain of typically-developing (TD) children responds to and integrates multisensory stimuli. Basic auditory (a simple tone) and visual (a red circle) stimuli were presented to TD children ranging in age from 5-15 years. Multisensory interactions were studied by comparing the responses to multisensory audiovisual (AV) stimulation with the linear summation (A+V) of the unisensory constituents presented alone. Data from two groups, younger and older children, suggest that there are developmental changes in multisensory integration. The spatio-temporal dynamics of multisensory integration for these two age groups are reported and compared.

D 57

EFFECT OF ATTENTION ON CORTICAL PROCESSES UNDERLYING THE SOUND INDUCED EXTRA FLASH ILLUSION *Jyoti Mishra[1], Antigona Martinez[1,2], Terrence Sejnowski[1,3], Steven Hillyard[1]; [1]UCSD, [2]Nathan Kline Institute New York, [3]Salk Institute* – When a single flash of light is presented interposed between two brief auditory stimuli separated by 60-100 msec, subjects typically report perceiving two flashes (Shams et al., 2000, 2002). We have recently demonstrated that perception of the illusory extra flash is based on a very rapid dynamic interplay between auditory and visual cortical areas that is triggered by the second sound (Mishra et al., 2006). This interaction included an early modulation of visual cortex within 30-60 ms after the second sound, identified as the PD120 ERP (event related potential) component. In the current study we investigated the effect of attention on the ERP correlates of the illusory flash and found the PD120 component that localizes to visual cortex to be manipulable by attention. Changes in the ERP associated with the illusory flash as a function of the visual field of stimulus presentation will also be discussed.

D 58

ELECTROPHYSIOLOGICAL CORRELATES OF MULTISENSORY INTEGRATION DURING THE VENTRILOQUIST ILLUSION: A HIGH-DENSITY STUDY *Jeannette R. Mahoney[1,2], Sophie Molholm[1,3], Daniel Senkowski[4], Manuel Gomez-Ramirez[1,3], Jennifer Montesi[1,3], Walter Ritter[1], John J. Foxe[1,3]; [1]Nathan Kline Institute, [2]Ferkauf Graduate School of Psychology, [3]The City College of the City University of New York, [4]University of Hamburg* – The direction of auditory apparent motion can be profoundly affected by the direction of concurrently presented visual apparent motion. We investigated the electrophysiological processes underlying this multisensory illusion, to assess the time-course and underlying brain regions. Participants were presented with AV stimulus pairs to different locations in close succession (i.e., AV1-AV2), giving the impression of movement. The auditory and visual elements were either spatially congruent or spatially incongruent. On each trial participants judged the direction of the stimuli as: 1) rightward congruent motion, 2) leftward congruent motion, or 3) incongruent motion/no motion. Participants perceived a high percentage of AV1-AV2 congruent pairs as congruous (90%). Demonstrating a strong multisensory motion illusion, they also perceived 87% of AV1-AV2 incongruent pairs as congruous (i.e., illusory trials), going in the direction of the visual apparent motion. Electrophysiological data revealed a difference between real and illusory responses at ~300 ms (i.e., 180 ms following the onset of the second stimulus in the pair of apparent motion stimuli) that was biggest over parietal scalp regions.

D 59

NEURAL CORRELATES OF LEARNING CROSS-MODAL ASSOCIATIONS *Aaron Heller[1], Petr Janata[2], Charan Ranganath[2]; [1]University of Wisconsin, Madison, [2]University of California, Davis* – Learning associations between auditory and visual stimuli is an important way we learn about objects in our world. Little is known, however, about the neural mechanisms that support gradual learning of cross-modal associations. Indeed, during the initial stages of associative learning, certain neural structures may support cross-modal binding, whereas a distinct network of regions may support the reactivation of learned associations. Here, we addressed this question by scanning participants over two days as they learned (Day 1) and retrieved (Day 2) arbitrary associations between faces and synthesized instrument sounds. On each trial, a delay of eight seconds was inserted between the two stimuli to allow for the dissociation of stimulus-driven and delay-period activity. Subjects separately performed auditory and visual localizer tasks in order to identify subject-specific regions of interest (ROIs) in auditory cortex and the fusiform gyrus. Map-wise results showed a posterior shift in activation with learning, such that prefrontal regions were activated early in learning, but dropped out as learning peaked. In contrast, posterior cortical regions, including sensory-specific and lateral parietal areas exhibited increasing activation over the course of learning. Auditory and fusiform ROIs revealed shifts in the temporal pattern of activity over the course of learning, such that activation in response to a cue stimulus eventually elicited activation of the ROI corresponding to the associate (the modality of the upcoming probe). These results suggest that prefrontal regions may support initial binding of cross-modal associations in order to support the eventual formation of associative links between sensory-specific cortical regions.

D 60

BOLD AND FREQUENCY RESPONSES TO MULTISENSORY SOCIAL SIGNALS: DIFFERENT RULES FOR DIFFERENT SENSORY SYSTEMS *Gemma A. Calvert[1], Thomas Thesen[2]; [1]University of Bath, [2]New York University* – Human speech is an inherently multisensory phenomenon as a speaker's articulatory mouth movements are intrinsically correlated with the produced sound. A large body of research shows that sensory integration of auditory-visual (AV) speech signals affords many behavioral advantages. In an effort to investigate the neurophysiological basis of such audio-visual convergence in the human brain, we have used a combination of imaging techniques. With event-related fMRI, we found evidence for crossmodal recruitment of primary sensory areas in both auditory and visual cortex. Visually presented dynamic mouth movements activated auditory cortex robustly starting at the presentation of the first stimuli. In visual cortex, however, responses to voice stimuli developed much later after prolonged pairing of the auditory-visual signals. MEG Beamformer signals from primary visual and auditory cortices also revealed a systematic difference in the pattern of cortical oscillatory responses. Crossmodal recruitment of visual cortex was mediated primarily by activity in the 8-20 Hz frequency band (alpha/low beta), whereas auditory cortex showed an additional event-related desynchronization in the 25-40 Hz frequency range (high beta/gamma). Results from both imaging modalities support an involvement of primary auditory and visual cortex in the convergence of AV speech signals. Results also show that the crossmodal activation pattern varies between sensory systems, and that these effects are likely to be mediated by different oscillatory neuronal mechanisms.

D 61

NEURAL MECHANISMS IN FIRST LANGUAGE ATTRITION *Hia Datta, Valerie L. Shafer, Loraine K. Obler; The Graduate Center, CUNY* – The current study is designed to investigate the underlying neurolinguistic mechanisms of attrition in the first language L1, in Bengali(L1)-English(L2) bilinguals living in their L2 environment. Our research questions include: (1) Is attrition in the first language an effect of L1-disuse or L2-interference? To examine the attrition mechanism we employ two sets of lexical items; one set varies in familiarity across L1 and L2 and another does not. We predict that if interference from L2 mediates attrition, then the differences in word-familiarity across languages will influence the amount of attrition in L1. Alternately, if disuse is the major factor, all L1 lexical items will be attritted irrespective of how familiar they are within or across languages. Our participants include Bengali-English bilingual individuals, aged 20-45 years, who have arrived in the United States at the age of 12 years or later and lived here for one to thirty-three years in an English-speaking community. A cross-modal priming paradigm (Jeschnicak 2000) enables us to use event related potentials, specifically the N400 component, as a neurophysiological measure of amount of attrition. Reaction time serves as the behavioral measure of the same process. Preliminary results indicate that attrition is apparent as early as six years of stay in the L2 environment. In addition the differences in the different word categories in Bengali, suggesting that interference from L2 plays a greater role than disuse in the attrition process.

D 62

CONTEXTUAL PRIMING IN GRAPHEME-COLOR SYNESTHESIA - AN EVENT-RELATED BRAIN POTENTIAL STUDY *David Brang, Vilayanur S. Ramachandran, Seana Coulson; University of California, San Diego* – In grapheme-color synesthesia, individuals experience vivid color perception upon the presentation of ordinary text, such that each letter/number (grapheme) elicits a highly specific and consistent color. This study examined the differential brain activity generated by synesthetes and normal controls in a modified sentence-priming paradigm. Subjects were presented with sentences ending in one of three forms. For example, in TEXT blocks, sentences such as "The sky is" ended with a color word ("blue"). In COLOR blocks, sentences ended with a rectangular color patch. In GRAPHEME blocks, sentences ended with a grapheme matched to each synesthete's perceived color (e.g. "The sky is 7"). Half of the sentences (40) in each block were congruous, half incongruous. Participants viewed two blocks of each type. ERPs were recorded from 5 grapheme-color synesthetes and 3 matched controls. In control subjects, sentence-final words in the TEXT conditions elicited a broadly distributed N400 sentence congruity effect; congruity effects for the COLOR condition involved an anteriorly distributed N400 component and a posteriorly distributed P2 component; the GRAPHEME blocks showed no effects. In synesthetes, ERPs in response the TEXT condition showed broadly distributed N400 effects; the color-patch condition elicited a posteriorly distributed N400 and an anteriorly distributed P2 component; the GRAPHEME condition showed a posteriorly distributed N400 component as well as an anteriorly distributed P2 component. Results suggest that synesthesia-based perception occurs early in the processing stream, consistent with theories that synesthesia is a perceptually based phenomenon.

D 63

AUDIOVISUAL FEEDBACK IMPROVES MOTOR LEARNING AND PITCH RECOGNITION *Amir Lahav[1], Marcus Eldridge[2], Elliot Saltzman[2], Gottfried Schlaug[1]; [1]Harvard Medical School, Boston, [2]Boston University, Boston* – This study investigates the effect of audiovisual feedback on motor learning and pitch recognition. We trained 56 nonmusicians subjects to play a short tune on a piano keyboard. Learning was accomplished by ear with no sight reading involved. In addition, we measured the subjects' ability to identify piano notes with the corresponding piano keys before and after they learned the piece (pitch recognition task). We varied learning conditions across two groups of subjects: the Audiovisual Group received both auditory and visual feedback during learning, whereas the Auditory Group received only auditory feedback. Interestingly, subjects of Audiovisual Group showed improved performance not only in terms of learning the piece faster and with fewer mistakes, but also in their performance on the pitch recognition task. These results indicate that locally blocking visual information during the acquisition of manual actions disrupts motor performance and impairs auditory learning. We further showed that when visual feedback is deprived previous kinesthetic experience may become particular handy; for example, strong typing habits on a computer keyboard (blind typing) are transferred to support finger accuracy also at the piano. In summary, this study shows that multisensory learning experience (in this case, audiovisual) improves performance even on a unisensory (auditory) memory recognition task, suggesting the potential use of multisensory stimulation to facilitate learning procedures in other domains.

D 64

WHAT YOU SEE IS NOT (ALWAYS) WHAT YOU HEAR: INDUCED GAMMA BAND RESPONSES REFLECT CROSS-MODAL INTERACTIONS IN FAMILIAR OBJECT RECOGNITION *Shlomit Yuval-Greenberg, Leon Y. Deouell; The Hebrew University of Jerusalem* – Gamma-band responses (GBR) are hypothesized to reflect neuronal synchronous activity related to activation of object representations. However, it is not known whether synchrony in the gamma range is also related to multisensory object processing. We investigated the effect of semantic congruity between auditory and visual information on the human GBR. The paradigm consisted of a simultaneous presentation of pictures and vocalizations of animals, which were either congruent or incongruent. EEG was measured in seventeen students while they attended either the auditory or the visual stimulus and performed a recognition task. Behavioral results showed a congruity effect, indicating that information from the unattended modality affected behavior. Irrelevant visual information affected auditory recognition more than irrelevant auditory information affected visual recognition, suggesting a bias towards reliance on visual information in object recognition. While the evoked (phase-locked) GBR was unaffected by congruity, the induced (non phase-locked) GBR was increased for congruent compared to incongruent stimuli. This effect was independent of the attended modality. The results show that integration of information across modalities, based on semantic congruity, is associated with enhanced synchronized oscillations at the gamma band. This suggests that gamma band oscillations are related not only to low level unimodal integration but also to the formation of object representations at conceptual multisensory levels.

D 65

'BRIDGING THE SENSES:' AN EEG AND FMRI CO-REGISTRATION STUDY OF AUDITORY, SOMATOSENSORY AND VISUAL MULTISENSORY PROCESSES *Manuel Gomez-Ramirez[1], Simon Kelly[2], Marina Shpaner[1], Glenn Wylie[2], Pejman Sehatpour[2], John Foxe[1]; [1]The Cognitive Neuroscience Program of The City College of the City University of New York, [2]Nathan S. Kline Institute for Psychiatric Research* – The integration of information from multiple sensory inputs is fundamental to perception and cognition. In recent years, many electrophysiological (EEG) and hemodynamic human and non-human primate studies have identified a number of cortical and sub-cortical regions involved in the merging of inputs from different sensory modalities. Regrettably, all of these studies have been restricted to two sensory modalities. This scenario precludes the direct comparison of the spatial and temporal multisensory integration (MI) effects across different pairs of sensory modalities. To this end, we conducted an EEG and fMRI study where subjects were presented with auditory, somatosensory and visual stimuli. The stimuli were presented alone or in pairs. Co-registration of the EEG and fMRI data revealed distinct temporal and spatial MI effects exist across the different modalities. In particular, the behavioral and EEG data suggest that the earliest coupling exists between auditory and visual inputs, which start approximately 60 ms after stimuli onset over posterior cortices. Other MI effects were observed during the time frame of the visual P1, auditory N1 and visual N1 response for audio-visual, audio-somatosensory, and audio-visual / visual-somatosensory couplings, respectively. The data show that the auditory and visual modalities have the earliest and perhaps, the strongest coupling across the three major senses in humans. Furthermore, the present study strongly contradicts the traditional dogma of MI processing, and clearly shows that MI can occur at 'very early levels' of stimulus processing.

D 66

LONG TERM TOOL-USE EXPERIENCE SHAPES SPACE REPRESENTATION. *Andrea Serino[1,2], Michela Bassolino[2,3], Alessandro Farnè[1,4], Elisabetta Làdavas[1,2]; [1]Università di Bologna, [2]Centro studi e ricerche in Neuroscienze Cognitive, Italy, [3]Cesena & Istituto David Chiassone, Genova, Italy, [4]INSERM, Lyon* – In the present work, we investigated whether an auditory peripersonal space exists around hand and whether such a space might be extended following a brief tool-use experience or by long term experience of using a tool in everyday life. To this aim, audio-tactile integration was studied in the space around the hand and in far space in blind subjects regularly using a cane to navigate and in sighted subjects, before and after a short training with the cane. In sighted subjects, before tool-use, auditory peripersonal space was limited around the hand, then it expanded after tool-use and contracted backwards after a resting period. On the contrary, in blind subjects, peri-hand space was immediately expanded when holding the cane but limited around the hand when holding a short handle. This suggests that long term experience with the cane induces a durably extension of the peri-personal space.

Perceptual Processes: High-Level Vision

D 67

HOW DO WE CONSTRUCT MEANINGFUL OBJECT REPRESENTATIONS? THE INFLUENCE OF PERCEPTUAL AND SEMANTIC FACTORS IN THE VENTRAL OBJECT PROCESSING STREAM *Kadia Acres, Emmanuel A. Stamatakis, Kirsten I. Taylor, Lorraine K. Tyler; Centre for Speech, Language and the Brain, University of Cambridge* – Object identification requires processing of both form and meaning. This processing occurs in a hierarchical stream in ventral temporal cortex, with visual processing in posterior regions and semantic processing in more anterior regions (Tyler et al, 2004; Moss et al, 2005; Taylor et al, 2006). We tested this hypothesis by contrasting the effects of form and meaning in these areas, using Haxby et al (2001)'s statistical approach. Twelve participants were scanned while viewing blocks of colour photographs and performing a one-back same/different task. We chose object-types to produce four relationships. Objects were either: a) semantically but not perceptually similar (red apples and bananas); b) perceptually but not semantically similar (red apples and cricket balls); c) both perceptually and semantically similar (same object type); d) neither perceptually nor semantically similar (red apples and sharks). We used the General Linear Model (SPM5) to model voxel-level responses to the odd and even blocks of each object type. Parameter estimates for significantly object-selective voxels (i.e., voxels responding differently to one object-type compared to all others) were extracted for each of the anatomically defined VOIs in ventral temporal cortex. These values were used to calculate correlation coefficients as indices of similarity. In each VOI we compared the similarity of activation patterns for the four kinds of object relationships. Our findings suggest that object form and meaning differ in their relative contributions to processing along the ventral stream. We discuss these findings in the context of neural models of object identification.

D 68

USING BACKWARD MASKING TO INVESTIGATE AGE-RELATED DEDIFFERENTIATION. *Meredith Minear, Ari Moskowitz, Sandra Hale; Washington University* — We present data from a backward masking paradigm designed to provide a behavioral test of possible age-related decreases in the specificity of the ventral visual cortex with age. Similarity effects in backward masking have been reported in younger adults in which a face is a very effective mask for another face, but other complex objects such as a house are no more effective than a simple noise mask (Loffler et al., 2005). Based on the results of Park et al. (2004) which reported less category specific activity in the ventral visual cortex of older adults compared to young, we hypothesized that older adults would show less specificity in masking (i.e., a house mask would lead to greater disruption to face processing than a noise mask). However, we failed to find evidence to support this hypothesis. We did find that face masking another face was highly disruptive for both younger and older adults with a substantial decrease in accuracy on a face recognition task and an increase in the total exposure time of the target face needed to escape the effect of the mask. However, although older adults were both less accurate in discriminating faces and needed a longer exposure to escape a mask, this did not interact with mask type. For both younger and older adults, there was no difference between houses and a random noise mask in terms of their effects on face processing. These findings are inconsistent with a hypothesized reduction in neural specialization with age.

D 69

THE TIME COURSE OF OBJECT-SENSITIVE CORTICAL ACTIVITY: AN EVENT-RELATED POTENTIAL STUDY *Lisa C. Lucia[1], Emily A. Slocombe[1], Haline E. Schendan[1,2,3]; [1]Tufts University, [2]Massachusetts General Hospital, [3]Boston University* — While object-sensitive cortical activation has been well-defined using functional magnetic resonance imaging (fMRI), the time course of this neural activation is largely unknown. We have previously found modulation of event-related brain potentials (ERPs) to objects during diverse categorization and memory tasks: The frontocentral P150 and polarity reversed occipitotemporal N170, the frontocentral object-sensitive negativities referred to as the N200 and N350, and the centroposterior late positive complex (LPC) encompassing N400 and P600 components. To investigate whether the standard methods used to activate object-sensitive cortex in fMRI studies also modulate these neurophysiological potentials, 64-channel ERPs (N=23) were recorded to intact photographs of real objects and scrambled images of the same objects but with the phases of the spatial frequencies scrambled completely to yield an unidentifiable texture-like image. Participants performed an object classification task on each image, pressing one button (index finger) as soon as they could identify the object or another button (middle finger) if the image was not an object but instead a scrambled nonsense picture. Preliminary results show near perfect task accuracy, and significant differences between intact and scrambled images for all ERPs that were predicted to be object-sensitive. The ERP time course suggests cortical processing is object-sensitive at multiple times after seeing an object.

D 70

CORTICAL RESPONSES TO INVISIBLE HAND GESTURES WITHIN THE HUMAN MIRROR SYSTEM *Ross Cunnington[1], Anton Lion[2], Trevor Chong[2], Jason Mattingley[2]; [1]Howard Florey Institute, University of Melbourne, [2]School of Behavioural Science, University of Melbourne* — The human "mirror" system is thought to underlie action perception and imitation by directly mapping observed actions onto an observer's own motor repertoire. Passive recognition of hand gestures activates inferior parietal, superior temporal and ventral premotor areas, and is hypothesised to proceed automatically without the need for voluntary control. In this study we examined the extent to which observed hand gestures can be processed in the absence of conscious perception. We used a binocular rivalry paradigm during fMRI to compare patterns of neural activation in response to hand gestures that were either visible or rendered invisible via interocular suppression. We also presented neutral face images as biologically-relevant control stimuli. A forced-choice test confirmed the effectiveness of the binocular rivalry paradigm to suppress conscious perception of the hand gestures and faces. The observation of visible hand gestures elicited extensive bilateral activation within the inferior and superior parietal cortex and angular gyrus, as well as activation specifically in the left ventral premotor cortex/pars opercularis. Crucially, unseen hand gestures also elicited significant activation bilaterally within the inferior parietal lobes, centred around the angular gyrus. In contrast, unseen face images did not elicit significant parietal activation, but involved occipital activation around the calcarine sulcus and lingual gyrus. These results suggest that areas of the human mirror system, specifically the inferior parietal lobes, are able to process hand gestures in the absence of conscious perception, and may support the automatic and direct matching of observed actions onto an observer's motor repertoire.

D 71

EQUISALIENCE FUNCTION ANALYSIS: DEVELOPMENT AND APPLICATIONS TO CHARACTERIZE THE VENTRAL/DORSAL DISTINCTION IN VISUAL PROCESSING *Alissa Winkler, Charles E. Wright, Charlie Chubb; University of California, Irvine* — Equisalience function analysis (EFA) combines an experimental design and a data analysis procedure to investigate basic questions about human functional architecture in the areas of cognition and perception by testing hypotheses about whether cognitive processes have similar access to different sorts of information in the sensory input stream. The motivation for developing EFA will be illustrated using examples from our research studying the ventral-dorsal streams of visual processing. Specifically, we model tasks' differential access to color and luminance information, supporting the hypothesis that visual processes underlying shape identification, allocentric spatial identification, and pointing tasks rely differentially on visual stream resources.

D 72

UPPER AND LOWER VISUAL FIELD DIFFERENCES IN SELF-FACE RECOGNITION *Yuan Hang Li[1], Eran Zaidel[2]; [1]UCLA, [2]Brain Research Institute, UCLA* — INTRODUCTION: Self recognition is central to consciousness, and Self-Face Recognition (SFR) is central to self recognition. Is SFR part of a general face recognition (GFR) system or is it modular? In a previous experiment, we found that SFR was poorer when the self-face was tachistoscopically presented 2 visual degrees below than above fixation. In contrast, recognition of a stranger's face or a scrambled face was the same above or below fixation. However, this dissociation may be due to the increased familiarity of self-faces. Thus, the present study examined SFR using familiar, rather than strangers', faces as foils. METHODS: Experimental variables included: Face Type (self, familiar) x Location (above, below) x Visual Field (left, right). Stimuli consisted of photos of the subject and a gender-matched familiar friend (known for > 1 year). RESULTS: The data was consistent with the previous findings. SFR was worse below than above fixation, whereas recognition of familiar-faces was the same above and below fixation. CONCLUSIONS: We suggest that SFR relies on a different recognition strategy than GFR. The lower facial features of self-faces may be more informative than the upper features, hence self-faces are recognized more effectively above than below fixation. This asymmetry does not occur for recognition of familiar or strangers' faces.

D 73

SEMANTIC KNOWLEDGE SHAPES THE EARLY VISUAL PERCEPTION AND LATER IDENTIFICATION OF OBJECTS: AN ERP STUDY *Rasha Abdel Rahman, Werner Sommer; Humboldt University Berlin* — Experts in object recognition differ from novices in two aspects: intense perceptual experience and advanced knowledge in the domain of expertise. While perceptual expertise has been shown to strongly affect the perception, discrimination and identification of objects (e.g. Tanaka & Curran, 2001; Gauthier et al 1999), little is known about the influence of advanced semantic background knowledge (i.e. semantic expertise) on these processes. Here we used a learning paradigm to manipulate the amount of acquired background knowledge about initially unfamiliar objects while keeping perceptual factors constant. In a separate test session 2 to 3 days after learning participants performed several tests on the objects that did not relate to the background knowledge. Enhanced knowledge resulted in an amplitude reduction of the P100, a component that is associated with early stages of perceptual analysis. This effect could reflect facilitated visual perception and/or integration of object features as a result of advanced knowledge about the object. Furthermore, the amount of acquired knowledge was reflected in an amplitude increase of an N400-like component that is associated with the effort or depth of semantic processing of meaningful stimuli. Both effects were present across a range of tasks from perceptual classification to naming, and despite the fact that the additional information was irrelevant for correct task performance. These findings suggest that first, semantic background knowledge about objects changes the way in which we perceive these objects early on and that second, advanced knowledge enhances the depth of semantic processing irrespective of specific task demands.

D 74

BRAIN ACTIVITY IN HUMAN ALBINISM DURING A VISUO-MOTOR INTEGRATION TASK *Barbara Wolynski, Martin Kanowski, Michael Hoffmann; Magdeburg University* — Purpose: In albinism the ipsilateral visual field is abnormally represented in the early visual cortex. Is the representation abnormality also evident in higher-tier areas involved in visuo-motor tasks? Methods: With event-related fMRI brain activity was determined (3T, Siemens TRIO; SPM5) for a visuo-motor memory task in six albinotic subjects and three controls: While the subjects fixated a central point monocularly, a coloured target embedded in an array (6.5° x 6.5°; centred at 5.5° left or right from fixation) of grey distractors was presented for 250 ms either in the left or right visual hemi-field. After a delay subjects were prompted to press the upper or lower response buttons for targets in the upper or lower visual field, respectively, either with the left thumb (blue targets) or with the right thumb (red targets). Results: (1) Controls: Motor activity was dominant in the motor cortex contralateral to the responding thumb, visual activity was dominant in the visual cortex contralateral to the stimulated hemi-field, and parietal activity was evident both bilateral and contralateral to the visual stimulus. (2) Albinism: For all subjects the same lateralisation of motor-activity as in the controls was observed. Visual activity patterns were heterogeneous corresponding to previous reports [1]. Abnormal representations in the early visual cortex tended to coincide with parietal abnormalities. This suggests that, despite a normal motor-representation, the abnormal visual representation is relayed from early to higher visually driven areas.

D 75

PERCEPTUAL RELEVANCE OF ABNORMAL VISUAL FIELD REPRESENTATIONS – STATIC VISUAL FIELD PERIMETRY IN HUMAN ALBINISM *Michael Hoffmann[1], Petra Seufert[2], Linda Schmidtborn[2]; [1]Magdeburg University, [2]Freiburg University* — Aim: In human albinism the plasticity of the visual system is challenged, as part of the temporal retina projects abnormally to the contralateral hemisphere. Is the sensitivity of the abnormally projecting temporal retina preserved? Methods: In 15 subjects with albinism and electrophysiologically determined extent of the retinal projection abnormality [1], and in 6 control subjects, we assessed the light spot detection sensitivities in the central 20° of visual field. The sensitivities were determined monocularly with static white-on-white perimetry using 'Octopus 101'. Results: In the subjects with albinism, the sensitivity of the abnormally projecting part of the temporal retina is not selectively reduced: Apart from the vicinity of the papilla, there was no significant sensitivity difference between nasal and temporal retina in both the subjects with albinism and in the controls. No correlation between visual field sensitivities differences of nasal and temporal retina and the extent of the projection abnormality was detected. Conclusions: While the papilla-induced scotoma can be detected in the subjects with albinism tested, there is no indication of a selective visual field defect induced by the projection abnormality. This contrasts with the selective visual field defects observed in some animal models of albinism and indicates that in humans, mechanisms of cortical self-organisation make the abnormal representation available for visual perception and visuo-motor integration.

D 76

FAMILY RESEMBLANCE: TEN PROSOPAGNOSICS IN A FAMILY *Brad Duchaine[1], Laura Germine[1], Lucia Garrido[1], Ken Nakayama[2]; [1]University College London, [2]Harvard University* — We report on neuropsychological testing done with a family in which many members report severe face recognition impairments. These ten individuals are high functioning in everyday life and performed normally on tests of low-level vision and high-level cognition. In contrast, they showed clear deficits with tests requiring face memory and judgments of facial similarity. They do not show deficits with all aspects of higher level visual processing as all tested performed normally on a challenging facial emotion recognition task and on a global-local letter identification task. On object memory tasks requiring recognition of particular cars and guns, they showed significant deficits so their recognition impairments are not restricted to facial identity. These results strongly suggest the existence of a genetic condition leading to a selective deficit of visual recognition.

D 77

DISENTANGLING VISUAL ATTENTION AND PERCEPTUAL AWARENESS IN HUMANS: THE ROLE OF GAMMA OSCILLATIONS *Valentin Wyart, Catherine Tallon-Baudry; CNRS / Université Pierre et Marie Curie, Paris, France* — It is difficult to imagine being aware of a visual stimulus without attending to it. Does it mean that visual attention and perceptual awareness are confounded, or just entangled? Gamma (30-120 Hz) oscillatory synchrony, a potential neural cooperativity mechanism, has been proposed as a neural correlate of both attention and awareness. We designed a paradigm in which attention and awareness were manipulated independently. 12 subjects were cued by a central arrow to covertly attend either left or right visual fields. A grating at contrast threshold for awareness could appear at the attended or unattended side. Subjects had to report stimulus orientation and whether they consciously perceived the stimulus or not. The same physical stimulus could thus be attended or not, and consciously perceived or not. Behaviorally, subjects consciously perceived 50 % of the stimuli. They were able to discriminate correctly the orientation of 80 % of the consciously perceived stimuli, and were at chance level for unperceived stimuli. As expected, subjects consciously perceived the stimulus more often when it appeared at the attended side. However, more than 40 % of the stimuli appearing at the unattended side were nevertheless consciously perceived. Magneto-encephalographic recordings showed that induced gamma oscillations within 50-60 Hz over contralateral occipital sensors were significantly larger when the stimulus was consciously perceived ($p < 0.0001$), but were unaffected by attention ($p > 0.5$). These gamma oscillations could therefore be a specific neural correlate of awareness, independent of attention.

Methodological Issues: Electrophysiology

D 78

ELECTROPHYSIOLOGICAL MEASURES OF METAPHOR PROCESSING BY THE TWO CEREBRAL HEMISPHERES *Miriam Faust, Abraham Goldstein, Yossi Arzouan; Bar-Ilan University* – There is some evidence for a unique contribution of the RH in processing figurative language. However, brain imaging studies of metaphor comprehension have reported contradictory findings. Our aim was to define the specific contribution of the RH in processing metaphoric language, and its timing, using electrophysiological measures. We compared the patterns of brain electrical activity elicited by processing two-word expressions denoting literal, conventional metaphoric, and novel metaphoric meaning, as well as unrelated word pairs. Participants performed a semantic judgment task in which they decided whether each word pair conveyed a meaningful expression. In order to estimate the neural sources of the waveforms for each condition, the average ERPs were subjected to LORETA. We compared the number of voxels in each hemisphere that were significantly different from a prestimulus baseline for each of the expression types. Novel metaphors elicited prominent activity in the RH at various times (peaking at 425, 600 and 710ms). Conventional metaphors showed relative greater LH activity at those times. Next, we used SPM and cluster analysis to compare our electrophysiological data to those of fMRI studies. Cluster analysis yielded four clusters for the conventional metaphors, three of them located in the LH (temporo-parietal, frontal, posterior) and one on the RH (temporo-parietal). Novel metaphors recruited two clusters, one on each hemisphere. The RH cluster included temporal, frontal and parietal areas, whereas the LH cluster consisted of mainly frontal areas. These findings are consistent with the claim that processing novel metaphors, compared to conventional ones, involves RH mechanisms.

D 79

TEST-RETEST RELIABILITY OF NEUROPHYSIOLOGIC RESPONSES TO ACOUSTIC CHANGE WITHIN VOWELS *Brett Martin, Karen Kushla; Graduate Center of CUNY, New York, NY* – The purpose was to examine, in adults with normal hearing, the amplitude, latency, and scalp distribution of the cortical auditory evoked potentials P1, N1, and P2 elicited by formant change within a vowel. In addition, test-retest reliability of these evoked potentials was assessed. There were three stimuli (/ua/, /ui/, and /uU/) produced in three conditions (natural, synthetic, and tonal). Significant effects of stimulus, condition, and their interaction were obtained, and reflected differences in the acoustic content and complexity of the stimuli. High test-retest reliability was obtained across test session using both intraclass correlations on the waveforms and dependent samples t-tests on the waveform peaks. These results have implications for evoked potential studies of speech processing as well as potential clinical application of P1-N1-P2.

D 80

EXAMINING THE EQUIVALENCY OF VISUAL DESIGNS ON FACE PROCESSING: AN EVENT-RELATED POTENTIAL STUDY *Bernadette Sibuma, John Black, Karen Froud; Columbia University, Teachers College* – To date, the electrophysiology research is mixed in regards to whether or not differences in the N170 event-related potential (ERP) component exist in processing emotional expressions (e.g., Batty & Taylor, 2003; Eimer & Holmes, 2002). In addition, little is known about the effect of the design modality on the time course of face processing. In this study, we examined the N170 as it presents in the processing of cartoon, computerized, and photographs of faces with neutral and fearful expressions. Preliminary results of a facial expression decision-making task showed a significant effect of design, i.e. cartoons and photographs of neutral faces both elicited significantly larger N170 amplitudes compared to computerized faces. Secondly, we found that, in computerized faces, emotion (fear) significantly enhanced the N170 amplitude. Since variance in the amplitude of a component has often been associated with the degree to which the associated cognitive process is engaged (e.g., Donchin & Coles 1988; Otten & Rugg, 2005), we hypothesize that the increase in N170 amplitude reflects an increase in engagement with cartoons, photographs, and emotional computerized faces more than with neutral computerized faces. Our findings have implications for the selection and equivalency of facial stimuli used within and across neurocognitive experiments.

D 81

CROSS-CORTICAL COMMUNICATION IN HEALTHY HUMAN AGING: A MUTUAL INFORMATION ANALYSIS OF EEG *Sidney Segalowitz, William Marshall, Karen Mathewson, William Tays, Jane Dywan; Brock University* – EEG coherence should reflect cross-cortical communication changes due to human aging but has not provided consistent results, possibly because coherence reflects only linear relations between sites. A potential solution is the application of Mutual Information (MI) Analysis, a nonlinear measure of cross-cortical communication. Predictions: Age-related losses in frontal white matter and a decline in frontally-based executive functions suggests regional frontal decline in information transfer. Tasks: High density EEG was recorded while 14 young and 12 older adults engaged in a stimulus discrimination letter flanker task and a source monitoring word memory task. Analyses: EEG data were collected from dorsal-parietal, ventral-frontal and dorsal-frontal sites at 500 Hz (filtered at 1-50 Hz). MI and EEG coherence were calculated for ipsihemispheric combinations of sites based on 250 ms of EEG time-locked to stimulus onset for correct trials in each task with an MI lag of 100 ms for each combination. Results: EEG coherence did not differentiate the groups and there were no differences in EEG information (entropy) between groups. Maximum MI values were higher in younger adults ($p=.003$). Ventral-dorsal frontal sites showed greater MI than the other combinations ($p<.001$), an effect that was significantly greater in the younger adults due to greater frontal MI ($p<.01$). This interaction was mirrored in the analysis of slope MI drop over the epoch ($p=.001$). MI at any of the frontal sites succeeded in discriminating the groups 100%.Conclusions: Mutual Information Analysis captures changes in cortical communication in the aging human brain during complex task performance.

D 82

AUTOMATIC COMPONENT DETECTION OF EVENT-RELATED POTENTIALS USING FUNCTIONAL DATA ANALYSIS *Jean-Philippe Thivierge[1], Natalie Phillips[2]; [1]Universite de Montreal, [2]Concordia University* – By capturing the stimulus-dependent fluctuations in neuroelectric activity on the surface of the scalp, event-related potentials (ERPs) allow a wealth of information to be collected on cognitive and perceptual processes. However, they also raise difficult challenges in analysis and interpretation, which is partly due to poor signal-to-noise ratios. Our research provides a novel approach for extracting and quantifying the main characteristics of ERP signals. This approach is divided in two parts. First, nonlinear b-spline smoothing of the raw EEG (electroencephalographic) data is performed based on Functional Data Analysis (FDA). Then, a novel technique termed automatic components detection (ACD) is applied that identifies the distinct peaks and troughs (i.e., components) in the smoothed signals, based on their derivatives. A key advantage of ACD is that it assumes no a priori knowledge of the distribution of components. The combined FDA-ACD approach was successful at replicating findings of an empirical study on the effect of healthy aging on language processing. A central finding was that this approach employed only half the number of trials required by the original averaging approach to obtain the same results. Analyses showed that older participants obtained N400 components with lower amplitudes, longer durations, and increased latencies compared to younger participants.

D 83

EVENT-RELATED POTENTIAL CORRELATES OF SWITCHING BETWEEN TRUTHFUL AND DECEPTIVE RESPONSES *Michelle Phillips, Scott Meek, Veena Nair, Carmen Sanchez, Adam Craig, Yuliya Komarova, Laura Smarandescu, Deepa Vijayakumar, Jennifer Vendemia; University of South Carolina* – The influence of deception and stimulus congruity on brain event-related potentials (ERP) was examined in a two-stimulus sentence verification task. In the current study, 20 college-aged participants viewed questions to which they were randomly prompted to respond with two levels of deception and congruity. The resulting ERPs were analyzed with two strategies: 1) a spatial principal components analysis, and 2) an independent components analysis. Although the ability of these two analysis techniques to recover dipoles from simulated data has been established (Richards, 2003), the current study examines the benefits and costs of these strategies in a less controlled data set. Dipole models for both solutions were calculated for components related to the early positive wave (P3a), a late positive wave (P3b), and a late anterior negativity (N4). Research using the two-stimulus paradigm, has identified distinct potentials related to each of these waveforms using standard peak analysis approaches (Vendemia et al., 2005). The dipole models were calculated using both a 4-shell and realistic head model. The comparison of these techniques and their relationship to a theory of deception that involves early and late processing is discussed.

D 84

TOPOGRAPHICAL VARIABILITY OF ERP RESPONSE IN OLDER ADULTS IS INVERSELY RELATED TO INTERFERENCE IN A WORKING MEMORY TASK *William Tays, Sidney Segalowitz, Karen Mathewson, Jane Dywan; Brock University* – Prefrontal cortex (PFC) activity tends to be less differentiated in older adults than younger adults (HAROLD model). This reduction in cortical specificity may reflect age-related difficulties in recruiting specialized neural mechanisms (dedifferentiation hypothesis) or it may represent recruitment of additional cognitive resources to maintain performance (compensation hypothesis). We investigated changes in the topographic variability of ERP responses in younger and older adults during a working memory task that varied the degree and kind of proactive interference effects. Predictions: We hypothesized that, as the demands on executive control in working memory increased, older adults would show reduced selectivity of neural responses at recording sites over PFC (i.e. greater variability of N450 responses) compared to younger adults. Results: In younger adults, the N450 amplitude was sensitive to interference manipulations, but not in older adults. However, both younger adults and older adults showed sensitivity to interference effects in the topographic variability of their N450 response. As the level of interference increased, the variability of the N450 topography decreased in both groups, such that older adults' neural response became more similar to younger adults as difficulty increased. Therefore, older adults showed evidence of increased neural specificity that may mark MORE efficient information processing under greater task interference, a finding not anticipated on the basis of the compensation or dedifferentiation hypotheses. Conclusions: The analysis of topographical ERP response variability represents a novel means of identifying individual differences in PFC function and may constrain hypotheses based on age differences in the ERP components themselves.

D 85

AN ERP STUDY OF PROSODICALLY DRIVEN PRONOMINAL (DIS)AGREEMENT *Efrat Pauker, Inbal Itzhak, Karsten Steinhauer, John Drury, Shari Baum; McGill University* – Manipulations of the prosodic properties of auditorily presented sentences were studied with event-related potentials (ERPs) to probe the mechanisms supporting the on-line establishment of co-reference between pronouns and antecedents. Sentences such as "Whenever John calls (#A) his mother (#B) HE is happy" were presented with either one prosodic break or two (i.e., at position #B or at both #A and #B). In the single break (B) conditions, the pronoun HE is construed as co-referential with the subject of the preposed adverbial clause (John). However when there are two such breaks (A&B), we hypothesized that the tendency might be for the pronoun to link with the immediately prior nominal expression ("his mother"), thereby creating a gender mismatch (cf. "His mother, SHE/*HE is happy"). Previous ERP studies of the processing of pronominal (co)reference have contrasted different target words, for example "The aunt heard that *HE/SHE had won the lottery" (Osterhout & Mobley 1995; see also King & Kutas 1997; Schmitt et al. 2002; Hammer et al. 2005). Results have been mixed and reported either N400 or P600 like effects, or both. We found that prosodic boundary information determined the pronoun co-reference, and that the resulting gender mismatch yielded an N400 type effect - in contrast to control conditions involving no such mismatch. Implications for models of prosodic processing and co-referential relationships will be discussed.

D 86

A TWO-STATE ANALYSIS OF EVENT-RELATED SCALP POTENTIAL DATA RELEVANT TO THE DETECTION OF DECEPTION *Michael Schillaci, Jennifer Vendemia, Robert Buzan, Eric Green, Scott Meek; University of South Carolina* – We present our recent efforts in the development of a theory of deception using both eeg/erp and mri/fmri correlates attained during several two-stimulus experiments. In particular our early work on autobigraphical information has been expanded to refine our model of workload dependence and pilot findings from a misinformation paradigm show that up-front modulation occurs. In addition to conventional waveform peak and latency analyses we also present an energy-based analysis that allows for a detailed temporal description of the possible "neural circuits" involved in the process of deception. We show that while these processes are similar to thos of truth telling the relative timing of cognitive workload in anterior and posterior regions of the cortex differ with deception taking longer.

Methodological Issues: Neuroimaging

D 87

NEURAL ADAPTATION REVEALS STATE-DEPENDENT EFFECTS OF TRANSCRANIAL MAGNETIC STIMULATION *Juha Silvanto[1], Neil Muggleton[2], Alan Cowey[3], Vincent Walsh[2]; [1]Harvard Medical School, [2]University College London, [3]University of Oxford* – Transcranial magnetic stimulation (TMS) is now widely used as a "virtual" lesion paradigm to investigate behavioural functions, but the mechanisms through which it influences neural processing are unclear. To understand the differential effects of TMS on spatially overlapping populations of neurons we manipulated the relative activity levels of visual neurons by adapting subjects to a range of visual stimuli. By applying TMS to the visual cortex representing the central visual field, we show in two experiments that the behavioural effects of TMS depend on the state of adaptation of the neural population stimulated by TMS. Specifically, we demonstrate that within the stimulated area TMS stimulates the adapted, and therefore less active, neural population relatively more than an unadapted population. We demonstrate the generality of this principle for both suprathreshold and subthreshold TMS as well as for color and orientation-contingent colour using both subjective reports and psychophsyical measures. These findings can explain how TMS disrupts cognitive functions and therefore have implications for all studies which use TMS to disrupt behaviour.

D 88

AGE-RELATED DIFFERENCES IN REGIONAL BRAIN VOLUMES: MANUAL VOLUMETRY VS. VOXEL-BASED MORPHOMETRY *Kristen M. Kennedy[1,2], Kirk I. Erickson[3,4], Karen M. Rodrigue[1,2], Michelle Voss[3,4], Arthur F. Kramer[3,4], Naftali Raz[1,2]; [1]Wayne State University,*

[2]*Institute of Gerontology,* [3]*University of Illinois at Urbana-Champaign,* [4]*Beckman Institute* – Regional manual volumetry from structural MRI is the current gold standard of in vivo neuroanatomy in the studies of the aging brain and cognition. Recently, voxel-based morphometry (VBM) has become readily available and widely used. As popularity of VBM increases there is a need to systematically evaluate its performance vis-a-vis manual volumetry. To date, such comparisons have been limited to small number of regions, small samples, and less than optimal VBM techniques. We present a study designed to overcome these limitations, by applying an optimized VBM approach to a sample of 199 adults spanning the ages from 18 to 80 for which highly reliable manual volumetric measures have been previously obtained (Raz et al., 2004, Neurobiol Aging, 25, 377-396). Although we observed qualitative similarities in the pattern of regional effects of age, a quantitative evaluation of the differences revealed discrepancies between the methods. Specifically, the greatest differences emerged in the regions that showed extreme (high and low) effects of age. Relatively low correlations between the results obtained by volumetry and VBM (age-volume r = .56 for dorsolateral prefrontal to -.01 for the inferior parietal white matter) suggest that the techniques may not be measuring the same thing. Possible reasons for the discrepancies will be discussed, including problems of registration, segmentation, smoothing, and underlying assumptions of VBM as well as individual variability of anatomical structures.

D 89

HIPPOCAMPAL ATROPHY IS THE CRITICAL BRAIN CHANGE IN PATIENTS WITH MEMORY DISORDER RESULTING FROM ANOXIC EPISODE. *Margherita Di Paola[1], Lucia Fadda[2], Laura Serra[1], Carlo Caltagirone[2,1], Giovanni Augusto Carlesimo[2,1]; [1]IRCCS Santa Lucia Foundation, Rome, Italy, [2]University of Rome "Tor Vergata", Italy* – Anoxia is considered a good model to study amnesia, nevertheless not all individuals who experience anoxic events develop memory problems. Moreover is still unresolved the question whether in patients with amnesia and without significant other cognitive, after anoxia, the damage is limited to hippocampi. Here we investigated the brain damage in a selected sample of adults affected by exclusively amnesic syndrome after an anoxic episode, applying the Voxel-Based Morphometry. We studied five anoxic patients and thirty-three well-matched healthy subjects. Our aim was: a) to quantify regional gray and white matter changes associated with chronic anoxic damage compared to control subjects; b) to identify regions of common abnormality across all patients; c) to investigate whether measures of regional gray matter volume correlate with memory scores. When we compared anoxic patients to healthy subjects (Group Comparison Analysis), we found a significant reduction of gray matter volume in the hippocampus bilaterally. When we looked at the significant gray matter atrophy common to all patients (Conjunction Analysis), we found a gray matter reduction in the hippocampus bilaterally. When we performed correlation analysis we found just a trend between the Prose immediate free recall test and the left hippocampus. Findings from the present study indicate that the hippocampus is the elective target of cerebral damage in adults with amnesic deficit after anoxia. Each patient may present damage to other brain regions, but the results of the conjunction analysis point to the hippocampal atrophy as the critical damage for the rise of the memory disorder.

D 90

INVESTIGATION OF SENSITIVITY OF NOVEL MRI TECHNIQUES IN DETECTING WHITE MATTER CHANGES IN NORMAL AGEING *Francesca Schiavone[1], Rebecca Charlton[1], Thomas Barrick[1], Robin Morris[2], Hugh Markus[1]; [1]St. George's University of London, [2]Institute of Psychiatry, Kings College London* – White matter damage has been identified as one of the main of age-related changes. Diffusion Tensor Imaging (DTI) and Magnetization Transfer (MT) have been demonstrated to be sensitive techniques in detecting white matter damage. We performed both DTI and MT in an elderly population (age-range 54-85 years) to assess whether MT added additional information to that obtained by DTI. Histograms were generated for Mean Diffusivity (MD), Fractional Anisotropy (FA) and Magnetization Transfer Ratio (MTR) for white matter. Peak Height Normalized Frequency was derived from each histogram and used in subsequent correlation and regression analyses between MRI parameters, age and cognitive functions. There were significant correlations between all MR measures and age, but the correlations were stronger with the DTI parameters (FA r = .737, p = < 0.01; MD r = -.646 p= < 0.01, MTR r = -.456, p= < 0.01). As indicated by regression, DTI parameters explained 40% of the variance of Information Processing Speed measures (MD and FA Adjusted R square = .400, Sig F change = .003); whether MT did not contribute significantly to the model (MTR Adjusted R square = .413, Sig F change = .123). In addition, Beta coefficients demonstrated the only FA contributed significantly to the model (Beta coefficient = -.435 p < 0.05). DTI, and particularly FA, appears to be the most sensitive measure to assess age related white matter damage. The stronger relationships may reflect the fact that FA gives a direct measure of white matter changes observed in ageing.

D 91

TRACKING THE CONCENTRATIONS OF OXYGENATED AND DEOXYGENATED BLOOD IN THE VISUAL CORTEX WITH NEAR-INFRARED SPECTROSCOPY *Glenn Wylie, Gerald Voelbel, John DeLuca; Kessler Medical Rehabilitation Research & Education Corp., and UMDNJ-New Jersey Medical School* – The primary purpose of this study was to use functional near-infrared spectroscopy (fNIRS) to plot the time-course of changes in the concentration of oxygenated blood (oxyHb) in primary visual cortex, using what is known about this time-course from the fMRI literature as a benchmark. A secondary aim was to plot the time-course of the concentration of deoxygenated blood (deoxyHb) in primary visual cortex, since this information is not independently available in the BOLD signal. Subjects were fitted with an array of 30 fNIRS source/detector 'optodes', positioned over the occipital lobe. The room was darkened and, after a 5 minute baseline period, subjects viewed 120 presentations of a large, white square, with 10-20 sec between each successive presentation. This slow event-related design allowed us to extract the response to each stimulus from the time-series and average across the 120 presentations. This provided a 'model-free' assessment of the oxyHb and deoxyHb concentrations across time. We also analyzed the data using standard fMRI statistical methodology. The two approaches—averaging and modeling—yielded qualitatively similar results. The analyses of the oxyHb accord well with the extant fMRI literature. The analyses of the deoxyHb show the concentration of deoxygenated blood increases far more quickly than the concentration of oxyHb. The wider implications of these results will be discussed.

D 92

NOUN-VERB PROCESSING IN ITALIAN ACROSS THREE PRODUCTION TASKS: AN FMRI STUDY OF PICTURE-NAMING, READING AND REPETITION *Analía Arévalo[1], Daniela Perani[2], Stefano Cappa[2], Frederic Dick[3], Pasquale Della Rosa[2], Elizabeth Bates[4], Nina Dronker[1]; [1]VA Northern California Health Care System, Martinez, CA, University of California, Davis, CA, [2]Università Vita Salute San Raffaele, Milan, Italy, Milan, Italy, [3]School of Psychology, Birkbeck College, London, UK, [4]University of California, San Diego, CA* – The aim of this study was to evaluate the neural correlates of noun versus verb processing across three tasks (and two modalities) -- picture-naming (PN), word reading (WR) and word repetition (WRP) -- in healthy native speakers of Italian. Different brain areas have been implicated in the processing of the two word categories as well as these three different tasks, yet to date none of these comparisons have been run within individual participants. Here, participants viewed alternating blocks of PN, WR and WRP noun-verb stimuli (black-and-white line drawings, written and aurally-presented words, respectively) and were required to overtly name the pictures, read or repeat the words, depending on the run. As previously reported (e.g., Perani et al., 1999), we mostly observed areas more strongly activated for verbs relative to nouns (L middle frontal gyrus, L and R middle temporal gyrus, and R fusiform gyrus and cerebellum, FDR corrected level of p<.05, min. of 100-voxel clusters), but not the reverse. In other words, nouns and verbs activated similar networks but verbs activated additional areas, which does not support the notion of anatomically distinct noun and verb areas. Also, this noun-verb difference reached significance in PN and WRP (and not in WR), and was significantly larger in PN relative to WRP. For WRP, significant 'verb activation' was seen in the right middle temporal gyrus. We discuss theories of noun-verb processing, brain organization for tasks and word classes, as well as cross-linguistic perspectives.

D 93

USING FUNCTIONAL NEAR INFRARED SPECTROSCOPY TO STUDY VERBAL FLUENCY IN HEALTHY ADULTS *Jeannie Lengenfelder, Gerald Voelbel, Glenn Wylie, Neal Nadkani, Angela Smith, John DeLuca; KMRREC* – The objective of this study was to examine the use of functional Near Infrared Spectroscopy (fNIRS) to investigate the pattern of cerebral activation in the frontal lobes of healthy adults during a verbal fluency task. Participants were 9 right-handed, healthy adults (6 females, 3 males) between the ages of 20 and 51 without any history of neurological disease or psychiatric disorders. Participants were seated comfortably and 30 fNIRS source/ detector optodes were placed on their foreheads. Following a 60 second baseline period the verbal fluency task was administered according to standard administration. Participants produced words starting with the letters F, A, and S with a 60 second time limit for each letter. Across the 9 participants, there was significantly elevated oxyhemoglobin (OxyHb) detected in the left inferior frontal gyrus (Broadman Areas 45 & 46), between the left dorsal and ventral lateral prefrontal cortex, during the verbal fluency task when compared to the baseline period. This study demonstrates that fNIRS, a new functional neuroimaging technique, can be used to detect changes in OxyHb within the frontal lobe during a verbal fluency task in healthy adults. The increase in the left inferior frontal gyrus is consistent with prior functional imaging studies of verbal fluency tasks. The findings will be discussed in the context of the utility of fNIRS to measure functional changes in cerebral oxygenation due to cognitive activity in healthy adults.

D 94

NOVELTY/FAMILIARITY OF REWARD-PREDICTING CUES MODULATES THE REWARD ANTICIPATION RESPONSE IN HUMAN NUCLEUS ACCUMBENS AND MEDIAL MIDBRAIN *Ruth M. Krebs[1], Björn H. Schott[2,1], Hartmut Schütze[1], Georg Salloum[1], Hans-Jochen Heinze[1], Emrah Düzel[3,1]; [1]Otto von Guericke University, Magdeburg, Germany, [2]Leipniz Institute for Neurobiology, Magdeburg, Germany, [3]Institute of Cognitive Neuroscience, University College London, United Kingdom* – Reward anticipation in humans is associated with activation of the mesolimbic reward system, particularly the nucleus accumbens and the midbrain. Little is known, though, about the influence of reward-irrelevant cue features, such as novelty and familiarity. In the present event-related fMRI study we investigated whether novel and familiar reward-predicting cues are processed differently, using a 2x2-factorial design (rewarding/neutral x novel/familiar) in a sample of 24 healthy volunteers. Photographs of complex scenes served as reward-predicting cues, and subjects had been familiarized with half of the pictures the day before scanning. During the experiment subjects made an explicit novelty/familiarity judgment for each picture, followed by a number comparison task. Novelty/familiarity was irrelevant for the reward-prediction, whereas the reward-predicting quality of the pictures was carried by their content (indoor/outdoor). In rewarded trials, correct responses in the task were followed by a positive feedback indicating monetary gain, whereas incorrect responses led to a negative feedback indicating loss. As expected, both accumbens and medial midbrain showed an increased activation during reward anticipation, and this response was significantly stronger for familiar relative to novel cues. However, during positive feedback, activation in accumbens and midbrain was stronger after the presentation of novel relative to familiar reward-predicting cues. These results suggest that explicit novelty detection is associated with reduced reward prediction and an increased prediction error, whereas familiarity of reward-predicting cues facilitates anticipation processes due to a more efficient cue encoding. We currently investigate whether this response pattern also occurs when novelty/familiarity judgement is not explicitly required.

D 95

EFFECTS OF DURATION OF AUDITORY SPEECH VERSUS NON-SPEECH SIGNALS ON BRAIN ACTIVATION *Helen Chen[1], Einar Men[1], Saudamini Roy[2], Doug Whalen[3]; [1]Haskins Laboratories, [2]Carnegie Mellon University, [3]Haskins Laboratories & National Science Foundation* – The purpose of this study was to investigate the effects of auditory stimulus duration on brain activation using fMRI. Natural speech and non-speech auditory stimuli with 5 levels of duration ranging from 400ms to 1000 ms were presented to 20 subjects in an event-related design. A passive listening task with catch trials requiring a button press was used. Speech stimuli were pseudowords with consonant-vowel-consonant structure, non-speech stimuli were sequences of three musical chords, and catch trials were single piano notes. Direct comparison of speech and non-speech stimuli showed greater activation for non-speech stimuli in the anterior part of the superior temporal gyrus (STG) in both hemispheres, while activation induced by the speech stimuli was greater than that of the non-speech stimuli only in the left posterior part of the STG. Further, a positive linear correlation between stimulus duration and activation level was found for the non-speech condition in areas spread across the bilateral primary and secondary auditory cortex, but was largely restricted to the right STG for the speech condition. These results suggest that stimulus duration has a stronger effect across various parts of the auditory processing system for non-speech stimuli compared to that of the speech stimuli and provides reference data for when researchers need to carefully control stimulus duration in neuroimaging experiments.

D 96

AN INVESTIGATION OF PERFUSION IN STROKE SURVIVORS *Kathleen Brumm[1], Thomas Liu[2], Joanna Perthen[2], Frank Haist[2], Tracy Love[2,3]; [1]SDSU/ UCSD Joint Doctoral Program in Language and Communicative Disorders, [2]University of California, San Diego, [3]San Diego State University* – Magnetic Resonance Perfusion Imaging is used to measure regional cerebral blood flow (rCBF), which has been reported to be reduced in some neural areas of aphasic patients (Hillis et al., 2005). Prior research has shown that reduced rCBF, or hypoperfusion, in patients with aphasia is correlated with suboptimal neural functioning in areas that appear to be structurally intact (Love et al., 2002). Hypoperfusion may therefore lead to "functional lesions" that would not be revealed via structural imaging. These "functional lesions" may help to account for cognitive deficits that are not correlated with structural imaging results. Given the prior research indicating hypoperfusion in aphasia, we examined perfusion maps of aphasic patients in order to determine the time-course and localization of hypoperfusion. Arterial Spin Labeling (ASL) was used, in which radiofrequency pulses are used to magnetically tag aterial blood water. Images are then acquired following a post-labeling delay, across 8 total time delays, ranging from 300 ms to 3 seconds, in order to measure cerebral perfusion. Among aphasic patients relative to age-matched and young unimpaired controls we not only found hypoperfusion, but also uncovered a longer transit delay between the arterial tagging region and the imaging region. These results add to the growing body of literature regarding hypoperfusion in aphasia and also propose new avenues of research related to transit delays in cerebral perfusion. Implications of this study extending to aphasia research and neuroimaging methods will be discussed.

D 97

INFEROTEMPORAL REGIONS CRITICAL FOR NAMING CONCRETE ENTITIES REVEALED BY INFERENTIAL STATISTICS FOR LESION OVERLAP DIFFERENCE MAPS *Thomas Grabowski[1], David Rudrau[1], Sonya Mehta[1], Joel Bruss[1], Daniel Tranel[1], Hanna Damasio[2]; [1]University of Iowa College of Medicine, Iowa City, Iowa, [2]Brain and Creativity Institute, University of Southern California, LA, CA* – Maxima in lesion-overlap difference maps have been used to support anatomical-functional hypotheses regarding the brain substrates of naming (Damasio et al, 2004), but precise inferential statistical methods have not been used for thresholding. We derived exact statistics characterizing, voxelwise, the statistical behavior of lesion overlap difference maps when the null hypothesis of no association between lesion and deficit is true. We applied the method to 137 subjects with focal brain damage previously included in Damasio et al (2004), tested for deficits in naming in five conceptual categories of concrete entities (persons, animals, fruits and vegetables, tools, musical instruments). The results affirm some spatial segregation between regions involved in naming different classes of concrete entities. Deficits in naming nonunique entites were associated with lesions in the left temporal-occipital-parietal junction and inferior temporal lobe, whereas, for persons, lesions mostly concentrated in the left temporal pole. Lesions associated with deficits in naming natural (animals, fruits and vegetables) but not manmade (tools, musical instruments) entities, included the left inferior frontal gyrus. Also, the results reveal previously undetected regions involved in naming, independent of categories. Conjunction analyses showed loci in left IT and insula where significant lesion-naming deficit relationships were found for all five categories of stimuli. Subsequent logistic regressions showed that the likelihood of having a lesion in those regions significantly increases with the number of categories for which subjects manifest a naming deficit, and this effect was especially significant for IT. These findings emphasize the importance of inferential statistics in lesion-overlap difference map analyses.

D 98

ON THE ROBUSTNESS AND ATOMICITY OF NETWORKS OF ACTIVATION, AN FMRI STUDY *Alessandro Gagliardi, Catherine Hanson, Stephen Hanson; Rutgers University* – In this study, we examine the network of brain activity indicated by fMRI while a participant watches a normal video of an intentional human activity (i.e., building a chair, making coffee), a degraded version of the same, and random geometric motion (i.e., a circle moving randomly on the screen). We develop graphs of these networks using dynamic causal modeling (DCM) and compare these against results from structural equation modeling (SEM) and Bayesian methods. We find that these methods reveal subgraphs of activity indicative of elementary processes associated with these tasks (i.e., vigilance, theory of mind, etc.). We further demonstrate the robustness (and limitations) of these methods by perturbing our criteria of how we define a node of activation.

D 99

EFFECTS OF HYPERCAPNIA ON EVOKED HUMAN BRAIN ACTIVITY MEASURED WITH MEG *Eric Halgren[1], Thomas Thesen[2], Oleg Leontiev[1], Mingxiong Huang[1], Tao Song[1], Nima Dehghani[3], Don Hagler[1], Anders Dale[1], Richard Buxton[1]; [1]UCSD, [2]NYU, [3]Brown University* – Low to moderate levels of inhaled CO2 (hypercapnia) induce large increases in cerebral blood flow (CBF). The influence of such baseline changes upon the phasic effects of functional stimulation is one important method for examining quantitative models of the BOLD response. A common simplifying assumption is that neural activity is not affected by hypercapnia. However, evoked activity in rodent hippocampal slices is strongly decreased by hypercapnia, via a presynaptic mechanism involving adenosine receptors. We examined the effects of hypercapnia on the MEG response to auditory, visual and cognitive stimulation. Six normal subjects breathed 5%CO2 - 21%O2, through a mask for 210s, followed by a 240s period of normocapnic breathing. During repeated cycles of hypercapnic and normocapnic periods with steady-state endtidal CO2 levels, subjects were tested on auditory pattern monitoring and visual word recognition. Across both tasks, hypercapnia induced statistically highly significant decreases in event-related fields (ERFs). Decreases were observed in early sensory components in both auditory and visual modalities, as well as later cognitive components related to memory and language. Effects were approximately equal in all cortical regions. These results indicate that hypercapnia induces clear decreases in the neuronal response in various sensory systems and in higher-level cognitive processing areas in the brain. Considering that low cerebral pH would arise when CBF is unable to keep pace with neuronal activity, the results observed in the present study may reflect a homeostatic mechanism by which neuronal activity is adjusted to a level that can be sustained by available blood flow.

D 100

DYNAMIC CAUSAL MODELLING OF FMRI WITH NEURAL MASS MODELS *A. C. Marreiros, S. J. Kiebel, K. E. Stephan, C. C. Chen, L. M. Harrison, K. J. Friston; Wellcome Trust Functional Imaging Laboratory, UCL, UK* – INTRODUCTION The aim of this work was to endow dynamic causal models (DCM) for fMRI time series with a greater biological realism. This extension involves the explicit modelling of neuronal activity in each voxel or region and coupling different regions at the neuronal level. Current causal models for fMRI consider only one neuronal state per region. In this work we adopt a more biologically constrained and plausible model, using multiple neuronal sources or subpopulations per region. Critically, this allows us to incorporate multiple sources within each region so that we can model changes in both extrinsic and intrinsic connectivity. METHODS Current DCMs for fMRI are based upon a bilinear approximation to neuronal dynamics with one state per region. In this work we extend this model to cover two states per region. These states model the activity of an inhibitory and excitatory subpopulation. This has a number of key advantages. First, we can relax the shrinkage priors used to enforce stability in single-sate DCMs. Second, we can model both extrinsic and intrinsic connections. Third, we can enforce positivity constraints on the extrinsic connections. Finally, this re-parameterisation enables one to model the effect of context or experimental changes, on the coupling as a proportional increase or decrease in connection strength. CONCLUSION Preliminary results indicate that it is possible to adjudicate between changed in intrinsic and extrinsic connections using fMRI. This analysis demonstrates the utility of adopting generative or causal models of biological time-series that are informed by anatomic and physiological principles.

D 101

CORTICAL SURFACE-BASED ANALYSES IN FUNCTIONAL NEUROIMAGING: FOCUS ON WORKING MEMORY IN SCHIZOPHRENIA *Alan Anticevic, Donna Dierker, Sarah Gillespie, David Van Essen, John Csernansky, Deanna Barch; Washington University in St. Louis* – A consistent problem in functional neuroimaging is accurate alignment of structural as well as functional data. Many approaches have been used, however most analyses of cortical activation still center on a volume-based representation of the data. Consequently, spatial smoothing as well as alignment is done in the volume domain. This approach can have limitations. Spatial smoothing in the volume domain does not respect spatial topography and cortical organization. Additionally, alignment can be inadequate if inappropriate target atlases are used. Although these issues might present themselves in healthy participants, they can possibly emerge as even bigger problems when examining different patient populations (i.e. movement issues as well as potential structural cortical abnormalities). We attempt to address these limitations through surface-based group analyses in a study of working memory (WM) in patients with schizophrenia. Mounting evidence points to WM deficits and abnormal patterns of dorsal lateral prefrontal cortex (DLPFC) activation as key features of schizophrenia. We administered a '2-back' version of the n-back WM task while participants underwent scans on a 1.5T Siemens VISION system. Each participant's structural scan was used for cortical surface reconstruction using the SureFit method. Participants' fMRI data were mapped directly onto their cortical surface models. Six standard landmarks were used for alignment of cortical surface models to the population-average PALS-B12 atlas. We compared statistical results obtained from the surface-based methodology to results obtained from volume-based analyses in both patients and healthy participants. Furthermore, we demonstrate the importance of spatial topography when performing spatial smoothing of fMRI data.

D 102

IMAGING CORRELATES OF COGNITIVE FUNCTION IN TREATED VERSUS UNTREATED HYPERTENSION *Kristin Hannesdottir[1,2], Arani Nitkunan[1], Rebecca Charlton[1], Thomas Barrick[1], Graham MacGregor[1], Hugh Markus[1]; [1]St. Georges University of London, [2]Landspitali University Hospital* — Hypertension, especially if untreated, is an important risk factor for cognitive decline and dementia. This may partly be due to white matter hyperintensities possibly representing asymptomatic cerebral small vessel disease. The aim was to assess whether white matter abnormalities could be detected by diffusion tensor imaging (DTI; a recent MRI technique sensitive to white matter damage) in treated versus untreated hypertension and determine whether these correlated with neuropsychological performance. Forty patients with treated hypertension (mean age=69.3±11.3), 30 age-matched controls (mean age=68.2±8.5) and 10 patients with untreated hypertension (mean age=58.1±6.1) were recruited. Neuropsychological testing included measures of attention, executive function, memory and psychomotor speed. Both conventional MRI and DTI were conducted to assess white matter damage. Magnetic resonance spectroscopy (MRS) was performed in the white matter to assess cerebral metabolite changes and to explore possible abnormalities in N-acetylaspartate (NAA) as a marker of neuronal dysfunction. Cognitive performance was worse in untreated compared to treated hypertension on tests of executive functioning and psychomotor speed. There was no significant correlation between cognition and imaging in treated hypertension. In untreated hypertension there was a correlation between an executive functioning and attention component and DTI mean diffusivity values ($r=0.805$, $p=0.016$) and between psychomotor speed and MRS NAA/Cr levels ($r=0.853$, $p=0.015$). This confirms previous reports that there is cognitive impairment in untreated hypertension. The specific anatomical mechanisms underlying this impairment are yet unknown. The correlation between speed and NAA would suggest neuronal dysfunction may play a role in the impaired psychomotor speed found in untreated hypertension.

Methodological Issues: Other

D 103

ESTABLISHING PATIENT REGISTRIES FOR COGNITIVE NEUROSCIENCE RESEARCH: ADVANTAGES, CHALLENGES, AND PRACTICAL ADVICE BASED ON THE EXPERIENCE AT TWO CENTERS *Lesley Fellows[1], Marianna Stark[2], Arlene Berg[1], Anjan Chatterjee[2]; [1]McGill University, [2]University of Pennsylvania* — Neuropsychological studies continue to be an important source of evidence in cognitive neuroscience, complementing newer methods for investigating brain structure-function relationships in humans. Advances in neuroimaging, statistics, and information management now provide potentially powerful tools to support neuropsychological research. At the same time, changing ethical requirements and privacy concerns impose increasingly high standards on the procedures used to recruit research participants, and on subsequent data management. Shared, centrally-administered research registries provide a framework for addressing ethical considerations, streamlining recruitment and screening, and co-ordinating subsequent research contacts and data storage. The existence of such a resource can make patient-based research accessible to more investigators, and allows a priori determination of an experiment's feasibility. We report the experience of two such registries: the patient database of the Center for Cognitive Neuroscience at the University of Pennsylvania, and the Cognitive Neuroscience Research Registry at McGill University. Both are run by dedicated database managers, who act as the liaison between researchers and participants. The UPenn database has been operating since June 1999, and currently includes 171 patients, who have participated in 1013 research visits. The McGill registry recruited 59 patients in its first full year of operation, leading to 77 research visits. The long-term experience at UPenn indicates excellent retention, with only 15 participants withdrawing or lost to follow-up. Methods found to be effective for participant recruitment and retention at both sites will be reviewed. Practical approaches to consent, data access, and meeting the needs of multiple investigators will also be presented.

D 104

EEG BANDS AS PREDICTORS OF TMS INDUCED MOTOR EVOKED POTENTIAL (MEP) AMPLITUDE: PRELIMINARY FINDINGS *Jean-Francois Lepage, Dave Saint-Amour, Hugo Theoret; Universite de Montreal* — Transcranial magnetic stimulation is a powerful tool in the study of causal relationships between brain and behavior. However, the important variability observed in studies measuring excitability of the motor cortex through TMS-induced motor evoked potentials subjects suggests that the effects of single TMS pulses may also fluctuate in studies of cognition. One explanation to this phenomenon may reside in the ongoing, oscillatory activity of the brain. Here, we recorded EEG activity during the administration of 80 single TMS pulses. Coil position was held constant throughout the experiment via a neuronavigation system. EEG segments preceding the TMS pulse were averaged and submitted to FFT and wavelet analysis. Preliminary analysis suggests that the alpha band has a modulatory effect on the amplitude of the TMS-induced MEP. Indeed, in comparison to MEP of weaker amplitude, the EEG segments of strong MEP show a variation of spectral power as early as 400 ms prior to the pulse. These results might bear significant implications for the interpretation of TMS induced MEP in cognitive studies.

D 105

FUNCTIONAL CONNECTIVITY AND INFORMATION FLOW IN THE HUMAN BRAIN DURING LANGUAGE PROCESSING: EVIDENCE FROM ECOG DATA *Galit Fuhrmann Alpert[1], Tim Mullen[1], Sundari Suppiah[1], Erik Edwards[1], Ryan Canolty[1], Sarang Dalal[2], Maryam Soltani[1], Heidi Kirsch[2], Nick Barbaro[2], Robert T. Knight[1]; [1]Helen Wills Neuroscience Institute, UC Berkeley, [2]UCSF* — We study how information propagates between functionally segregated regions in the human brain during the performance of a cognitive task. To address this goal, we developed an approach to explore functional connectivity and information flow using multi-channel subdural electrocortigoram (ECoG) data recorded from patients undergoing neurosurgery for epilepsy. The 64-channel grid is implanted for 4-7 days, during which experimental recording is performed. We first determine the all-to-all connectivity pattern, by considering for each pair of channels both mutual information (MI) and cross-correlation (CC) between shifted versions of the two time-series for various time-delays. The optimal time-delay between the channels is the delay maximizing MI (CC) at this connection. The degree of connectivity is set as the maximal MI (CC) value. Next, functional brain regions are defined using clustering analysis. The degree of connectivity and time delay are both considered, such that channels with high connectivity and short delays are functionally grouped. Finally, we study information flow between those functionally defined clusters and determine optimal delays between regions of interest. We applied this analysis to data recorded from a patient performing a simple language task. Analysis of functional connectivity between pairs of channels suggests a complex pattern of connectivity, including bidirectional connections. Clustering analysis resulted in several functional clusters including classically known language areas, e.g Broca and Wernicke regions. The analysis of information flow between these functional regions supports signal propagation from Broca to Wernicke, with a delay matching a theoretically computed conduction delay via the arcuate fasciculus. Supported by NINDS-NS-21135.

Motor Control

D 106

YOUR TASK IS ALWAYS ON MY MIND: SHARED STIMULUS-RESPONSE MAPPING IN CO-ACTING INDIVIDUALS *Chia-Chin Tsai[1], Wen-Jui Kuo[1], Jung-Tai Jing[1], Daisy L. Hung[1], Ovid J.-L. Tzeng[2,1]; [1]Institute of Neuroscience, National Yang-Ming University, Taiwan, [2]Academic Sinica, Taipei, Taiwan* – Mirror-neurons activating when taking an action and perceiving similar actions made by others mediate a direct matching mechanism, a match between representations of observed actions onto internal motor commands. One fascinating capacity in humans is to represent infinite actions of others in the social world, and match them onto our limited behavioral repertoire, suggesting that not only the outcome of observed actions per se but also the knowledge about "when" and "how" of the actions evokes the representations activated. To test this hypothesis, paired-individuals were instructed to perceive the same perceptual event but co-act with different stimulus-response mappings by responding to different stimulus attributes (i.e. color of the stimulus and direction of a particular feature of the stimulus). Results showed that RTs were slower when perceiving a stimulus which also required other's response (double response trial) than only required one's response (single response trial). The neurophysiological evidence (Go and NoGo-P3) extends our knowledge that, we also anticipate and evaluate another's stimulus-response mapping even we didn't have overt responses. Such co-representation process may thus occur at the stimulus evaluation rather than response selection level.

D 107

ELECTROENCEPHALOGRAPHY (EEG) REVEALS AGE-RELATED CHANGES OF THE VOICE-RELATED-CORTICAL-POTENTIAL (VRCP) DURING PHONATION. *Jessica Galgano, Karen Froud; Columbia University, Teachers College* – Purpose: To examine with EEG the VRCP's time course, distribution, and morphology during phonation in older adults. Design/method: The time course, distribution, and morphology of the Voice-Related Cortical Potential (VRCP) were characterized in 25 healthy adults (age range 45-75 years) and 25 younger controls (age range 18-28 years). We implemented a stimulus-induced voluntary movement paradigm in which trials of volitional exhalation and vocalization were presented in subject-specific randomized orders, and electroencephalography was concurrently recorded. Physiological measurements of vocal fold movement and respiration onset were integrated with the simultaneously-sampled brain data. Analysis: EEG data were digitally low-pass filtered at 30Hz. The continuous recording was segmented from 3000 milliseconds prior to movement onset, and epochs were corrected to a 200 msec baseline. Trials containing EOG and other artifact were rejected. Source localization was applied to estimate generator sources of all VRCP components. Results: VRCP properties in healthy older adults, compared to young control subjects, were significantly different in: (a) the degree of activation of brain areas involved in voice planning and production; (b) timing and sequencing of activations. Source localization demonstrated that premotor, primary motor, sensorimotor, and auditory regions were involved in voice planning and production. Significant positive correlations were found between VRCP parameters and data obtained using acoustic and lung function measures. Conclusion: These findings provide valuable information about the neural mechanisms for voice planning and production in healthy young and older populations. They also have potential for providing valuable information about cortical reorganization to voice disorders and their therapies.

D 108

GRASPING THE SAME OBJECT FOR DIFFERENT END-GOALS: EFFECTS ON HAND SHAPING *Caterina Ansuini, Livia Giosa, Luca Turella, Umberto Castiello; Università di Padova* – Introduction. Manipulative hand movements are choreographed on the supposition that the intended activity determines what type of hand configuration is used for any given action (for example, grasping a bottle to pour may involve a different grip than grasping it to throw it). An untested question is whether fingers' shaping towards the same object changes depending on end-goal. Methods. Each subject (N=20) reached towards and grasped a bottle filled with water and either simply grasp it; lift and throw it; pour the water within a container; place it on a base matching the diameter of the bottle; pass it to the experimenter. Joints' angular excursions for all digits and abduction angles between digits were recorded by means of a CyberGlove. Results. Principal component analysis showed that the first three components (PCs) could account for >80% of variance implying a reduction from 10 recorded degrees of freedom for all actions. However, the weighting coefficients for each joint differed depending on end-goal. In particular, the degree of independence across digits increased when the end-goal required a greater level of accuracy. Conclusions. When intending to grasp an object the functional goal modulates hand shaping. In particular, when the end goal implies a high level of accuracy, each digits' joints is more independent than when the level of accuracy is low. This may be indicative of a control strategy in which the level of independence is determined by the need for fine adjustments.

D 109

KNOWING WHAT YOU DO IS LIKE DOING IT MYSELF: BOUNDARY CONDITIONS OF TASK CO-REPRESENTATION IN THE FLANKER PARADIGM *Silke Atmaca, Natalie Sebanz, Guenther Knoblich; Rutgers Newark* – Humans perform most of their actions in social context. Previous research demonstrated that individuals' action performance is influenced by others' future actions, even when coordination is not required (Sebanz et al., 2003). The present study examined whether knowing another person's task also affects one's own task performance. Using the Flanker paradigm (Eriksen & Eriksen, 1974), pairs of participants performed a go-nogo task in response to target letters arbitrarily linked to two response keys, with each participant being responsible for one key (joint condition). The results resembled results of single participants in charge of both responses (two-choice setting), but differed from results of participants performing the same go-nogo task in isolation (individual condition). In a further study, we tested whether the mere belief that a co-actor is performing the complementary task is sufficient for such effects of task co-representation to occur. For this purpose, we seated the co-actors in two different rooms. Finally, we tested whether the co-actor's actions need to be intentional in order for their task to be co-represented. We compared a condition in which participants were co-acting with a confederate performing intentional actions with a passive movement condition in which the co-actor's finger was pulled down by a magnet. Our results suggest that task co-representation is a cornerstone of social cognition.

D 110

THE CASE OF DR. JEKYLL AND MR. HYDE: A KINEMATIC STUDY ON SOCIAL INTENTION *Luisa Sartori[1], Cristina Becchio[2], Umberto Castiello[1]; [1]Università di Padova, Italy, [2]Università di Torino, Italy* – Introduction. What is a social action? Intention mechanisms modulate motor activation (Edwards, Humphreys & Castiello, 2003) and kinematic patterns for cooperative and competitive behaviour are distinct from those performed in isolation (Georgiou et al., 2006). We focused on the kinematics of social intended actions to investigate whether social intentions affect kinematics. Methods. Participants (N = 13) were requested to reach towards, grasp an object, and either pass it to another person (social condition) or put it on a small platform (single agent condition). Movements' kinematics were recorded using a 3-D motion analysis system. Results. Results revealed specific motor patterns for actions motivated by social intentions. In particular, the wrist pathway was longer, the point of maximum wrist trajectory height was higher, the amplitude and time of peak velocity were lower and earlier, respectively, for the 'social' than for the 'single agent' condition. These results are suggestive of a more careful honing phase when the goal is nested within a social interaction: a longer deceleration phase is applied to perform a more careful action. Conclusions. Differences in intentions are reflected in kinematics: specific kinematic patterns connote and distinguish actions executed with social goals from actions motivated by individual goals. These differences may be used by the motor system to discriminate between actions serving different intentions. If intentions shape kinematics – as the present results show – then simulating an action may enable the observer to represent the agent's intentions.

D 111

ACOUSTIC ANALYSIS OF FIRST AND SECOND LANGUAGE DYSARTHRIA IN PATIENTS WITH TRAUMATIC BRAIN INJURY *Monika Polczynska-Fiszer; School of English, Adam Mickiewicz University* – Post-traumatic dysarthria is an articulatory impairment caused by damage to the nervous system that leads to the disruption of motor speech execution. The present study investigates the characteristics of first and second language speech of 6 Polish patients with traumatic brain injury (TBI) who knew English to various degrees before trauma and 10 control subjects. According to standarized scales used in Polish clinics, there were 3 individuals with mild and 3 with moderate dysarthria. A detailed acoustic analysis of the speech was carried out, following recovery from coma. The following observations of TBI dysarthria were been made: (1) vowels were less distorted than consonants, (2) single phonemes were more intelligible than longer phrases, (3) speech fluency was 47% lower than in the control group, (4) maximum pitch variation (intonation) was smaller by 128 Hz, (5) there was impairment problems with phonation and resonance (nasality). TBI individuals did not have sufficient motor control to articulate sounds. In order to communicate, they simplified sounds by the use of processes that appear in first language acquisition. However, there were considerable differences in the frequency and occurrence of phoneme modifications used by the post-coma population and children. The patients favored processes which helped them overcome weakness of the tongue, lips, lower jaw, velum and the vocal folds- processes are uncommon in child language development. Dysarthria in English was more severe than in Polish and the subjects performed more radical processes of pathological speech (e.g. phoneme omissions) in their foreign language.

D 112

NEGATIVE BOLD ACROSS AGE GROUPS *Keith McGregor, Michelle Benjamin, Benzi Kluger, Valeria Drago, Kenneth Heilman, Keith White, Tomoyuki Mizuno, Anastasia Ford, Zvinka Zlatar; University of Florida* – Objectives:
This event-related fMRI investigation was concerned with age-related differences in levels of negative BOLD during a tactile-cued, simple motor response task. Methods: Eighteen (9 older; 9 younger) right-handed individuals performed a simple unimanual hand raise in two response conditions(Uncrossed; Crossed). During Uncrossed trials, subjects were to move the hand receiving tactile stimulation (computer-controlled air puff). In Crossed trials, subjects were asked to move the hand opposite of tactile stimulation. Subjects performed a total of 200 counterbalanced response executions (50 per hand per condition). A three-factor analysis of variance (ANOVA: Age x Response Condition x Handedness) for the whole brain was completed using area under the curve of the estimated hemodynamic response functions obtained from a deconvolution procedure. A region of interest (ROI) analysis was also performed for primary motor cortices (Left & Right M1). Hemodynamic response function estimates for maximally active voxels in selected ROI for each subject and response condition were subsequently compared using repeated measures ANOVA. Results: Relative to the movement laterality and regardless of response condition, both age groups displayed negative BOLD in ipsilateral M1 and positive BOLD in contralateral M1. ANOVA analysis indicated younger adults displayed greater response amplitude in both positive and negative BOLD as compared to older adults regardless of movement laterality. Conclusions: These preliminary results indicate age-related differences in response patterns during the tested movements. Results are compared with a previous investigation using a learned, complex response sequence comparing negative BOLD across age groups.

D 113

THE MODULATION OF CORTICOSPINAL EXCITABILITY AND INTRACORTICAL INHIBITION BY VISUAL FEEDBACK AND PERFORMANCE GOAL *Richard H.S. Thomson, Michael I. Garry, Jeffery J. Summers; University of Tasmania* – Motor practice can induce changes in corticospinal excitability (plasticity) thought to be important for motor learning. However, there remains uncertainty as to what aspects of the task and its performance are important. While most studies have examined corticospinal excitability before and after practice, we concentrated on how excitability is affected during motor practice. To investigate the aspects of the task that contribute to plasticity, we examined the effect on corticospinal excitability of visual feedback and a performance-goal. In session 1, subjects were instructed to perform simple finger abduction movements briskly, and with moderate force without visual feedback or a target. In the second session, we supplied concurrent visual feedback of force output and a target force level that was yoked to the force produced in the first session. This enabled us to manipulate the task goal and visual feedback across sessions, while controlling for motor output. Corticospinal excitability and intracortical inhibition (ICI) of the hand were assessed during the period of relaxation between successive responses. Force output did not differ between the two sessions. Cortical excitability progressively declined across blocks during session 1 (no feedback, no goal), but remained nearly constant during session 2 (visual feedback, force goal) and ICI was significantly lower during session 2. Variations of corticospinal excitability and ICI during task performance appear to depend on the presence of visual feedback and a task goal, and not solely on motor output. This may have implications for motor practice paradigms aimed at promoting cortical plasticity and motor learning.

D 114

CHILDREN WITH AUTISM SHOW IMPAIRED MOTOR SEQUENCE LEARNING BUT SPARED MOTOR ADAPTATION *Jennifer Gidley Larson[1], Amy Bastian[1,2], Opher Donchin[2], Reza Shadmehr[2], Stewart Mostofsky[1]; [1]Kennedy Krieger Institute, [2]Johns Hopkins University School of Medicine* – Deficits in motor learning might help to explain impaired acquisition of motor skills commonly observed in autism. To investigate this hypothesis, motor learning was examined in twelve high-functioning children with autism (HFA) and thirteen typically-developing children, ages 8-13 years, using both tests of motor adaptation and of motor sequence learning. Motor sequence learning was assessed using a Rotary Pursuit task consisting of four blocks of four 20-second trials, with learning measured as change in time-on-target across successive blocks of trials. Motor adaptation was assessed using: 1) Prism Adaptation, in which subjects were instructed to throw a ball while wearing prism goggles, and 2) Reaching Adaptation in which subjects moved a planar two-joint manipulandum to a visually-displayed target, with either a force or visual perturbation applied. For all adaptation tasks, dependent measures included adaptation rates, learning indices, and post-adaptation after-effects. For Rotary Pursuit, repeated measure ANOVA indicated a significant "diagnosis x block" interaction ($p=0.05$) with the HFA group showing less improvement across successive blocks than did controls; furthermore, this effect was stronger in a larger sample of subjects who completed Rotary Pursuit (37 children with HFA and 37 controls; $p=0.005$). No significant group differences were found on the tasks of motor adaptation. The results suggest that children with autism have intact ability to adapt their movements but are impaired in learning complex motor sequences. These findings may explain autism-associated difficulties with acquiring complex motor skills, including social/ communicative gestures, and the tendency to instead display more stereotyped patterns of behavior.

D 115

THE HYBRID NEURAL SYSTEM TO GENERATE THE RULE-BASED DYNAMIC MOTOR SEQUENCE: AN FMRI STUDY *Chiaki Hirata[1,2], Ryota Horie[1], Ken Ueno[1], Roy Waggoner[1], Keiji Tanaka[1], Kang Cheng[1], Jun Tani[1]; [1]RIKEN, [2]Jumonji University* – Neural correlates of the generation of the dynamic motor sequence were detected. Participants received the intensive training of the point prediction task in which the trajectory of the flashing target followed the dynamic logistic equation. The probe experiment suggested that the participants acquired the dynamic rule not in the form of the "one-to-one mapping", but that they registered the several preceding timesteps as the context. Then, fMRI images were acquired with the fixed repeating motor sequence as the control condition. The first class of the brain region was found active both when generating the control sequence and when generating the various sequence according to the dynamic equation while showing the higher activation in the latter task. Those were, multiple parietal areas, the lingual gyrus, the caudate nucleus, and the cerebellar lobe IV. These areas may be responsible to preserving the acquired rule and enable the forward prediction. Another class of regions was active only when participants made the dynamic motor sequences. Those were, bilateral middle frontal gyrus and the anterior part of the left supplemental motor area. These brain regions may register the prediction error and may bring the internal context back to the coherent state. This process may be realized by the regression of the several preceding timesteps. The mechanisms for the dynamic sequence generation will be discussed in relation to the neural network model with the context unit, namely, the recurrent neural network.

D 116

MOTOR BEHAVIORAL AND NEUROPHYSIOLOGICAL EFFECTS OF UNEXPECTED PERTURBATIONS TO ANKLE MOVEMENTS *Lewis Wheaton, Timothy Judkins, Chris Mizelle, Richard Macko, Larry Forrester; University of Maryland School of Medicine* – Effects of unexpected perturbations with sensory feedback have been clearly evaluated in upper, but not lower extremities. Cortical physiology and motor behavior were evaluated while subjects performed an ankle targeting task with an ankle-robot. The robot constrained the ankle to move in a constant stiffness field while subjects were cued to make plantarflexion movements to a target displayed on a computer screen repeated 100 times. Randomly, the stiffness field was removed (catch trial, c) to induce error. Visual feedback of ankle motion on the screen (vision and proprioception V=P), or proprioception only with no visual feedback (PO) conditions were evaluated. Electroencephalography (EEG) was recorded to evaluate sensorimotor and parietal activations relative to the motor task. End-point target accuracy was determined for each movement. EEG and behavioral analyses were performed on the trial before the catch (c-1), c, and the two trials after (c+1, c+2). Results showed significant overshoots were made in the c trial, relative to the c-1 trial for both V=P and PO. Movement related cortical potentials (MRCPs) showed significant decreases in the bilateral parietal areas for c compared to the other trials in both V=P and PO, but not at the sensorimotor cortex. This suggests that unexpected deviations in motor control can be corrected in ankle movements, and that the posterior parietal cortex is a main source of activity related to this correction in both V=P and PO conditions. Further work will evaluate how vision and proprioception information are weighted to affect targeting tasks.

D 117

DEVELOPMENTAL CHANGES IN MOTOR SKILL LEARNING *Tal Savion-Lemieux, Jennifer A. Bailey, Virginia B. Penhune; Concordia University* – Recent evidence suggests that maturational changes in the brain coincide with and underlie changes in cognitive and motor abilities. A developmental model has been proposed suggesting that implicit learning develops early and is relatively invariant across childhood, whereas explicit learning shows greater changes over time. The present study examined performance on a multi-finger-sequence-task (MFST) in terms of two indices of learning: percent correct key presses, a more explicit measure, and response synchronization, a more motoric/procedural measure. We collected three samples of healthy right-handed children between 6 and 10, and a sample of young adults. On the MFST, participants reproduce a sequence of key-presses on an electronic keyboard. Testing occurred on two consecutive days. Participants received three blocks of practice on Day1 and two blocks on Day2. Across blocks of learning on Day1, Adults & 10Y.O. were significantly more accurate than 8Y.O. ($p < .03$); Adults & 10Y.O. did not differ. For response synchronization, adults were significantly more synchronous than children on the first two blocks of learning ($p < .01$), but by the third block 10Y.O. reached adult performance, whereas 8Y.O. did not. When comparing the last block on Day1 to the first block on Day2, only the 8Y.O. showed significant improvements on the more explicit measure of learning ($p < .01$). In contrast, for response synchronization all groups showed significant improvements between Days 1 and 2 ($p < .01$). These preliminary findings provide partial support for the developmental invariance model. Additional analyses will include data from the 6Y.O. sample.

D 118

DO BEHAVIORALLY INHIBITED RESPONSES PRODUCE SPECIFIC OR GENERIC INHIBITION OF THE MOTOR SYSTEM? *Jing Xu[1], Julie Duque[1], Adam Aron[2], Richard Ivry[1]; [1]University of California, Berkeley, [2]University of California, San Diego* – The Stop-Signal task has been used to study control processes required to inhibit a planned movement. By applying TMS to primary motor cortex (M1), it has been shown that the excitability of a muscle associated with the planned movement is inhibited following successful stops. The degree of specificity of this inhibition is unknown. It may be specific to the aborted movement, extend to all task-relevant muscles, or be generic, affecting muscles independent of task relevance. Participants performed a 2-choice RT task, responding with either the index or pinkie finger of the right hand. On some trials, the go signal was followed by a stop signal. The timing between the go and stop signals was adjusted, such that participants succeeded in aborting the planned response on 50% of the trials. By applying TMS over the right or left hemispheres, we measured motor evoked potentials (MEPs) in muscles associated with the task (left hemisphere) or homologous muscles irrelevant to the task (right hemisphere). Preliminary results (n=4) indicate that successful stopping is associated with some degree of generic inhibition. MEPs were decreased in the muscle involved in the response as well as in both the homologous and non-homologous muscle in the non-responding hand.

D 119

FUNCTIONAL ROLE OF INHIBITORY PROCESSES DURING HAND SELECTION *Julie Duque, Tim Verstynen, Richard Ivry; UC Berkeley* – In many situations, we can choose to use either hand to accomplish an action. Transcranial magnetic stimulation (TMS) studies have shown that during unimanual movements, inhibition is observed in muscles of the non-responding hand. Inhibition could result from hand selection processes, attenuating mirror-related activity in homologous muscles. To test this hypothesis, we measured motor evoked potentials (MEPs) in left first dorsal interosseous (FDI) elicited by TMS over the right motor cortex during a choice reaction time task involving left or right index finger abductions. Prior to an imperative signal, a cue was presented which was either informative, indicating the hand to be used in the forthcoming response, or uninformative. The imperative signal always indicated the required response. Prior to the imperative signal, left FDI MEPs were consistently inhibited, an effect more prominent when the cue indicated that this muscle could be required for the forthcoming response (all conditions except pre-cued right responses). Following the imperative signal, MEPs became larger when it signalled a left hand response, but remained inhibited preceding right hand responses, regardless of the type of cue. Interestingly, mirror activity was frequently observed in the homologous FDI. This effect was more prominent in the informative condition, perhaps due to reduced pre-imperative inhibition in that condition. These results fail to support the idea that inhibition of the non-responding hand reflects mechanisms that facilitate the selection of the appropriate response hand. As an alternative hypothesis, we propose that inhibition may be essential for preventing premature responses in the selected hand.

D 120

INFLUENCE OF ENDOGENOUS AND EXOGENOUS FACTORS ON PERISACCADIC MISLOCALIZATION *Florian Ostendorf, Hendrik Puhlmann, Carsten Finke, CHristoph J. Ploner; Charité, Berlin* – Perisaccadically flashed stimuli appear systematically distorted in space. Two components of perisaccadic mislocalization have been identified: first, a uniform shift of apparent stimulus positions in saccade direction and second, a compression of visual space, centered at saccade target position. Perisaccadic mislocalization has been assumed to reflect the spatio-temporal dynamics of an extraretinal eye position signal that is not perfectly aligned with the corresponding saccade. Respective underlying extraretinal signals could originate somewhere along the oculomotor pathway from prefrontal cortex down to superior colliculus and brainstem. Here, we probed perisaccadic mislocalization in normal subjects while we intended to modulate endogenous and exogenous contributions to oculomotor activity. By insertion of a temporal gap between fixation offset and saccade target onset we modulated an exogenous factor in comparison to a saccadic step-task. In a second experiment we varied the predictability of saccade direction as an endogenous factor. The modulation of both the endogenous and exogenous factor resulted in modulations of the shift component of perisaccadic mislocalization while the compression component remained largely unaffected. However, modulations of the shift component in the gap-task occurred in a very restricted perisaccadic time window, while predictability-dependent differences in perisaccadic mislocalization occurred in a longer time window of hundreds of milliseconds before and after the saccade. These results point towards a differential influence of endogenous and exogenous factors on perisaccadic mislocalization. Besides signals directly associated with the actual saccadic motor command, higher cognitive factors such as attention and prediction may influence perceptual mislocalization around saccades on a different time-scale.

D 121

THE EFFECT OF VIEWING ACTIONS AND GRASPABLE OBJECTS IN PARKINSON'S DISEASE *Ellen Poliakoff[1], Adam Galpin[1], Steven Tipper[2]; [1]University of Manchester, [2]University of Wales, Bangor* – In Parkinson's disease (PD), external stimuli can hinder movement and produce 'freezing', yet visual cues can sometimes facilitate movements. We asked whether two classes of action relevant stimuli, which are known to activate sensorimotor brain areas in healthy controls, would also implicitly evoke action in patients. We compared the influence of both action observation and action-relevant objects on movement execution in PD patients and age-matched controls. In experiment 1, participants viewed a moving finger (action-relevant) or object (baseline), and subsequently performed a finger response to a target. Responses were faster if the executed and observed movements had compatible directions. The controls showed a larger effect for the finger than object movements, but the patients showed the reverse trend. In experiment 2, participants responded to the shape of a door handle (action-relevant object) or an abstract bar stimulus (baseline) that could be oriented toward or away from the response hand. Responses were faster when response hand and object were spatially compatible. In both experiments, controls showed a larger effect for the action-relevant object over baseline, whereas the patients did not. Thus, our results revealed that whilst low-level spatial or directional cueing were unaffected by PD, the patients did not show an additional effect of action-relevance. This suggests that in Parkinson's disease, external cues exert their influence through lower-level visual processes and that the influence of action-relevant stimuli on the motor system is disrupted.

D 122

SPEECH PRODUCTION: DISSOCIATIONS WITHIN PREMOTOR AREAS RELATED TO RHYTHM *Novraj Dhanjal, Jane Warren, Richard Wise; Imperial College London* – 'Rhythmic mandible-generated close-open alternations of the mouth' account for speech production based on a simple alternation between vowels and consonants (MacNeilage and Davis, 2001). However, although some languages have a simple CVCV word structure, e.g. Japanese, most permit a more complex structure, such as the word 'strength' (CCCVCCC) in English. Further, cognitive and linguistic constraints result in a continuous need to alter amplitude, stress and rate of production during normal speech production. An exception is the recitation of sequences, such as counting, which more closely approximates to CVCV speech production and is produced at a simple rhythmic rate. In a PET study (n=24 subjects) the contrast of propositional speech with counting demonstrated that the motor control of normal speech depended on neural systems within the left pre-SMA and dorsolateral premotor/prefrontal cortex. The reverse contrast demonstrated that counting activated the SMA proper; and that the rhythm of counting was expressed through modulation of activity within bilateral ventral premotor and primary motor cortex. Activity in these medial and lateral areas was significantly greater during counting than during propositional speech. Based on single cell recordings in non-human primates, the ventral motor region controls jaw opening and closure. Therefore, although speech early in the evolution of language may have developed from the same neural system that controls rhythmic jaw movements used in chewing (MacNeilage and Davis, 2001), propositional speech has come to depend on higher order premotor systems, anatomically situated between 'cognitive' prefrontal cortex and lower order premotor cortex directly connected to motor cortex.

D 123

RESPONSE/EFFECT CONGRUITY AND DISRUPTION OF TIMING BY DELAYED AUDITORY FEEDBACK DURING SEQUENCE PRODUCTION *Peter Pfordresher; University at Buffalo, The State University of New York* – It is well known that delayed auditory feedback (DAF) slows timing and can disrupt accuracy during sequence production. Some have suggested that the effect of DAF results from the timing of perceived event onsets relative to movement timing, regardless of whether the informational content in auditory feedback (e.g., the pitch classes one hears when playing music) matches the expected outcomes of actions (Howell et al., 1983). However, no research has varied independently the type of sequence one executes and the degree to which feedback contents match the expected outcomes of actions. An experiment was conducted in which musically untrained participants produced rhythmically isochronous sequences at a prescribed rate (500ms inter-response intervals). Production tasks included tapping and the production of simple melodies on a keyboard (designed such that untrained persons could produce them). Auditory feedback was presented in synchrony with actions, or at delays scaled to production rate that ranged from 13 – 138% of inter-response intervals. In addition, auditory feedback pitch could either match the actions that were produced (e.g., hearing a monotone sequence in response to taps), or the alternate type of action sequence (e.g., hearing a melody in response to taps). Results suggest that slowing of production by DAF is enhanced when information in auditory feedback matches the kind of sequence one tries to produce. These findings suggest that neural systems regulating the timing of perception and production are sensitive to factors beyond the timing of onsets themselves and may incorporate goal-related information.

D 124

MOVEMENT IS MORE STRONGLY ATTRACTED TO MUSIC THAN TO SPEECH *Simone Dalla Bella, Anita Bialunska; University of Finance and Management in Warsaw* – People often move in synchrony with musical beats whereas synchronization of movement with speech accents is rare. To examine whether movement is more likely to be captured by music than by speech, 33 nonmusicians tapped their finger in synchrony with an isochronous auditory Target sequence (i.e. tones with 600-ms IOIs) while a Distractor sequence was presented (i.e. well-known musical excerpts or fragments of children poetry). Distractors were presented at one of various phase relationships with respect to the target. The analysis of the asynchronies and of their variability showed that musical distractors attracted movement more strongly than speech distractors. The attraction was larger when distractors preceded the target tones than when they followed them. This effect was replicated when controlling for potential confounding variables which may account for the differences between music and speech, such as distractors' average pitch and temporal variability, and the timbre of the Target sequence. Differences between speech and music in attracting participants' taps were attenuated by these manipulations, but still significant. In addition, similar results were obtained in a further experiment where a continue measure of the force participants exerted during synchronization with the Target sequence was recorded with a force transducer. In sum, there is converging evidence that musical rhythms attract movement more than stress structure in speech. Music, because of the regularity of its metrical structure, may be particularly well-suited to engage brain mechanisms underlying sensorimotor synchronization and motor entrainment (e.g. the cerebellum and the basal ganglia).

D 125

EFFECTS OF PALLIDOTOMY ON SENSORIMOTOR SYNCHRONIZATION IN PARKINSON'S DISEASE *Ilona Laskowska[1], Simone Dalla Bella[2], Paulina Rolinska[2], Aleksander Litwinowicz[3], Edward Jacek Gorzelanczyk[1], Marek Harat[3]; [1]Kazimierz Wielki University, Poland, [2]University of Finance and Management in Warsaw, Poland, [3]Military Hospital, Poland* – When we listen to rhythmic auditory stimuli (e.g. music) we often spontaneously or deliberately move in sync with their beat (e.g. by foot tapping). Sensorimotor synchronization (SMS) has been linked to the activity of the basal ganglia and of the cerebellum. To clarify the contribution of the basal ganglia to SMS, we examined SMS in 10 nondemented patients suffering from intractable Parkinson's disease (Experimental group) 2 days before, 3 months, and 6 months after pallidotomy (i.e. surgical treatment consisting in the ablation of the postero-ventral portion of the Gpi). The Experimental group was compared to 2 matched control groups: 10 nondemented medicated Parkinson's disease patients and 10 healthy participants. Patients and controls were asked to tap their finger/hand along with 1) a sequence of nonmusical stimuli (i.e. a metronome), 2) familiar music, and 3) amplitude-modulated noise. Moreover, perceptual tests (i.e. detection of anisochrony) were performed. The patients in the Experimental group exhibited impaired SMS before surgery as compared to controls. Only very few patients in the Experimental group showed improved synchronization (i.e. a larger number of synchronized taps and smaller variability) 3 and 6 months after the surgery. Most patients either maintained the initial performance or exhibited worse synchronization accuracy. In contrast, pallidotomy had a positive effect on time perception: in several cases the performance in the anysochrony detection tests improved 3 and 6 months after the surgery. These findings suggest that SMS and the detection of anysochrony may be supported by partly independent neuronal substrates.

D 126

MOTOR CORTICAL AREA ACTIVATION DURING MOTOR SEQUENCE LEARNING: A FMRI STUDY. *Sharleen Sakai, Rudy Bernard, Jie Huang, Elizabeth Hendriks; Michigan State University* – The present fMRI study investigated the role of the motor cortices [primary motor area (MI), supplementary motor area (SMA) and presupplementary motor area (pre-SMA)] during a serial reaction time motor sequence learning task. Subjects were scanned on a 3.0 T General Electric magnet using a standard block design during which the subjects were presented with 10 iterations of a task which required them to alternate between pressing 1 of 4 buttons corresponding to the location of a red circle for 12 sec and watching a fixation point for 24 sec. The stimuli were presented under a random condition (R1) first, followed by the sequence learning condition (S1). This was followed by a practice period of 18 min after which the subjects were scanned again in the sequence learning condition (S2) and the random condition (R2). Overall a decrease in activation was found in SMA, pre-SMA and MI between S1 and S2 in most subjects. Comparison between R1 and R2 revealed a decrease in activation in MI and SMA but not in pre-SMA. While these results suggest an overall decrease in signal change across the conditions, they also indicate variation in activation levels across individuals. Learning was confirmed by shorter latencies and reduced error rates. Although previous studies have reported activation in the pre-SMA during initial learning and a shift in activation to the SMA when a motor sequence becomes well learned, activation in both SMA and pre-SMA generally decreased during sequential learning in the present study.

D 127

INVESTIGATING NEURAL MECHANISMS INVOLVED IN INTENTION ATTRIBUTION UNDER CONDITIONS OF PHYSICAL RESTRAINT *Roman Liepelt, D. Yves von Cramon, Marcel Brass; Max Planck Institute for Human Cognitive and Brain Science – MPI CBS* – Converging evidence has shown that action observation and action execution are strongly linked. The mere observation of an action directly activates the internal motor representation in the observer (direct matching). Although direct matching is a very simple and automatic mechanism it might be the underlying mechanism of higher order cognitive processes, as for example reading the intention of an observed action (Iacoboni, et al., 2005). In a series of behavioural experiments we tested whether direct matching is modulated by intention attribution. We compared motor priming effects for small (incomplete) finger lifting movements under two conditions. In the unrestrained condition the intention of the observed action was ambiguous. In the other condition, we added a physical restraint to the observed movement, allowing the attribution of intention to the observed action. Our results indicate that attributed intentions modulate direct matching effects. Based on these findings we used functional magnetic resonance imaging (fMRI) to test whether the neural circuits usually involved in direct matching of observed movements (the so-called "mirror system") are also involved in the attribution of intention. Our data suggest that the superior temporal sulcus, a region which was previously found to be involved in mentalizing tasks (Frith & Frith, 1999), seems to be crucial for the attribution of intention under conditions of physical restraint.

D 128

DISRUPTED VISUOMOTOR TRANSFORMATIONS INTO HEAD- AND BODY-CENTERED COORDINATES IN OPTIC ATAXIA *Steven Jax[1,2], H. Branch Coslett[2], Eunhui Lie[2], Laurel Buxbaum[1,3]; [1]Moss Rehabilitation Research Institute, [2]University of Pennsylvania Medical School, [3]Thomas Jefferson University* – Many theories of motor control propose that visually-guided reaching involves multiple coordinate frame transformations of the retinal target location into limb-centered coordinates. We have previously suggested that reaching errors in optic ataxia (OA), a disorder of visually-guided reaching, may be caused by inaccuracies in these transformations (Buxbaum & Coslett, 1998). Two recent studies (Dijkerman et al., 2006; Khan et al., 2005) report that patients with OA produce errors that depend on the gaze-relative, but not head- or body-relative, target position. These findings suggest that OA results from the disruption of early transformations of retinal target information into gaze-centered coordinates but not later transformations of gaze-dependent information into head- and body-centered coordinates. Because evidence for this proposal comes from a small number of patients, we attempted to replicate this finding by testing KE, a patient with OA following bilateral parietal lesions (and significant non-specific white matter disease), on a reaching task in which we systematically varied the position of his head and torso while holding the gaze-relative position of the target constant across trials (always foveated). In contrast to previous reports that reaching accuracy in OA depends only on the gaze-relative target location, we observed that rotating the head or body away from the midline led to both increased average end point error (constant error) and increased end point variability (variable error). These results suggest that disrupted transformations into other, non-gaze-centered, coordinates may be observed in OA.

D 129

DO YOUNGER AND OLDER ADULTS DIFFER IN THEIR IMPLICIT LEARNING AND CONSOLIDATION OF A FINE MOTOR SEQUENCE? *Sarah Fraser, Tal Savion-Lemieux, Caroline Doramajian, Karen Li, Virginia Penhune; Concordia University* – Age differences in the implicit learning and consolidation of a fine motor sequence was evaluated using a multi-finger-sequence-task (MFST) with 17 younger (YA) and 14 older (OA) adults. On two consecutive days of testing, participants reproduced sequences of key presses on an electronic keyboard. Within a block participants tapped to learn trials which contained ten repetitions of a ten-element fixed pattern sequence interspersed with four random trials of scrambled ten-element sequences. Participants were not informed of any pattern in the sequences presented to them. They received three blocks on Day1 and two blocks on Day2. Learning was assessed with percent correct key presses (accuracy) and response synchronization (a reaction time measure). Improvements on learn relative to random sequences, served as measures of implicit learning. Improvements from the last block of Day1 to the 1st block of Day2, without additional practice, served as a measure of consolidation. Both groups were very accurate (MYO = 95%), with YA slightly more accurate than OA overall ($p < .04$) and with YA showing greater learning on learn versus random trials than OA ($p < .02$). YA were faster at response synchronization than OA ($p <.001$), and no age-related differences were found in implicit learning such that both age groups were faster on learn trials compared to random ($p < .001$). Across both age groups accuracy ($p < .009$) and response synchrony ($p < .001$) data revealed consolidation. Results demonstrate that implicit learning and consolidation of fine motor sequences may be preserved in aging.

D 130

LINKING CONTROL OF IMITATION AND SOCIAL COGNITION: NEUROPSYCHOLOGICAL EVIDENCE FROM PREFRONTAL AND TEMPORO-PARIETAL LESIONS *Stephanie Spengler, Marcel Brass, D. Yves von Cramon; Max Planck Institute for Human Cognitive and Brain Sciences* – In this study we argue that the intentional control of imitation shares common underlying computational mechanisms (the capacity for self-other differentiation and building of intentional states) with social cognitive abilities such as mentalizing, perspective-taking and empathy. Several recent theories have proposed a relationship between imitation and 'Theory of Mind' (ToM) but have not yet provided strong empirical evidence. We therefore focus on the ability to regulate overt imitative behavior, as previous neuroimaging studies showed that the inhibition of imitation draws on regions (anterior fronto-median cortex and the temporo-parietal junction) implicated in higher-level social cognitive processing. This study investigates whether there is a functional association between the inhibition of imitation and tasks assessing perspective-taking/ ToM by computing correlations between these two groups of tasks in a sample of 28 brain-damaged patients (15 patients with prefrontal lesions, 13 patients with lesions around the temporo-parietal-junction). Supporting our hypothesis a highly significant correlation can be found between a ToM-task ('Strange Stories') and the imitation-inhibition task in the group with frontal lesions, whereas posterior lesioned patients show a highly significant correlation between cognitive perspective-taking abilities (Interpersonal Reactivity Index) and the imitation-inhibition task. Even after controlling for the performance in tests on executive functions and the control condition of the ToM-task the results remain significant. Similar correlations in a group of adults with autistic spectrum disorders support these findings. These results confirm our hypothesis and provide the first empirical evidence for a link between the control of imitation and social cognitive abilities.

D 131

BRAIN ACTIVITY DURING SACCADE INITIATION AND INHIBITION: AN EVENT-RELATED FMRI STUDY *Benedikt Reuter, Christian Kaufmann, Julia Bender, Norbert Kathmann; Humboldt-Universitaet zu Berlin* – Pro- and antisaccades are gaze shifts toward and away from visual target stimuli respectively. In antisaccades, task preparation (preparing for the saccade type before onset of a target stimulus) recruits more brain activity in well-known oculomotor areas, such as the frontal eye fields (FEFs) and the supplementary eye fields (SEFs), and in brain areas that are more generally involved in action control, such as the dorsolateral prefrontal cortex. It is not clear, however, whether the same brain areas are involved in antisaccade execution, which implies suppression of a reflexive glance toward the target stimulus and initiating a volitional saccade in the opposite direction. To disentangle these two response components we used functional magnetic resonance imaging to measure blood oxygen level-dependent (BOLD) signal changes following different oculomotor responses. 19 healthy participants had to inhibit reflexive glances toward peripheral stimuli both with and without simultaneous saccade initiation. The experimental procedure prevented task specific preparation. Saccade initiation activated FEFs and SEFs bilaterally. Inhibition related brain activity did not include FEFs and SEFs, but rather involved a more anterior part of the superior frontal gyrus and inferior parietal regions. The results suggest that dissociable neural networks are involved in saccade initiation and inhibition.

D 132

ACTIVITY IN HUMAN POSTERIOR PARIETAL AND PRE-MOTOR CORTEX DURING VISUALLY GUIDED REACHING AND SACCADIC EYE MOVEMENTS: A MEG STUDY. *Leighton Hinkley[1], Sarang Dalal[2], Adrian Guggisberg[2], Srikantan Nagarajan[2], Elizabeth Disbrow[1]; [1]University of California, Davis, [2]University of California, San Francisco* – Areas in posterior parietal cortex (PPC) are part of a network involved in translating information from the retina into a reference frame anchored to a particular body part or effector, in order to guide motor behavior. Currently, it is unclear at what stage of response preparation these areas interact during visually guided movement. Using magnetoencephalography, we examined activity in humans during reaching and saccades to peripherally presented visual targets. Data was collected using a whole-head 275-channel biomagnetometer (VSM MedTech, Coquitlam, BC) and analyzed using the NUTMEG time-frequency analysis toolkit (http://bil.ucsf.edu). Subjects prepared either an eye or arm movement based on a peripheral cue, and executed that response when a target appeared at the same spatial location. During movement preparation, bilateral desynchronization in the beta (12-35Hz) range peaked at about 400ms over the caudal regions of PPC in the putative lateral intraparietal area and parietal reach region. For visually guided reaching, greater desynchronization in the beta band was observed in ventral pre-motor cortex (PMC; 225ms) and over the rostral intraparietal sulcus (600ms) in the hemisphere contralateral to the responding arm. At saccade onset, we observed activity in the beta band over the frontal eye fields, while at reach onset the pattern of activity in PMC and PPC became bilateral. These findings suggest that information in the visual domain representing the destination of an eye or arm movement is processed in the caudal regions of PPC and then selectively fed forward to effector-specific regions of PFC and PPC for movement execution.

D 133

UNDERSTANDING ACTION UNDERSTANDING *Marcel Brass[1], Ruth Schmitt[2], Stephanie Spengler[2], György Gergely[3]; [1]Ghent University, [2]Max Planck Institute for Human Cognitive and Brain Sciences, [3]Hungarian Academy of Sciences* – Despite the important role of action understanding in our social life, the underlying functional and neural mechanisms are still poorly understood. Currently, there are two opposing views on action understanding. The mirror neuron approach suggests that action understanding is achieved by motor simulation of the observed action in the mirror system. The alternative approach suggests that functional mechanisms such as mentalizing are involved in action understanding. In the present study we investigated the neural mechanisms underlying action understanding by adapting a paradigm pioneered in developmental psychology. In this paradigm participants observe an actor executing a very common action in an unusual way (i.e. operating a light switch with the knee). In one condition the hands of the actor are occupied with very heavy folders, making the unusually action very plausible (hands occupied condition). In some trials, however, the hands of the actor are not occupied, which makes the action very implausible (hands free condition). Finally, we also included a condition where the hands were implausibly occupied. The crucial contrast for investigating action understanding is the contrast of the hands free condition (implausible action) and the hands occupied condition (plausible action). This contrast revealed brain activation in the superior temporal sulcus (STS),the temporo-parietal junction (TPJ) and the anterior fronto-median cortex. Since all three regions have no mirror properties, our data seem to support the view that action understanding in terms of its reasons is primarily mediated by functional mechanisms other than motor simulation.

D 134

PROPRIOCEPTIVE FEEDBACK AIDS TIMING ACCURACY IN COMPLEX FINGER SEQUENCES *Werner Goebl, Caroline Palmer; McGill University, Montreal* – Sequential actions such as playing a piano or tapping in synchrony to an external signal put high cognitive and motor demands on producers, including the generation of precise timing. It has been proposed that movement accelerations are useful landmarks for proprioceptive regulation of timing (Balasubramaniam, 2006). We addressed the hypothesis that reduction of timing errors at higher movement frequencies or shorter time intervals (Aschersleben & Prinz, 1995) might be related to movement accelerations in piano performance. 12 professional pianists performed melodies on a digital piano at 4 rates ranging from fast (143 ms inter-onset interval, IOI) to slow (500 ms IOI) in a synchronization-continuation paradigm. The motions of their finger tips were recorded with a three-dimensional motion capture system. Pianists' timing errors (expected versus observed IOI) were smaller at fastest (1.7 ms) than at slowest rates (12.1 ms). Some keypresses included finger-key contact, marked by an increased acceleration (peak accelerations larger than 35 m/s/s) when a finger made contact with a piano key surface; other keypresses occurred after the finger was already resting on the key surface. Significantly more finger-key contacts were observed in keypresses at the fastest rates (94% of keystrokes) than at slowest rates (41%). Most important, timing errors decreased as the magnitude of the finger-key contact accelerations increased ($r = -.51$, $p < .01$), across participants, fingers, and rates. These findings suggest that proprioceptive information that is available at finger-key contact enhances the timing accuracy of finger movements in piano performance.

D 135

EFFECTS OF RATE AND FINGER INDEPENDENCE ON TIMING AND MOTION IN TAPPING SEQUENCES *Janeen Loehr, Caroline Palmer; McGill University* – Information processing approaches to the neural processes underlying movement timing suggest that timing is represented independently of the movements used to generate it, whereas dynamical systems approaches suggest that timing is an emergent property of those movements. We tested whether finger motion and timing precision during tapping were similarly affected by rate and degree of finger independence. Twelve experienced pianists tapped repeating 4-finger sequences on a table at rates ranging from slow (550 ms interonset intervals, IOIs) to fast (250 ms IOIs) in a synchronization-continuation task. Finger 2 (least coupled finger) and Finger 4 (most coupled finger) were preceded by a physically adjacent (coupled) or non-adjacent (less coupled) finger's tap. Fingertip motion was recorded using a three-dimensional motion capture system. Finger 4's timing accuracy differed when a physically adjacent (coupled) or nonadjacent finger produced a preceding tap at fast rates. In contrast, Finger 2's timing accuracy was unaffected by the preceding finger across all rates. Motion trajectories showed a similar pattern: Finger 4's motion (velocity and acceleration) during taps at faster rates was reduced when a coupled finger produced a preceding tap, whereas Finger 2's motion was unaffected by coupling to the preceding finger across all rates. These findings indicate that finger coupling and tapping rate influence individual finger motions in tapping sequences, and that timing is not independent of the movements required to generate the timing.

D 136

SENSORIMOTOR COMPLEXITY DIFFERENTIALLY AFFECTS CORTICAL ACTIVITY DURING KNEE MOVEMENT *J.C. Mizelle, Lewis A. Wheaton, Richard F. Macko, Larry Forrester; University of Maryland School of Medicine* – This study evaluated how sensorimotor task complexity affects brain activation related to knee movement. Thirty-two channel electroencephalography (EEG) was recorded during knee extension under four conditions of sensorimotor complexity: no weight, no visual target (NWNT); ankle weight without visual target (WNT); no weight, visual target (NWT); and combined weight and target (WT). Quadriceps surface electromyography (EMG) was used to epoch EEG from -4.5s before to 1s after EMG onset. Epochs were averaged to derive cortical potentials (MRCPs) for each condition. MRCP amplitude from -2s to EMG onset was evaluated at electrodes over motor, sensory, frontal, and parietal areas. MRCPs were subjected to Condition*Time ANOVA and Bonferroni corrected post-hoc comparisons ($p<0.05$ for all differences). Motor cortex MRCPs differed by the number, but not type, of modalities added (NWNT < WNT = NWT < WT). Posterior parietal MRCPs differed according to the type of modality, but were not sensitive to the number of modalities (NWNT = WNT < NWT = WT). Mesial frontal and parietal MRCPs differed by absolute cortical demand (NWNT = WNT = NWT < WT). These results suggest that selective cortical activation in lower extremity movement may be achieved through sensory manipulation. Specifically, information processing related to sensorimotor demand can be differentially affected in motor and parietal cortices according to the number and type of added sensorimotor modality. Manipulating sensorimotor demand by increasing both the number and type of movement constraints can induce activity in multiple cortical sensorimotor regions, which may have implications for developing neurological rehabilitative therapies.

D 137

VISUAL AND PROPRIOCEPTIVE FEEDBACK AFFECTS ADAPTATION TO PERTURBED ANKLE MOVEMENTS *Timothy Judkins, Lewis Wheaton, J.C. Mizelle, Richard Macko, Larry Forrester; University of Maryland School of Medicine* – We sought to evaluate behavior and cortical physiology while subjects performed targeted ankle movements. Subjects wore an ankle-robot on the left foot, which constrained the foot in a stiffness field. Subjects were cued to make ankle plantarflexion movements to a target displayed on a computer screen. Ankle position was indicated on the screen by a cursor. The stiffness field varied unpredictably for each movement. Movements were repeated 100 times for three conditions: veridical vision and proprioception (V=P), proprioception only (no cursor, PO), or stochastic vision (V≠P). During V≠P, a virtual stiffness was applied to the cursor that varied randomly. An autoregressive model was used to determine the contribution of prior trial movement error and current and prior stiffness on current movement error. Prior movement error was weighted more during the PO condition compared to V≠P ($p<0.05$) while the V=P did not differ statistically from PO and V≠P. Prior stiffness was weighted more during PO and V=P compared to V≠P ($p<0.05$). Current stiffness contributions did not differ statistically among conditions. Electroencephalography (EEG) was recorded to evaluate sensorimotor and parietal activations relative to the motor task. Movement related cortical potentials (MRCPs) showed significant decreases in amplitude in bilateral parietal areas and mesial sensorimotor cortex for PO compared to the other conditions. These results suggest that ankle motor control is influenced by the availability and reliability of sensory information during targeted movements. Further work will investigate sensory contributions in patients with sensory deficits such as peripheral neuropathy and stroke.

D 138

NEURAL CORRELATES OF TRIAL-BY-TRIAL VARIABILITY IN REACTION TIME: A META-ANALYSIS *Tal Yarkoni, Deanna Barch, Thomas Conturo, Todd Braver; Washington University* – Functional neuroimaging studies increasingly complement analyses based on experimental manipulations with correlational approaches that seek to identify neural activity associated with trial-by-trial variability in specific behavioral parameters. To date, most studies that have analyzed overt behavioral measures have focused on differences in response accuracy. Relatively few studies have explicitly analyzed neural activity in relation to trial-by-trial reaction time (RT) variation. Here we report the results of a systematic meta-analysis of RT effects across several reanalyzed fMRI datasets. The samples studied spanned a broad range of experimental tasks (working memory, decision-making, and affect ratings), fMRI designs (event-related, blocked, and mixed), populations (young adults, older adults, and schizophrenics), and scanners (1.5T vs. 3T). Despite this variability, we found a remarkable consistency in RT-related activation, with trial-by-trial increases in RT predicting increased activation in motor cortex, medial and lateral PFC, and inferior parietal cortex in all samples. A dissociable set of regions showed the opposite effect, with increased activation reliably predicting shorter RTs. Subsequent analyses indicated that these effects did not vary substantially as a function of gender, population, or stimulus modality. The results supplement previous studies implicating frontoparietal regions in domain-general cognitive control functions. Since the exercise of top-down control is time-consuming, greater recruitment of frontoparietal regions is likely to introduce a significant source of variance in behavioral response latencies. The robustness of the observed effects also highlights the importance of considering RT as a potential confound in functional neuroimaging studies where mean RTs differ systematically across experimental conditions.

D 139

REPRESENTING EFFECTOR LOCATION : CONTRIBUTIONS OF PREDICTED STATE AND SENSORY STATE INFORMATION *Jared Medina[1], Steven A. Jax[2], H. Branch Coslett[1]; [1]University of Pennsylvania, [2]Moss Rehabilitation Research Institute* – Many models of motor control suggest that both sensory state information (sensory feedback) and the predicted state of the effector (derived from the “forward model”) are important in generating an on-line representation of effector location. We developed a task to separate the contributions of predicted state and sensory state information. A central tactile marker and four peripheral tactile markers were placed on the underside of an opaque digitizing board. During the ACTIVE condition, subjects with unilateral stroke moved their (unseen) contralesional hand from the central marker to one of the four peripheral markers; after locating the designated peripheral marker, subjects then moved their ipsilesional hand located on top of the digitizing board to match the position of the contralesional hand. The PASSIVE condition was identical except that the experimenter moved the subject's contralesional hand to a peripheral target. On ACTIVE trials, the location of the contralesional hand is informed both by proprioception and the predicted state. However, on passive trials subjects rely solely on proprioception to localize the contralesional hand. Subjects with damage to the posterior parietal cortex (PPC) were significantly less accurate on passive versus active trials when compared to subjects with damage to the cerebellum and lateral frontal lobe. These data suggest that the PPC is critical for updating the on-line representation of effector location but that information regarding the predicted state of the effector derived from the forward model can compensate for this deficiency.

D 140

THE ACCURACY OF SACCADIC EYE MOVEMENTS PLANNED IN OBJECT-CENTERED AND WORLD-CENTERED REFERENCE FRAMES *Paul K. Mitchell, Jay A. Edelman; City College of New York* – We examined the saccadic system’s ability to use information encoded in an object-centered or world-centered reference frame. Saccade endpoint error was measured in a visually-guided (VG), memory-guided (MG) and a novel reinforcer-guided (RG) saccade task in which the target location is fixed across a block of trials with respect to a reference object, but in which the target is invisible before the saccade. In separate blocks of trials, saccade target locations were fixed relative to a reference object of particular radius (3.25°, 6.5°, 13° or 26°), which could appear at a fixed location or shift locations trial-to-trial. In certain blocks of trials, no reference object was present, with the target location fixed with respect to the display. EMs of 3 Ss was recorded at 500 Hz using EyelinkII. When the position of the reference object (and thus target position) shifted across trials object size had little effect on VG and MG endpoint error. However, RG endpoint error increased substantially with increasing object size. When reference object position was fixed with respect to the visual display, RG endpoint error was low and independent of object size, as was also the case when no reference object was present. Shifting head position in between trials had little effect on endpoint error, suggesting that a head-centered reference frame was not used. These results suggest that small objects or a visually sparse, but stable, visual world can serve as landmarks for saccade programming, but that large shifting objects cannot.

Neuroanatomy

D 141

ABNORMAL CEREBRAL CORTEX STRUCTURE IN CHILDREN WITH ATTENTION-DEFICIT HYPERACTIVITY DISORDER *Sasha Wolosin[1], Marin Richardson[1], Martha Denckla[1,2], Stewart Mostofsky[1,2]; [1]Kennedy Krieger Institute, Baltimore, MD, [2]Johns Hopkins School of Medicine, Baltimore, MD* – OBJECTIVE: Findings from previous studies suggest that attention-deficit hyperactivity disorder (ADHD) is associated with reduced cerebral gray matter volume. In this study, ADHD-associated differences in cerebral cortical gray matter structure were examined in detail using an automated surface-based analysis technique. METHODS: Anatomic magnetic resonance images were acquired from 34 children with ADHD (13 girls) and 41 typically developing controls (16 girls), aged 8-12 years. Full-brain thickness maps were produced for each subject and statistical difference maps were generated by conducting t-test comparisons between the two groups at every point along the surface. Cortical volume, surface area, mean thickness and folding were measured for the entire hemispheres and frontal, temporal, parietal and occipital lobes within each hemisphere. RESULTS: Children with ADHD showed significantly reduced cortical gray matter volume compared to controls ($p < .001$); volume reduction was diffusely distributed bilaterally throughout all four lobes. No group differences in mean cortical thickness were detected in the statistical difference maps (threshold of corrected $p < .05$). The ADHD group, however, showed an overall decrease in surface area of more than 7% within each hemisphere ($p < .001$) with decreased cortical folding in both the right ($p = .002$) and left ($p = .012$) hemispheres. CONCLUSIONS: Decreased cortical gray matter volume in ADHD appears to be related to differences in surface area and not thickness. Decreased cortical folding may account for the reduced surface area; this could help to identify neurodevelopmental mechanisms that contribute to ADHD.

D 142

AN MR VOLUMETRIC STUDY OF THE MOTOR HAND REGION AND INSULA IN DEAF, HEARING, AND HEARING-SIGNING INDIVIDUALS *John S. Allen[1], Karen Emmorey[2], Joel Bruss[3], Hanna Damasio[1]; [1]University of Southern California, [2]San Diego State University, [3]University of Iowa* – We used high-resolution MRI to examine the effects of auditory deprivation and experience with sign language from birth on gray and white matter volumes in the motor hand region (handknob) of the precentral gyrus and the insula. We predicted that the bimanual requirements of signing would result in differences in handknob anatomy between hearing non-signers and deaf/hearing signers. Given the role of the insula in auditory-speech processing, we also predicted that insular anatomy would differ between deaf and hearing individuals. Subjects included 25 hearing non-signers (14F, 11M), 25 deaf signers (14F, 11M), and 16 hearing signers (10F, 6M); all were right-handed. Regions of interest were manually traced on contiguous MR image slices (1.5mm). ROIs included: all of the major lobes; a parcellation of the frontal lobe including the precentral gyrus and handknob; and the insula. Gray and white matter volumes and GM/WM ratio were calculated following automated segmentation of the MR images. Preliminary results indicate that hearing non-signers have a strong rightward asymmetry in the GM and WM volumes of the handknob; deaf signers are significantly less rightwardly asymmetric for both tissues and hearing signers are significantly less asymmetric for the WM compared to non-signers. Significant differences in insular anatomy were also found between deaf and hearing individuals. However, the surrounding frontal and parietal lobes show no differences between groups. These results indicate that both deafness and life-long signing can result in macroscopic changes in neuroanatomy. Research supported by NIH DC06708.

D 143

ANATOMICAL CONNECTIVITY OF THE POSTERIOR FUSIFORM GYRUS *Joseph T. Devlin[1], Cathy J. Price[2]; [1]University of Oxford, [2]Wellcome Centre for Imaging Neuroscience* – Very little is known about the anatomical connectivity of the ventral occipito-temporal region in humans, partly due to differences in regional morphology between humans and macaques. Here we investigated the cortico-cortical connectivity of the posterior fusiform gyrus directly in humans using probabilistic DTI tractography and observed three different patterns of connectivity, depending on the rostro-caudal position along the gyrus. The most posterior zone (approximately Y = –70 to –65) demonstrated strong links with the lingual gyrus, middle occipital gyrus, and posterior superior temporal sulcus as well as long range connections with ventral and lateral regions of anterior temporal lobe. In the middle zone (Y= –60 to –50) there was a short path linking with lateral infero-temporal cortex while a longer path connected with the ventral anterior temporal lobe. The rostral most zone (Y= –45 to –40) also showed local connections with lateral infero-temporal cortex and with the rostral tip of the occipito-temporal sulcus (OTS). Finally, between adjacent fusiform zones we observed reciprocal local connections, particularly along the medial bank of the OTS. These results suggest a possible anatomical pathway underlying the so-called "semantic" route to reading: namely, a poly-synaptic path first linking posterior fusiform gyrus with anterior temporal cortex via the inferior longitudinal fasciculus and then continuing onto ventral regions of Broca's complex via the uncinate fasciculus. In contrast, we were unable to identify an anatomical path linking the posterior fusiform with the "non-semantic" reading route through the inferior parietal lobe.

D 144

ASSESSMENT OF AGE-RELATED CHANGES IN WHITE-MATTER STRUCTURES USING DTI AND TENSOR-BASED TRACTOGRAPHY *Simon W. Davis, Nancy A. Dennis, Vanessa A. Thomas, Matthew R. Emery, Amber B. Tarter, Leonard E. White, David J. Madden, Roberto Cabeza; Duke University* – Previous studies using volumetric methods to assess neuronal white matter found greater age-related decline in fractional anisotrophy (FA) in frontal compared to posterior cortices. Degradation of white matter can have a significant impact on the functional interactions between cortical regions and measures of cognitive performance which rely on these interactions. In order to assess age-related differences in white matter integrity we used diffusion tensor imaging (DTI) and tensor-based tractography to analyze 6 major white matter tracts in vivo: the genu and splenium of the corpus callosum, the uncinate fasciculus, superior longitudinal fasciculus, inferior lateral fasciculus, and cingulum. By using tensor-based tractography the current study expands upon previous work in that it assesses age-relate differences in FA along the length of each tract. Additionally, we investigated the relationship between white matter integrity with behavioral performance measures from the Cambridge Neuropsychological Test Automated Battery. Results revealed significant age-related differences in FA within all tracts and greater age-related decline associated with anterior compared to posterior sections of each tract. This finding augments previous studies by showing that age-related differences are present within frontal sections of individual tracts as well as within volumetric analyses of frontal volumes. Furthermore, FA in discrete tract sections was found to correlate with several measures of cognitive performance, including working memory, strategic processing, and reaction time. Taken together results reveal a consistent frontal pattern of age-related decline in axonal integrity within white matter tracts and indicate that this decline is associated with cognition in older adults.

D 145

GENDER DIFFERENCES IN BRAIN STRUCTURE ASSESSED USING MRI *Locke Welborn, William Schmidt, Suzanne Bloise, Deidre Reis, Lisa Marchiondo, Xenophon Papademetris, Nallakkandi Rajeevan, Jeremy Gray; Yale University* – We examined sex differences in brain structure in 121 healthy young right-handed adults, controlling statistically for multiple other sources of individual variation. We used BET (FSL) to estimate grey, white, and total brain volume for each individual, and BioImage Suite (www.bioimagesuite.org) to register each individual's brain to a reference subject. For each subject, we computed a b-spline based, nonlinear transformation to the reference subject. Information about localized differences in local brain volume are reflected in the resulting transformation images. The determinant of the jacobian of the nonlinear-only portion of the image transformation indexes local (voxel-level) differences in brain volume and is insensitive to linear, global effects (including overall differences in total brain volume). As expected, total brain volume was greater for male than female subjects, $r = .64$, and so we focused on the nonlinear-only component of the transformation. In an ANCOVA, with age and intelligence (Raven's Advanced Progressive Matrices) as covariates, we found strong sex differences in the anterior left striatum contiguous with differences in nearby white matter tracts of the coronal radiation (MNI -25 -7 18; $p<.000001$; all p's uncorrected). More posteriorly, sex differences were observed in right temporal lobe white matter (MNI 27 -20 10; $p<.000001$) and the cerebellum (MNI 6 -52 -6; $p<.0001$). Weaker but potentially very interesting sex differences were observed in ventromedial PFC (MNI 3 34 -15; $p<.0001$) and right orbitofrontal cortex (MNI 30 47 -6; $p<.001$).

D 146

PERSONALITY MARKERS OF LEADERSHIP COVARY WITH THE VOLUME OF THE RIGHT MEDIAL PFC *Lisa Marchiondo, Noah Shamosh, Deidre Reis, Xenophon Papademetris, Nallakkandi Rajeevan, Jeremy Gray; Yale University* – Most MRI studies of personality to date have examined the neural correlates of single personality dimensions in isolation, such as extraversion or neuroticism. While useful, this strategy neglects complex but important traits that depend on several dimensions simultaneously. One such cluster of personality (high Extraversion, Agreeableness, Openness, and low Neuroticism) is widely hypothesized to be associated with transformational leadership (TL; also known as charismatic leadership). To investigate the potential neural substrates of TL, we assessed personality (five-factor NEO-PI-R) and brain structure using MRI (MPRAGE) in 117 healthy right-handed adults. We correlated a measure of TL (E + A + O – N) with voxel-level variation in regional brain volume (as estimated using BioImage Suite, www.bioimagesuite.org). When holding sex, age, and intelligence constant, TL correlated positively (pr=0.38) with brain volume in right medial prefrontal cortex (PFC) / Brodmann Area 10 (MNI 10 34 40; $p<.0001$) and effectively no other area, even at low threshold. These data suggest that examining differences in brain structure in relation to complex personality traits may be fruitful as a research strategy. More speculatively, the findings may have implications for understanding the effectiveness of different people in their social and professional roles.

D 147

THE BIG FIVE PERSONALITY TRAITS ARE ASSOCIATED WITH BRAIN VOLUME IN DISTINCT REGIONS *Colin G. DeYoung, Xenophon Papademetris, Nallakkandi Rajeevan, Jeremy R. Gray; Yale University* – Personality research is beginning to connect personality traits with specific brain systems. To further this project we examined the independent associations of the Big Five personality traits with local brain volume in 117 subjects, using structural MRI and controlling for age and sex. We used BioImage Suite (www.bioimagesuite.org) to register each individual's brain to a reference subject and compute a nonlinear transformation to the reference subject. The determinant of the jacobian of the nonlinear portion of the image transformation indexes local (voxel-level) differences in brain volume and is insensitive to linear, global effects (including differences in total brain volume). We then regressed this determinant on the Big Five, age, and sex simultaneously, in an exploratory analysis using uncorrected p-values because of difficulty in anticipating effect sizes. Neuroticism was associated with volume in a region of right dorsomedial PFC ($p<.0001$) and in a region of left medial temporal lobe including amygdala ($p<.0005$). The latter association is consistent with the involvement of both Neuroticism and amygdala in negative emotions like fear and anxiety. Extraversion was associated with volume in the medial orbitofrontal cortex ($p<.0005$), a region involved in the coding of reward that Depue and Collins (1999) identified as a likely substrate of Extraversion. Agreeableness, which reflects empathy and prosociality, was associated with volume in a region near the right temporo-parietal junction, an area associated with social cognition and theory of mind ($p<.001$). Conscientiousness and Openness/Intellect showed weaker associations ($p<.004$) with left dorsolateral PFC and right superior parietal cortex, respectively.

D 148

SEX DIFFERENCES IN BRAIN STRUCTURE AND ASYMMETRY IN HEALTHY COLLEGE STUDENTS *Christiana Leonard[1], Stephen Towler[1], Suzanne Welcome[2], Laura Halderman[2], Christine Chiarello[2]; [1]University of Florida, [2]University of California, Riverside,* – The Biological Substrates for Language project presents an opportunity to study sex differences in brain structure and asymmetry in a large normative sample unselected for hand preference (55 women, 55 men, mean VIQ = 110+/-11, PIQ = 110,+/- 11, age = 22.0 +/- 3.64 years). Although there were no sex differences in IQ, age, or hand preference, there were the expected highly significant sex differences in gray matter [t (left) = 4.65; t (right) = 5.68] and white matter volumes [t (left) = 8.22, t (right) = 8.6] as well as white matter proportion [t (left) = 4.58, t (right) = 5.38]. Women also had a larger corpus callosum relative to total white matter ($t = 2.46$, $p < .02$). White matter volumes explained about 10% of the variance in PIQ and VIQ in women but were not related to IQ scores in men. It was surprising to find that the only significant sex difference in asymmetry was in the opposite direction from expected. The women had a more asymmetrical planum temporale coefficient of asymmetry (.39 +/- .74) than the men (.22 +/- .94), $t = 2.04$, $p < .05$, due entirely to differences in the size of the right planum temporale. There were no sex differences in the asymmetry of pars triangularis, pars opercularis or the ascending and descending branches of the Sylvian fissure. In the poster we will report data on the complete sample of 200.

Poster Session E

Cognitive And Brain Development

E 1

MMN IN INFANTS EXPOSED TO PRENATAL MATERNAL DEPRESSION *Deana Davalos, Carly Yadon; Colorado State University* – Maternal depression during the prenatal period is a potentially devastating condition for women often accompanied by difficult decisions regarding pharmacological intervention options and the possible consequences for both mother and baby. Despite research suggesting that almost one in ten women meet diagnostic criteria for depression during pregnancy, prepartum maternal depression is a condition that has been historically understudied and is poorly understood in terms of the possible effects on the developing fetus. To date, limited research suggests that physiological deficits may be present in infants of mothers diagnosed with prepartum depression. However, research has not been conducted to assess whether the use of antidepressants may ameliorate these deficits or lead to less optimal physiological activity. The aim of our study is to determine the effects of prenatal maternal depression on synaptic development using a neurophysiologic measure, mismatch negativity (MMN). MMN is thought to be related to later developing higher order cognitive processes (e.g. learning and memory) and is ideal for use with neonates. To address the effects of prepartum depression, two groups of mother/infant dyads are included: (1) mothers diagnosed with depression during the prepartum period and their infants and (2) mothers with no psychiatric history and their infants. The prepartum depression group includes mothers either medicated or unmedicated during the prepartum period. Preliminary data suggests that the use of antidepressants during the prenatal period may improve performance on at least one physiological index (MMN) that is associated with development of higher order cognition.

E 2

DO BREAKDOWNS IN INTERHEMISPHERIC PROCESSING CONTRIBUTE TO AGE DIFFERENCES IN EMOTION RECOGNITION? *Mary Askren[1],David Bissig[2], Cindy Lustig[1], [1]University of Michigan, [2]Wayne State University* – The ability to recognize others' emotions plays a critical role in social interaction. This ability is impaired in both aging and Alzheimer's disease (Phillips et al., 2002; Hargrave et al., 2002). Age differences in emotion processing are often attributed to reduced amygdale function, or to older adults' use of controlled, strategic processes for maintaining positive affect. We tested the hypothesis that age differences in interhemisheric processing may also play a role. The right hemisphere is preferentially involved in emotional expression and recognition. This right hemisphere dominance results in a paradox: Information from the more expressive left side of a viewed individual's face is preferentially processed by the less emotionally-tuned left hemisphere of the perceiver's brain. Young adults may resolve this paradox via interhemispheric transfer of emotional information. Less efficient interhemispheric processing by older adults, possibly due to degradation of white matter tracts, may thus contribute to age differences in facial emotion recognition. Young (18-30 years) and old (60+ years) adults judged the emotion of photographed faces that were normally positioned or mirror-reversed, such that information from the right side appeared on the left and vice versa. Young adults performed equally well on both normal and mirror-reversed photographs, but older adults' performance was higher on mirror-reversed photographs. These results indicate that age differences in processing of emotional faces may be due to decreased quality of interhemispheric transfer of information in older adults.

E 3

FEEDBACK MODULATION OF PROBABILISTIC LEARNING: A DEVELOPMENTAL PERSPECTIVE *Natasha Kirkham, Daphna Shohamy; Stanford University* – A central question in developmental research concerns unsupervised implicit learning. There remains, however, a dearth of research examining feedback-based learning in childhood. In adults, extensive evidence suggests that feedback-based incremental learning depends on the basal ganglia and midbrain dopamine system. By contrast, non-feedback observational learning depends on the medial temporal lobe. Here, we examined feedback-based vs. observational learning in children. Given differential changes in these neural systems over development, one important question is what cognitive and neural strategies children use in feedback-based vs. observational learning, and whether these strategies change across development. To examine this question, we tested children aged 3 to 6 on a probabilistic learning task under feedback-based and observational conditions. Participants learned to associate between Mr. Potatohead characters with distinct features (tie or glasses) that were probabilistically associated with colored balloons (green or yellow). In feedback-based learning, participants saw a Potatohead on the screen, guessed which balloon he prefers, and received feedback. In the observational condition, participants saw a Potatohead holding a balloon, guessed his favorite balloon, but received no feedback. Results indicate that children were better at feedback-based than observational learning. Performance improved with age for both conditions. In addition, we found individual variability in learning strategies. Interestingly, children tended to spontaneously verbalize about the potential pattern in both conditions, suggesting the use of explicit learning, at least in some cases. These results provide insight into learning strategies used in early childhood and give rise to theories about the neurological underpinnings of those strategies.

E 4

DEVELOPMENTAL CHANGES IN RESPONSE PREPARATION MEDIATION OF VOLUNTARY RESPONSE INHIBITION *Sarah Ordaz, Emi Yasui, Beatriz Luna; University of Pittsburgh* – Though cognitive control over behavior is known to improve over the course of childhood and adolescence, it remains unclear what factors may mediate this improvement. The ability to voluntarily inhibit a response is crucial for cognitive control of behavior and has been characterized extensively using the antisaccade task. In this task, subjects are shown a fixation cross during a response preparation period indicating that they should suppress a saccade toward an ensuing cue and look to the mirror location. Behaviorally, error rates as well as response latencies for correct antisaccades and error prosaccades are known to decrease from childhood through adolescence and into adulthood. Monkey studies indicate that crucial to antisaccade performance is the early recruitment of the circuitry supporting response inhibition during the instruction/preparation period. Given the dramatic improvement in performance throughout childhood and adolescence, we manipulated the duration of response preparation time in order to investigate developmental changes in preparatory time mediation of response inhibition. Healthy children (n=56), adolescents (n=61), and adults (n=47) performed an antisaccade task consisting of trials with variable response preparation times (500msec, 2000msec, 4000msec, 6000msec). Results indicate that subjects across all age groups improved their ability to suppress responses with increasing preparation time. As expected, latency to initiate responses decreased with increased preparatory time though children and adolescents did not show the same gains in latency as adults in the longer preparatory times. These findings suggest immaturities in response preparation are still present in adolescence, reflecting limitations in retaining task rules for prolonged periods.

E 5

DEVELOPMENTAL CHANGES IN THE CIRCUITRY UNDERLYING SUSTAINED WORKING MEMORY *Charles Geier, Krista Garver, Beatriz Luna; University of Pittsburgh* – The ability to sustain visual spatial working memory (VSWM) across delay periods continues to mature into adolescence. However, relatively little is known about the brain basis of this developmental change. Thirty-one subjects (16 adults, aged 18-30 years, 7 teens, aged 13-17 years, and 8 children, aged 8-12 years) were scanned using fast, event-related fMRI as they performed the oculomotor delayed response task with "short" (2.5 seconds) and "long" (10 seconds) delay trials. Results indicated that a widely distributed circuitry including frontal, parietal, and temporal regions were present in all age groups, indicating a core working memory network. Age- and delay-related differences were found in frontal regions (DLPFC, FEF, SEF) as evidenced by comparing time courses from functionally defined regions of interest as well as comparison of the extent of activation. These analysis strategies indicated that with maturity, more efficient use of core regions is evident in working memory. Our results are discussed in terms of how the maturation of cognitive abilities may involve refinement of processing in task-essential regions as well as the recruitment of distal performance-enhancing regions.

E 6

NEURAL CORRELATES OF REWARD ANTICIPATION AND OUTCOME PROCESSING THROUGH ADOLESCENCE *Linda Van Leijenhorst, Kiki Zanolie, Katrien Van Meel, Michiel Westenberg, Serge Rombouts, Eveline Crone; Leiden University* – Adolescence is characterized by a normative increase in risk-taking, impulsivity and sensation-seeking. It has been suggested that adolescent poor decision making might be driven by immature motivational circuitry. The present study uses functional magnetic resonance imaging (fMRI) to gain insight in developmental changes in the neural substrate underlying reward anticipation and outcome processing during gambling from early adolescence through early adulthood. Twenty older adolescents (14-16 years old) and twenty young adults (18-25 years old) performed a modified version of the "Slot-Machine" Task described by Donkers, Nieuwenhuis and van Boxtel (2005). A unique feature of this task is that the outcome is unrelated to the participants' behavior, allowing us to study brain activity associated with monetary gains and losses that are not contingent on previous choices or actions. Participants were instructed to watch three pictures that appeared successively on a computer screen. Pictures were presented in three possible orders 1) three different pictures (XYZ type), or 2) two identical and one different picture (XXY type) or 3) three identical pictures (XXX). Participants were told that they would gain _ 0, 05 on each XXX trial. In both adolescents and adults, anticipation of the last picture elicited enhanced activation in bilateral insula, inferior frontal gyrus, and medial prefrontal cortex, but only on trials where the third picture could indicate a potential gain (XXY trials) as compared to trials where the second picture had already averted a gain (XYZ trials). Additional data for twenty early adolescents (10-12 years old) are currently being collected.

E 7

PUBERTAL TIMING AND COGNITIVE PERFORMANCE *Yemisi Olagunju-Jones, Beatriz Luna; University of Pittsburgh* – The ability to voluntarily suppress responses continues to improves into adolescence. The antisaccade task, which requires the active inhibition of a prepotent response to saccade towards a stimulus, and a voluntary saccade to an empty space in the mirror location, is used to characterize the maturation of voluntary response suppression. To characterize the contribution of pubertal timing to cognitive development, pubertal stage was obtained in 157 healthy subjects, age 8 to 28 using self-report developmental questionnaires (Tanner and Petersen Pubertal Development Scales). As expected, performance improved with age as well as pubertal stage, but age was a better predictor of performance. Males compared to females demonstrated a higher association between pubertal development and age related improvements in response inhibition. Additionally, subjects aged 8-17 were grouped intro three categories according to projected Tanner stage for age as early maturers, on-time maturers, or late maturers. Early maturers consistently performed worse than on-time maturers who performed worse than late maturers These results indicate that a biological time table is more closely tied to determining cognitive development than pubertal timing. However, the duration of pubertal development is associated with the voluntary response suppression performance suggesting that puberty may play an important role in the level of cognitive maturity reached.

E 8

AUDITORY EVOKED POTENTIALS DISCRIMINATE BETWEEN ADULTS, AND CHILDREN WITH AND WITHOUT SENSORY PROCESSING DISORDERS *Patricia Davies, William Gavin, Wen-Pin Chang; Colorado State University* – This study examined auditory evoked potentials (AEPs) of stimuli differing in frequency and intensity for adults, and children with and without Sensory Processing Disorders (SPD). While children with SPD display abnormal behaviors in response to sensory stimuli, little evidence exists demonstrating that their brain responses differ from typically developing children. Eighteen healthy adults (9 males; age M=33.3; SD =11.35), 22 typical children (13 males; age M=8.3; SD=1.88) and 26 children with SPD (22 males; age M=7.7; SD=1.80) participated. Electroencephalography (EEG) was recorded while 4 auditory stimuli (1kHz and 3kHz 50ms tones each presented at 50 and 70 dB SPL) were randomly presented in 4 blocks of 100 trials with an ISI of 2 seconds. ANOVAs and post-hoc tests revealed differences between groups at N1, P2, N2, and P3 of averaged AEPs at Cz and Fz sites. The adult group demonstrated the largest amplitude shifts across N1/P2 components for each stimulus, and typical children had slightly larger amplitude shifts across N1/P2 than children with SPD. Children with SPD displayed the largest amplitudes across N2/P3 components. A discriminant analysis revealed 2 functions (Lambda=.107, $p < .0005$, Lambda= .682, $p = .010$) that correctly classified 85% of all participants (adults 100%, typical children 78.3% and children with SPD 81.5%). Summarizing, differences in the peak-to-peak amplitude of N1/P2 that separated the adults from the children may reflect maturation and differences in the N2/P3 amplitude that separated the two child groups may reflect increased attentional effort elicited in the children with SPD.

E 9

INCREASED MOTOR CORTEX WHITE MATTER VOLUME PREDICTS MOTOR DYSFUNCTION IN AUTISM *Melanie P. Burgess[1], Stewart H. Mostofsky[1,2], Jennifer C. Gidley Larson[1]; [1]Kennedy Krieger Institute, [2]Johns Hopkins School of Medicine* – Correlations of motor signs with anatomic MRI measures offer an important means of investigating brain abnormalities contributing to autism. Motor signs, such as those documented in autism, are highly quantifiable and reproducible and can serve as markers for deficits in parallel systems important for socialization and communication. Correlations between motor cortex white matter volumes and basic motor skill performance were examined in 20 children with autism and 36 typically developing controls, ages 8-12 years. Regional tissue volumes were measured using automated tissue classification and semi-automated parcellation techniques. Motor performance was assessed using the Physical and Neurologic Examination of Subtle Signs (PANESS). Children with autism showed significant motor impairment, with higher total PANESS scores compared with controls ($p<0.0001$). There were no significant group differences in motor cortex white matter volumes (right, left, total), which is consistent with prior findings in this age range. Independent linear regression analyses revealed that for controls there was a significant negative correlation between total PANESS score and left motor cortex white matter volume ($R2=0.15$, $p=0.02$), such that increased volume predicted better motor skill. In contrast, children with autism showed a robust positive correlation between total PANESS score and left motor cortex white matter volume (R2=0.60, p<0.0001), such that increased volume predicted poorer motor skill. The results suggest that overgrowth of localized connections contribute to impaired function in children with autism. These findings provide insight into fundamental pathogenic mechanisms that may also contribute to the social and communicative deficits that define autism.

E 10

THE FUNCTIONAL MATURATION OF MENTALIZING DURING COLLEGE *Craig Bennett[1], Carolyn Rabbitt[1], Abigail Baird[2]; [2]Vassar College, [1]Dartmouth College* – The transition from late adolescence to adulthood is a time of tremendous change. Dramatic shifts in romantic relationships, risk taking behavior, insight, and worldviews have been well documented during this time. Changes in brain structure have also been noted, with areas of prefrontal and lateral temporal cortex continuing to mature well past the age of 18. This study sought to examine the potential relationship between behavioral improvements in mentalizing (Theory of Mind) and functional changes in the brain consequent to structural maturation. Sixteen freshmen (mean age = 18.6, 7 female) and thirteen seniors (mean age = 23.9, 6 female) participated in the fMRI study. Subjects were shown a series of photographs depicting an individual in an emotional situation and asked to imagine what that person must have been feeling. A multiple-choice question followed each photo to verify that situation comprehension. We compared the regional brain responses of the seniors and freshmen during the blocks of photos and blocks of questions. In the photo condition a region of right anterior prefrontal cortex (BA10) was significantly more active in the senior group (p<0.001, uncorrected). In the question condition a constellation of regions were more active in the seniors, including anterior prefrontal cortex, left frontal operculum, STS, and somatosensory cortex (p<0.001, uncorrected). No voxels were more active in the freshmen in either condition. The present study demonstrates that the ability to mentalize is not static during late adolescence. Ongoing cortical maturation may contribute to observed changes in social cognition and functional activation.

E 11

WHITE MATTER DEVELOPMENT FROM CHILDHOOD TO YOUNG ADULTHOOD CORRESPONDING TO COGNITIVE DEVELOPMENT. *Jae Woo, Robert Terwilliger, Miya Asato, Yemisi Olagungu-Jones, Bea Luna; University of Pittsburgh* – Cognitive development continues into adolescence and adulthood concurrent with brain maturation processes such as myelination. Myelination supports the efficient integration of widely-distributed circuitry, which our previous work has shown supports the development of cognitive function including response inhibition. We examine the contribution of myelination to development using diffusion tensor imaging (DTI) in 97 individuals (36 children, ages 8-13, 36 adolescents, ages 14-17, 25 adults, ages 18-25), undergoing cognitive assessments including the antisaccade task and fMRI. Results indicated that most of the white matter integrity is mature by childhood however specific regions continue to mature into adolescence. From childhood to adulthood regions of the superior corona radiata and posterior limb of the internal capsule were the primary areas showing age related changes. Stage-wise analyses revealed that from childhood to adolescence the inferior longitudinal fasciculus and subcortical to prefrontal projections are the primary regions showing developmental improvements. In the following developmental stage of adolescence to adulthood the inferior longitudinal fasciculus and thalamic projections, amongst others showed continued age related changes. In addition, we found that age-related changes in FA were better predicted by chronological age than pubertal status suggesting a biological timetable that may be less influenced by environmental factors. Finally, results of region of interest analyses will be discussed depicting the association between cognitive development, brain function and age related changes in FA. These results support the contribution of myelination particularly in tracts integrating frontal and subcortical regions to age related improvement in cognitive control.

E 12

DOES ORIENTATION INFLUENCE THE PROCESSING OF FAMILIAR AND UNFAMILIAR FACES IN INFANTS? EVIDENCE FROM ERPS *Alissa Westerlund[1], Vanessa Vogel-Farley[1], Dana Kuefner[2], Tracy DeBoer[3], Venessa Pena[4], Hannah Mandel[5], Charles A. Nelson[1,4]; [1]Children's Hospital Boston, [2]Università degli Studi di Milano-Bicocca, [3]MIND Institute, [4]Harvard Medical School, [5]Tufts University* – de Haan and Nelson (1997) have demonstrated that 6-month-old infants show a differential pattern of brain activity when viewing pictures of their mother's face compared to a female stranger's face. Halit, de Haan and Johnson (2003) have found that infants are sensitive to orientation when viewing unfamiliar faces. The goal of this study was to investigate the effect of orientation on the recognition of both familiar and unfamiliar faces. Event-related potentials (ERPs) of six-month-old infants were recorded from 63 scalp locations. Two groups of infants were tested with pictures of faces in upright and inverted orientations. One group saw pictures of their mother; the other saw pictures of a female stranger. Artifact-free data were obtained from 14 infants in the stranger's face group and 17 infants in the mother's face group. Analyses revealed that latency to peak P400 response was faster in infants who viewed their mother's face compared to infants who viewed a stranger's face (main effect of GROUP, $F(1,29) = 4.22$, $p < .05$). An interaction revealed that mother inverted elicited greater P400 amplitude than mother upright; however, the stranger's face elicited an equivalent response, regardless of orientation. Analysis of the NC indicated that the inverted faces elicited a larger response than upright faces (main effect of ORIENTATION, $F(1,29)$, $p = .011$). These results, as well as behavioral preferential looking data, will be discussed within the framework of the developmental literature on the specialization of face processing skills during the first year of life.

E 13

LOW FREQUENCY OSCILLATIONS IN RESPONSE TIME IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER *Adriana Di Martino[1,2], Manely Ghaffari[1], Jocelyn Curchack[1], Chris Hyde[3], F. Xavier Castellanos[1]; [1]NYU Child Study Center, Child Psychiatry, NY, [2]University of Cagliari, Italy, [3]BioAssessments, LLC, Elkton, MD* – Background. Greater intra-individual variability is a consistent finding across a range of tasks in children and adults with attention-deficit hyperactivity disorder (ADHD). The amplitude of low frequency oscillations (< 0.1 Hz) in reaction time (RT-LFO) is significantly higher in children with ADHD compared to controls, and is normalized by methylphenidate. Similar LFO of regional cerebral blood flow have been used to map functional neuronal connectivity, and are associated with "default mode" functional brain networks observed during rest in healthy adults. Default mode activity is related to intra-individual variability. Aims. This study aims to characterize RT-LFO in children with ADHD, and to determine the relationship between these LFO and lapses in attention, as measured by errors. Methods. Data were continuously recorded during a 15 min Eriksen-flanker task. The main outcome variables are accuracy (percent correct) and RT-LFO spectral power. Thirty-one children with ADHD (28 males, mean age 12 ± 3 years), and 24 controls (8 males, 12 ± 3) participated. Results. Preliminary results show that 1) RT-LFO correlates significantly with number of errors ($r=0.37$, $p<.05$, and $r= 0.69$, $p<.01$ for directional errors and omissions, respectively), and 2) controlling for sex, RT-LFO discriminates between children with ADHD and controls ($p=.04$). Discussion. RT-LFO may represent a quantitative endophenotype linking the dynamic interplay of default-mode networks to attentional lapses in ADHD and related disorders. Ongoing studies are exploring the relationships between LFO in RT and BOLD signal in ADHD as well as Autism.

E 14

MATURATIONAL CHANGES IN PREFRONTAL AND CINGULATE REGIONS DURING AN INHIBITORY-WORKING MEMORY TASK IN CHILDREN AND ADOLESCENTS *Jennifer Realmuto[1], Paul Eslinger[1], Clancy Blair[2], Jianli Wang[1], David Baker[2], Steven Thorne[2], David Gamson[2], Erin Zimmerman[1], Qing Yang[1], Lisa Rohrer[3]; [1]Penn State College of Medicine, [2]Pennsylvania State University, [3]University of Minnesota* – Introduction. Inhibitory-working memory processes are important resources for a variety of behavioral domains, and particularly for acquisition of diverse cognitive abilities and self-regulatory expertise. We tested the hypothesis that the neurodevelopmental bases of inhibition and working memory are associated with maturational plasticity in prefrontal cortex and anterior cingulate regions. Methods. Participants were healthy children and adolescents 8 – 19 years of age who completed a visuospatial go no-go task while being scanned in a Philips 3T magnet with visual display goggles. Images were processed with SPM2 software and analyzed for average activation as well as age regression effects. Results. Average activation maps revealed significant clusters in right dorsolateral and ventrolateral prefrontal cortex and left anterior cingulate along with the hippocampus and insula. Age regression analyses showed marked developmental decreases in left and right prefrontal regions, mid-posterior cingulate, insula and hippocampus. In contrast, significant developmental increases in activity occurred in the right dorsolateral and superior prefrontal cortex and the right mid-posterior cingulate. Conclusion. Findings suggest that with developmental expertise in inhibition-working memory processes, there is a marked decrease in prefrontal cortex activity as well as in a larger network of cortical and subcortical structures, although right prefrontal activation remains evident. Anterior cingulate activity also remains evident but there appears to be a dynamic shift in the activity of mid and posterior cingulate regions. Neuromaturational changes for inhibition-working memory processes appear to become more focal and physiologically efficient within cortical systems.

E 15

FRONTAL MIDLINE THETA ACTIVITY AS A CORRELATE OF THE DEVELOPMENT OF RESPONSE MONITORING AND COGNITIVE CONTROL IN ADOLESCENTS *Kristin Sullwold, Paul Collins, Noah Venables, Monica Luciana; University of Minnesota* – Developmental studies have shown age-related differences in event-related potential (ERP) components associated with response monitoring and cognitive control. This study used ERP time and frequency analyses to investigate response monitoring and inhibitory control during a go no-go/shift task performed by adolescents and young adults. As compared to adults, adolescents produced theta activity that showed (a) greater overall amplitude and (b) less discrimination between stimulus and response categories. When presented with lower-probability stimuli signaling a requirement to withhold a prepotent response, or shift to an alternate response, midline frontal theta activity increased substantially in adults, but significantly less so in adolescents. Similarly, adolescents produced less of an increase in frontal midline theta following response errors, as compared to adults. These age-related theta effects were stronger than those observed for baseline-to-peak measures in the ERP time domain (for N2 and event-related negativity [ERN] components, respectively). Behavioral data indicated that adolescents were less able to discriminate stimulus conditions associated with varying degrees of response conflict (reduced d-prime values). The results will be interpreted in relation to developmental interactions between the anterior cingulate and the lateral prefrontal cortex during the period from early adolescence to young adulthood.

E 16

DIFFERENTIAL RESPONSE TO AUDITORY AND VISUAL STIMULI DURING SLEEP FMRI IN 3-4 YEAR OLD CHILDREN *Elizabeth Redcay[1], Eric Courchesne[1,2]; [1]University of California, San Diego, [2]Children's Hospital San Diego* – The transition from infancy to the preschool years is a time of dramatic and dynamic neural and cognitive change. However, very limited functional imaging data exist from infants and young children due to the difficulty in acquiring such data. We utilized a relatively novel method in which fMRI data were collected during natural sleep. Reliable fMRI data were collected from thirteen 3-4 year old children during presentation of auditory stimuli in a block design. Stimuli were presented in four 20-second blocks for each of the three conditions (tones (T), vocal sounds (V), and non-vocal environmental sounds (NV)) alternating with 'rest' periods during which time no stimuli were presented. Six of those children were additionally presented with eight 20-second blocks of visual flashing lights at 2.5 Hz alternating with 20-second 'rest' blocks. An additional six were presented with the visual stimuli alone. All auditory stimuli combined elicited activation within bilateral superior temporal gyri/sulci (STG/S) and right cerebellum ($p<.05$, corrected). Response to visual stimuli was localized to occipital cortex. We found a significant difference between auditory stimulus types (V, NV, T) within right STG. Specifically, a significantly greater response was seen to nonvocal than to vocal sounds ($p<.01$). In sum, 3-4 year olds showed a differential response both between stimulus modalities and between stimuli in the auditory modality. These findings provide evidence that neural discrimination capabilities are present in very young children during natural sleep. We conclude that sleep fMRI is a valuable tool for examining functional brain development in young children.

E 17

DEVELOPMENTAL CHANGES IN BRAIN FUNCTION SUPPORTING VOLUNTARY RESPONSE SUPPRESSION IN HIGH-FUNCTIONING AUTISTIC INDIVIDUALS *Ran Liu[1], Krista E. Garver[2], Charles Geier[2], Nancy Minshew[2], John A. Sweeney[3], Beatriz Luna[2]; [1]Carnegie Mellon University, [2]University of Pittsburgh, [3]University of Illinois, Chicago* – Autism is disorder characterized by limitations in social processing and communication as well as executive processing. Our past studies have indicated compromised prefrontal circuitry underlying limitations in executive processing in adult autistic subjects. Developmental studies on executive function indicate that while individuals with autism are impaired in the development of voluntary response inhibition, they do show some improvements in performance throughout late childhood and adolescence that is similar to normal individuals. We performed a fast event related fMRI (3T) study on 22 high-functioning autistic subjects and 22 healthy control volunteers 14-33 years of age during the antisaccade task, where BOLD activity during correct trials were examined. In the antisaccade task subjects must suppress a tendency to foveate a suddenly appearing peripheral cue and instead make a voluntary saccade to the mirror location. Results indicate that a large part of the circuitry known to support response inhibition is in place by adolescence in autistic individuals. Differences in the recruitment of key regions including frontal systems as well as differences in the efficiency of activating these regions, reflected in differences in the timecourse hemodynamic response function, were present in the autism group. We also found many similarities in developmental transitions in the autism and typicals group from adolescence to adulthood, suggesting preservation of key developmental processes. These studies indicate impairments in neocortical function in autism that is present across development.

E 18

ERP EVIDENCE FOR LIFE-SPAN DEVELOPMENT OF EXECUTIVE FUNCTIONS: THE ROLES OF TASK PREPARATION AND INTERFERENCE CONTROL IN A CUED TASK-SWITCHING PARADIGM *Daniela Czernochowski, Yael M. Cycowicz, Marianne de Chastelaine, Cort Horton, David Friedman; Cognitive Electrophysiology Laboratory, New York State Psychiatric Institute* – Relative to young adults, children and older adults exhibit difficulty in interference control. However, it is currently unclear whether deficits in this control process can be ameliorated if given sufficient time to prepare for upcoming interference. Hence, the cue-target interval [CTI] was manipulated in a task-switching paradigm in children (9-10 years), young (20-25 years) and older adults

(61-83 years). Participants responded on the basis of which number or how many numbers were presented in compatible (1, 333) or incompatible (3, 111) target displays, the latter requiring interference control. Reaction time costs were observed for all groups, but pronounced for incompatible switch trials in children and older adults. Children also had high error rates in this condition. Additional preparation time (1200 vs. 600 ms CTI) increased children's accuracy and reduced reaction times for older adults. Switch relative to stay cues in mixed blocks elicited larger ERP amplitudes beginning ~200 ms, ~350 ms, and ~500 ms post cue for young adults, older adults and children, respectively. However, for older adults, this differentiation was considerably reduced in amplitude. These data suggest that older adults' difficulties may originate from a reduced ability to prepare for an upcoming switch. Therefore, when faced with incompatible target displays, they need to recruit control processes to reduce interference thereby maintaining accurate performance, but at the cost of longer RTs. Unlike the elderly, children appear able to prepare when given sufficient time, but fail to exert adequate control in response to incompatible targets as indicated by their error-prone behavior.

E 19

STIMULUS-DEPENDENT HEMISPHERE ASYMMETRIES IN DEVELOPMENT: AN MEG STUDY OF M100 LATENCY IN CHILDREN WITH AUTISM DISORDER AND TYPICALLY DEVELOPING CONTROLS *A. Lisette Isenberg, Paul Fillmore, M. Anne Spence, Nicole Gage; University of California, Irvine* – In adults, the auditory evoked M100 component detected by magnetoencephalography (MEG) peaks within a narrow (~20ms) time window across left (LH) and right (RH) hemispheres. For most adults, M100 latency peaks later in LH vs. RH for both speech and non-speech sounds, although the neural bases are unknown. We use MEG to record auditory responses for speech and non-speech sounds in typically developing (TD: n=8) children and children with autism disorder (AD: n=8) to determine if (i) the M100 latency (LH>RH) asymmetry is present during development; (ii) it differs for speech vs. non-speech sounds using within-subject analyses, and (iii) results for AD children with language impairment are similar to TD. Stimuli - Speech: consonant-vowel (CV) syllables; Tones: (Spectral) pure-tones (250-2000Hz), (Temporal) tones with brief discontinuities (gaps, 5-40ms). TD results – Speech: M100 latency LH>RH for all CV syllables; Tones: Spectral and Temporal: M100 latency LH<RH for all stimuli. AD results show similar patterns to TD, but with increased variability. Findings provide evidence that (i) M100 LH>RH asymmetries for speech are present in TD and AD children by age 8; (ii) asymmetries are reversed for tonal stimuli in both groups across Spectral and Temporal conditions; (iii) despite greater variability, AD have a similar pattern of results. Thus, children (TD and AD) show an adult-like M100 asymmetry (LH>RH) for speech, with an opposite (LH<RH) pattern for non-speech. Findings indicate that there are maturational differences in LH/RH time-to-peak for the auditory evoked M100 component.

E 20

RELATIONSHIPS BETWEEN WHITE MATTER DEVELOPMENT AND DELAY/ PROBABILITY DISCOUNTING IN ADOLESCENCE *Elizabeth Olson, Paul Collins, Catalina Hooper, Ryan Muetzel, Monica Luciana; University of Minnesota* – Discounting tasks assess the extent to which the subjective value of a reward decreases as the time until the delivery of the reward or the odds against receiving the award increases. Associations have previously been demonstrated between impulsive and/or risk-taking behavior (such as illicit drug use) and performance on discounting tasks, with impulsive subjects showing greater rates of discounting (i.e. greater declines in subjective value over time). Functional MRI studies have implicated the prefrontal cortex as well as the parietal cortex in discounting behavior. Previous work by this and other research groups indicates continuing maturation on tasks believed to recruit prefrontal regions over the course of adolescence, suggesting a protracted developmental timecourse of prefrontally mediated functions. For this reason, we hypothesized that discounting rates would decrease over the course of adolescence and that these changes would be associated with changes in the brain's structural maturation. In this study, healthy adolescents completed computerized delay and probability discounting tasks and a diffusion tensor imaging (DTI) brain scan using a 3T magnet. Voxelwise and region-of-interest approaches were used to analyze the data. Findings indicate behavioral differences in discounting behavior between younger and older adolescents. Relationships between changes in white matter organization in prefrontal, parietal, and other cortical regions and changes in delay and probability discounting rates are evident and will be discussed relative to theories of adolescent brain development and the neural networks presumed to underlie discounting behavior.

E 21

PHANTOM PENISES IN TRANSSEXUALS; A PROBE FOR UNDERSTANDING INNATE GENDER SPECIFIC BODY-IMAGE IN THE BRAIN *Paul McGeoch, Vilayanur Ramachandran; Center for Brain and Cognition, UCSD* – 70% of men after amputation of the penis for carcinoma, or other causes, experience a phantom. Conversely, in male to female transsexuals, who have undergone gender reassignment surgery, we found the incidence of a phantom penis to be 30%. This is consistent with their report that they feel like women and never felt that their penises belonged to their body-image in the first place. Remarkably, 60% of female to male transsexuals report vivid phantom penises- with erections- existing from early childhood; long before they had phalloplasty. Indeed most of them had undergone no genital surgery at all. They report enhancement of the sensation by testosterone therapy. Also only about 10% of female to male transsexuals report phantom breasts following surgery to remove breast tissue (compared with 35 to 50% following mastectomy for carcinoma). We explain these intriguing findings by postulating a hardwired gender specific body image in the brain (specified by hormonal cascades and direct genetic effects in the embryo) that does not match the external somatic gender. These reports are not confabulatory; female to male transsexuals often try to "grab" their member during masturbation or (unconsciously) purchase jeans with low crotches. Secondly, apotemnophiliacs (a "control" group who feel that a limb isn't part of their body image), always experience phantoms after amputation. Koro (a syndrome in which Malaysian males have the delusion of a shrinking penis) may arise from related mechanisms. The converse delusion- elderly white males experiencing phantom expansion of the penis (S.M. Anstis; 2006) remains un-named.

E 22

THE EFFECTS OF AGE, LANGUAGE PROFICIENCY AND SES ON ERP INDICES OF SYNTACTIC PROCESSING IN CHILDREN *Laura Sabourin, Eric Pakulak, David Paulsen, Jessica Fanning, Helen Neville; University of Oregon* – Recent research into children's syntactic development has suggested that an adult-like biphasic LAN-P600 pattern (a left anterior negativity followed by a later posterior positivity to syntactic violations) is present, albeit at delayed latencies, in children as young as two years (Oberecker, Friedrich and Friederici, 2005). This and other child language Event-Related Potential (ERP) research investigating syntactic development have used isolated sentences during auditory stimuli presentation. The goal of this study was to investigate syntactic processing in 4- and 5-year-olds using natural speech which accompanied and formed a coherent narrative for 7 minute animated video clips. Participants saw up to five of these video clips. Each clip contained 100 sentences, of which 20 (per video) were syntactic canonical/violation pairs of interest. Adult participants showed the expected biphasic LAN-P600 pattern to these same sentences. In addition we analyzed the ERP responses to canonical and violation sentences in four and five year-old children. Language proficiency measures (using standardized tests) were obtained for each child during extensive behavioural testing and family SES was determined using a parent questionnaire. Results show that the anterior (adult LAN) and posterior (adult P600) effects are independently affected by age, proficiency and SES. We conclude that age, SES and proficiency differences are reflected in brain organization for language in children and thus it is important to consider each of these factors in studies of language development.

E 23

DIFFERENTIAL CORTICAL ACTIVATIONS DURING VISUAL LETTER PROCESSING IN FIVE-YEAR-OLD CHILDREN AND ADUTLS: AN FMRI STUDY *Yoshiko Yamada, Laura Sabourin, Scott Klein, Mark Dow, Helen Neville; University of Oregon* – Neuroimaging studies on 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. In this study, hemodynamic responses to visually presented letters and false fonts were examined in adults and five year olds who have just begun to develop reading skills. During the acquisition of functional magnetic resonance images (fMRI), letters and false fonts were presented in separate blocks interleaved with rest blocks. Adults and children differ greatly in the amount of experience with printed letters; however, false fonts used in this study were novel to both groups. Subjects were asked to respond when the same letter or false font was repeated in two successive trials (i.e., a 1-back task). Increases in the BOLD signal to false fonts relative to letters suggested that adults and children recruit similar bilateral posterior brain regions when processing visually presented novel stimuli. In contrast, the pattern of activations to letters differed between adults and children, and only adults exhibited greater activations to letters as compared to false fonts in the temporo-parietal region, a part of the reading network. The results will be discussed in terms of how experience modulates the organization of reading-related cortical regions.

E 24

THE EFFECTS OF PARENT TRAINING: ENHANCING CHILDREN'S NEUROCOGNITIVE FUNCTION *Jessica L. Fanning, David Paulsen, Stephanie Sundborg, Helen Neville; University of Oregon* – Past research indicates that when parents adopt specific behavior management techniques they produce positive conduct outcomes in their children (Fisher, et al., 2002). The current study tested the hypothesis that, with specialized training, parents can be made aware of interaction techniques and language facilitation strategies and that such training would enhance children's neurocognitive development. We randomly assigned parents to either the experimental (N=14) or control (N=14) condition. Treatment group parents participated in the Success in Parenting Preschoolers (SIP2) training program by attending weekly 2-hour classes for eight weeks. We tested the relationship between completion of the SIP2 training and children's behavioral performance on specific measures of cognitive processes, i.e. language, attention, memory, visuospatial cognition, numeracy, and IQ. We also examined event-related potential (ERP) measures of language (semantics, syntax) and auditory attention. Here, we report behavioral data showing increased abilities in receptive and expressive language, vocabulary, IQ, working memory, and sustained attention in children whose parents completed SIP2 training. These improvements were significantly greater than the gains made by the control group of children. We also report preliminary ERP data showing a more mature pattern of brain organization for the treatment group of children. Taken together, these results suggest that explicit training in parenting skills can lead to enhancements in children's neurocognitive function.

E 25

ERP INDICES OF SPEECH PROCESSING IN INFANT AND TODDLER: MATURATIONAL CHANGES FROM 3 MONTH TO 7 YEARS OLD OF AGE *Karen Garrido-Nag, Yan Yu, Thia Datta, Nancy Vidal, Valerie Shafer; The Graduate Center, CUNY* – Studying speech sound processing abilities in infants and toddlers can provide important information about the association between speech processing deficits and language impairment in young children (e.g., Trehub & Henderson, 1996). The purpose of this study was to investigate the maturational changes in the spatial-temporal patterns of the brain's obligatory and mismatch responses (MMR) to speech input. Infants and children (3 months to 7 years) listened to 250ms-long, phonetically similar vowel contrasts (I vs. E) presented in an oddball paradigm while event-related potentials (ERPs) were collected from 65 scalp sites. The preliminary results show that the latencies of the obligatory "P100" component and positive MMR discriminative response systematically shift earlier with increasing age, as expected (see Morr, et al., 2002). The amplitude of the positive MMR decreased and shifted from a right dominant to a more central topography with age, up to 3 years of age. By age four, the positive MMR had disappeared and is replaced by a negativity which is consistent in topography with the adult mismatch negativity (MMN). A late negative (LN; 500-800 ms) discriminative response starts to appear at the age of 18 month, with its latency gradually reducing with increasing age. Variation from these general patterns of maturation that are related to language experience (monolingual versus bilingual input), language measures and gender will be presented.

E 26

SUPPRESSING UNWANTED MEMORIES: A DEVELOPMENTAL FMRI STUDY *Pedro M. Paz-Alonso[1], Simona Ghetti[1], Bryan J. Matlen[1], Michael C. Anderson[2], Silvia A. Bunge[3]; [1]University of California, Davis, [2]University of Oregon, [3]Helen Wills Neuroscience Institute, University of California, Berkeley* – The Think/No-Think paradigm has attracted substantial interest for the study of intentional inhibitory-control processes on memory suppression (Anderson & Green, 2001). In this paradigm, participants first learn a series of word-pairs. In a later phase (i.e., Think/No-Think), they are presented with the first member of the pair (i.e., cue), and they are asked to either remember or suppress the second member of the pair (i.e., target). In the final recall task, suppressed targets typically are remembered less than baseline and this decrease is larger as a function of the number of times the targets were suppressed. The interaction between hippocampus and DLPFC appears to be critical for suppressing unwanted memories. Specifically, No-think trials have been associated with increased dorsolateral prefrontal activation, and reduced hippocampal activation in adults (Anderson et al., 2003). The present fMRI study was aimed at investigating the neural underpinnings of developmental inhibitory-control processes on memory suppression. A total of 32 healthy, native English speakers, from two age groups (8- to 12-year-olds, and adults) will participate in the present fMRI study. Neuroimaging data will be acquired during the think/no-think phase. After scanning, memory for all the word-pairs will be tested twice (i.e., same- and independent-probe memory tests). We predict that, compared to adults, 8-12-year-olds will exhibit lower behavioral suppression levels and a weaker negative correlation between prefrontal cortex and the MTL, given that Menon et al (2005) documented the development of functional connection between the DLPFC and MTL between 11 and 19 years of age during memory encoding.

E 27

RESPONSE INHIBITION IN CHILDREN WITH ASD: REDUCED PREFRONTAL RECRUITMENT AND COMPENSATORY POSTERIOR CONTRIBUTIONS *Anne Della Rosa[1], Jennifer Foss-Feig[2], Bryan Harrison[1], Philip Lee[2], Benjamin Yerys[1], Chandan Vaidya[2], William Gaillard[1], Lauren Kenworthy[1]; [1]Children's National Medical Center, [2]Georgetown University* – Neuroimaging studies have documented recruitment of frontostriatal networks for successful performance on response inhibition measures (Rubia, et al., 2006). One study of adults with Autism Spectrum Disorders (ASD) noted abnormalities in prefrontal recruitment on measures of response inhibition (Schmitz, et al., 2005), however whether these abnormalities are present in children with ASD is unknown. The current study used fMRI imaging techniques and a Go/No-Go task to examine the neural underpinnings of response inhibition in 7-12 year old children with ASD and age/IQ matched controls. During fMRI, children pressed a button in response to all letters (Go trials), except the letter X (No-Go trials). Trials were blocked such that blocks of all Go trials (Go blocks) alternated with blocks comprising 75% Go and 25% No-Go trials (No-Go blocks). For each subject, activation during response inhibition (No-Go vs. Go blocks) was identified in SPM99. Behaviorally, no significant group differences in reaction time or accuracy were observed. Functionally, typically developing children recruited regions associated with response inhibition, including inferior frontal regions, (BA 11/47), anterior cingulate (BA 24/32), and inferior parietal regions (BA 40). In contrast, children with ASD demonstrated reduced recruitment of inferior frontal regions (BA 11/47), but increased recruitment of striatal regions, middle temporal regions (BA 21/22), inferior parietal areas (BA 40), and premotor cortex (BA 6/8). These results implicate reduced function in frontal regions in children with ASD, and suggest compensatory recruitment of striatal and posterior regions to allow behavioral performance comparable to controls on a measure of response inhibition.

E 28

THE DEVELOPMENT OF CORPUS CALLOSUM MICROSTRUCTURE AND BIMANUAL TASK PERFORMANCE IN HEALTHY ADOLESCENTS *Ryan L. Muetzel, Paul F. Collins, Bryon A. Mueller, Kelvin O. Lim, Monica M. Luciana; University of Minnesota* – The corpus callosum (CC) is the primary connection between cerebral hemispheres, allowing for interhemispheric integration of sensory, motor, and cognitive processes. Although reports are somewhat inconsistent, both cross-sectional and longitudinal studies suggest that the CC continues to mature structurally from infancy to adulthood. Diffusion tensor imaging (DTI) provides in vivo information about brain tissue microstructure and shows potential for elucidating subtle brain changes that occur late in this developmental sequence. We used DTI to examine CC microstructure in healthy right-handed adolescents and young adults (n=94, age 9-24 years), and correlated the imaging data with behavioral performance on motor tasks. The primary DTI variable was fractional anisotropy (FA), which reflects the degree of white matter's directional organization. Participants completed two bimanual coordination tasks and the Grooved Pegboard Task to assess interhemispheric transfer and fine motor control functions. Performance on each measure was significantly correlated with age. Males generally outperformed females. Significant correlations between age and FA were observed in the splenium of the CC, which interconnects posterior cortical regions. FA levels in the genu and splenium correlated significantly with task performance. Regression analyses indicated that bimanual coordination was significantly predicted by age, gender, and splenium FA. Decreases in interhemispheric transfer time and increases in FA likely reflect increased myelination in the CC and more efficient neuronal signal transduction. These findings expand upon existing neuroimaging reports of CC development by showing associations between bimanual coordination and white matter microstructural organization.

E 29

CULTURE AND/OR LANGUAGE-SPECIFIC DEVELOPMENT OF NEURAL BASES OF VERBAL AND NONVERBAL 'THEORY OF MIND' *Chiyoko Kobayashi, Elise Temple; Cornell University* – Theory of mind (ToM) – our ability to predict behaviors of others in terms of their underlying intentions – has been examined through verbal and nonverbal false-belief (FB) tasks. Results of our previous functional magnetic resonance imaging (fMRI) study with American English-speaking adults and children have indicated that temporo-parietal junction (TPJ) may be important for ToM processing throughout the development. In order to replicate this finding in children with a different cultural/linguistic background, we studied 12 Japanese bilingual children (8-12 years-old) with the same verbal (story-based) and nonverbal (cartoon-based) FB tasks. A significant overlap of the story and cartoon ToM-specific brain activations of the Japanese adults and children was found primarily in bilateral ventro-medial prefrontal cortex (vmPFC). These results suggest that the ways in which neural bases of ToM develop are not entirely universal.

E 30

ADOLESCENT CHANGES IN CORTICAL CONNECTIVITY MEASURED BY DIFFUSION TENSOR IMAGING *Monica Luciana, Paul Collins, Ryan Muetzel, Catalina Hooper, Kelvin Lim; University of Minnesota* – Recent studies concur that brain development continues throughout adolescence, with reports of cortical gray matter volume decline and increments in white matter volume. These changes appear to be particularly pronounced in the prefrontal cortex. Neuroimaging innovations allow us to expand upon these findings to make inferences about the potential for cortical connectivity. One such innovation is diffusion tensor imaging (DTI), which measures three-dimensional water diffusion. As neuronal fibers develop more myelination and stronger directional organization, water diffusion becomes increasingly restricted along axes perpendicular to the fibers, which can be quantified in terms of fractional anisotropy (FA). Initial reports indicate that in healthy children and adolescents, FA levels increase significantly with age. We hypothesized that this increase would be particularly pronounced in the prefrontal cortex, concordant with changes in high level reasoning skills that are also observed during adolescence. Healthy adolescents, ages 9 to 23 (n=60), completed a structural MRI scan including a DTI sequence using a Siemens 3T scanner, in the context of a longitudinal study. Voxelwise and region-of-interest analyses revealed significant FA increases with age, both broadly throughout the cortex and in subcortical pathways that connect the frontal lobe with striatal regions. Gender did not substantially moderate these associations. Radial diffusion, a DTI index of myelination, also showed age-related changes. Findings will be considered relative to volumetric changes in this age range, and implications for functional connectivity will be discussed.

E 31

MATURATION OF NEURAL SYSTEMS MEDIATING CALCULATION IN TYPICALLY DEVELOPING CHILDREN AND ADOLESCENTS *Hilary Knipe[1], Paul Eslinger[2], Jianli Wang[2], Jennifer Realmuto[2], David Baker[1], Steven Thorne[1], David Gamson[1], Erin Zimmerman[2], Qing Yang[2], Bryn Lipovsky[2], Lisa Rohrer[3]; [1]Penn State University, [2]Penn State College of Medicine, [3]University of Minnesota* – Introduction. We tested the hypothesis that the neurodevelopmental bases of mathematical cognition entails a complex set of structures subserving not only number sense but also representational knowledge and operational processes. This neural system includes the superior parietal cortices as well as dorsolateral prefrontal cortex and the anterior cingulate region. Methods. Participants were healthy children and adolescents 8 – 19 years of age who completed number calculation (addition and subtraction) and coin calculation tasks while being scanned in a Philips 3T magnet with visual display goggles. Images were processed with SPM2 software and analyzed for average activation as well as age regression effects. Results. Average activation maps revealed significant clusters in parietal, occipital- temporal, prefrontal, and medial temporal regions bilaterally. Age regression analyses showed selective dynamic changes in parietal activation during development, with the right superior parietal cortex increasingly active with age but the inferior parietal cortex activity decreasing with age. Contrasting activation effects with age were found in prefrontal cortex and cingulate. The number and coin calculation tasks showed overlapping activation in the right and left superior parietal lobes as well as the right occipital-temporal region. Conclusion. Findings suggest that a large scale network of cortical and subcortical structures subserve mathematical cognition, prominently including the intraparietal sulcus region. Age-related maturational changes identified increasing activity in superior parietal cortices but decreasing activity in prefrontal, medial temporal, and inferior parietal areas. Coin calculation problems engaged more activity in these regions than number problems, but showed similar patterns of neuromaturational change with age.

E 32

THE EFFECTS OF INSTRUMENTAL MUSIC TRAINING ON BRAIN PLASTICITY AND COGNITION IN YOUNG CHILDREN *Gottfried Schlaug[1], Andrea Norton[1], Marie Forgeard[1], Udita Iyengar[1], Martin Kotynek-Friedl[1], Katie Overy[1], Ellen Winner[2]; [1]Harvard Medical School, [2]Boston College* – Previous research has revealed functional and structural neural differences comparing musicians with matched non-musician controls, with intensity and duration of instrumental training being important predictors of these differences. It has also been demonstrated that music training in children results in long-term enhancements in extramusical cognitive domains. However, the underlying neural basis of such enhancements and the differential contribution of nature and nurture to these brain differences is not known. We report initial behavioral and neuroimaging results of our longitudinal studies in young children. Matched (age, handedness, gender, IQ) groups of children (instrumental or non-instrumental) underwent a battery of behavioral tests that included auditory-perceptual, motoric, and various cognitive tests as well as a high-resolution structural and functional MR imaging study examining the neural correlates of pitch and rhythm discrimination. We found no pre-existing neural, cognitive, motor, or auditory-perceptual differences between the groups of children that were about to pursue instrumental music training compared to those children that did not pursue instrumental training. After 16 months of observation in our longitudinal study, we found significant group differences in tests related to the primary training domains (auditory-perceptual discrimination and fine finger movements skills). No significant transfer effects were seen yet. Functional imaging analysis showed significant changes in temporal, frontal, and cerebellar activation only in the instrumental group, but not in the control group. Preliminary voxel-based morphometric analyses revealed trends in gray matter changes in superior frontal and temporal regions.

Linguistic Processes: Syntax

E 33

THE GENERATION OF SYNTACTIC STRUCTURES: INSIGHTS FROM EEG TIME-FREQUENCY ANALYSES *Dietmar Roehm[1], Hubert Haider[2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences Leipzig, Germany, [2]University of Salzburg, Austria* – In the present EEG experiment we investigated the generation of minimal syntactic structures. Participants were asked to produce verb-second (V2) sentences on the basis of sequentially presented NP-NP-Verb chunks Pizza / Junggeselle / bestellen ('pizza' / 'bachelor' / 'to order'). Visual cues either forced the sentence to be spelled out in past tense (i.e. with the finite verb in V2) or in the perfect (i.e. with a finite auxiliary in V2 and the main verb in sentence-final position). Verb-types differed with respect to whether they had an obligatorily separable particle (aussuchen 'to select') or not (bestellen 'to order') and whether an additional prefix was added (e.g. voraussuchen 'preselect', vorbestellen 'preorder'). ERPs timelocked to the onset of the verb revealed a late positivity (550-800 ms) for double-prefixed particle verbs in comparison to the other conditions independent of verb position. In contrast, frequency analyses revealed significant differences between conditions in the alpha (reflecting verbal complexity) and beta/gamma frequency range (indicating the degree of grammaticality). Furthermore phase coherence between electrodes revealed frequency-specific synchronization patterns reflecting long-range neural integration mechanisms during syntactic structure generation. The present results demonstrate that frequency-based analyses can overcome the methodological limitations of ERP acquisition during sentence production. Acknowledgements: The present research was supported by the Austrian 'Fonds zur Förderung der wissenschaftlichen Forschung", Project P16281-G03.

E 34

AN ERP INVESTIGATION OF SECOND LANGUAGE PROCESSING: EFFECTS OF PROFICIENCY AND EXPLICIT AND IMPLICIT TRAINING *Kara Morgan-Short[1], Karsten Steinhauer[2], Cristina Sanz[1], Michael T. Ullman[1]; [1]Georgetown University, [2]McGill University* – Second language (L2) event-related potential (ERP) research suggests that L2 grammatical processing generally differs from first language (L1) processing: grammatical violations in L2-speakers typically elicit a response that differs from the biphasic LAN-P600 L1 pattern in that LANs are usually absent, and N400-like negativities are sometimes found instead. However, LANs have been found at high proficiency levels of L2. Our understanding of L2 processing should be enhanced by examining low and high proficiency levels within-subjects. Additionally, the neurocognitive effects of different types of language training, in particular explicit (e.g., classroom) vs. implicit (e.g., naturalistic) have not been examined, even though such training differences are highly relevant to actual language learning. The current study examines these issues. Subjects learned to comprehend and speak a Romance language-like artificial language (BROCANTO2) to high proficiency under either explicit or implicit training conditions. For each training condition, morphological and syntactic processing were assessed within-subjects with behavioral and ERP measures at both low and high proficiency levels. Preliminary results from the study suggest that behaviorally, subjects receiving explicit training outperformed those receiving implicit training at low proficiency, whereas at high proficiency the pattern was mixed. ERP assessments suggest that at low proficiency, both training groups evidenced N400 patterns. Interestingly, at high proficiency, implicitly-trained subjects showed a LAN/P600 pattern whereas explicit subjects continued to show a N400 pattern. These results suggest that a change in L2 processing to L1-like processing can take place, but that it may tend to occur only under certain types of L2 training.

E 35

BOLD SIGNAL RESPONSE TO IMPLICIT SYNTACTIC PROCESSING *David Caplan[1], Gloria Waters[2,3], Jennifer Michaud[1], Jung Min Lee[1]; [1]Massachusetts General Hospital, [2]Sargent College, [3]Boston University* – BOLD signal was measured in sixteen participants a font change detection task. Participants made timed judgments about whether all the words in written sentences were in the same font. The syntactic form of the stimulus sentences was varied: half of the sentences contained an object-extracted relative clause and half contained a subject-extracted relative clause. For each of these stimulus types, half the sentences were presented with all the words in the same font, and half with one word in a subtly different font. Accuracy was above 85% for all sentence types. RTs showed unimodal distributions for all sentence types, indicating that the participants processed all sentences similarly, with some superimposed noise as expected. There were longer RTs to object- than to subject-extracted sentences, indicating that sentences were processed to the level of syntactic structure, despite this not being required by the task. BOLD signal increased for the more complex object-extracted sentences without font changes in Wernicke's area (L STG). This result must be due to the processing of the sentences, not the use of the results of this processing to accomplish the task, since the form of the sentence is irrelevant to the task and uninformative regarding the correct response. The result thus provides strong evidence that L STG plays a role in the syntactic processing of object-extracted relative clauses.

E 36

MONITORING OF SUBJECT-VERB AGREEMENT ERRORS IN COMPREHENSION: AN ERP STUDY *Els Severens[1], Bernadette, M. Jansma[2], Robert J. Hartsuiker[1]; [1]Ghent University, [2]Maastricht University* – In speech production more subject-verb number agreement errors are made if the head noun phrase contains a number-ambiguous determiner (Hartsuiker, et al., M&C, 2003). This finding has been explained by error monitoring in the comprehension system which would have more difficulties to detect and covertly filter out errors in the ambiguous sentence. We aimed to find comparable results in a comprehension experiment. Event-related potentials were used to examine if ambiguity in the head noun phrase in combination with the number of the local noun influences sentence comprehension. Participants read sentences like: De straat bij de kerk/kerken is/zijn mooi [The street (common gender) near the church/churches is/are beautiful] or Het plein bij de kerk/kerken is/zijn mooi [The square (neuter gender) near the church/churches is/are beautiful]. In Dutch the neuter gender determiner (het) is always singular; in contrast, the common gender determiner (de) can be singular and plural. When the local noun was singular we observed a more negative wave elicited by incorrect verbs compared to correct verbs in the 350-400ms time-window. This effect was largest when the head noun phrase contained no number ambiguity. When the local noun was plural the waves were more positive for incorrect verbs than for correct verbs in the 600-650ms time-window. This effect was largest when the head noun phrase contained no number ambiguity. The results demonstrate that the effect of agreement violations on comprehension is modulated by number ambiguity. They are therefore compatible with a monitoring account of number ambiguity effects in production.

E 37

AUDITORY SENTENCE PROCESSING IN ADOLESCENTS WITH SPECIFIC AND NON-SPECIFIC LANGUAGE IMPAIRMENT: ERPS FOR SEMANTIC AND GRAMMATICAL CONSTRAINTS ON VERBS *Christine Weber-Fox[1], Amanda Hampton[1], John Spruill, III[1], Bruce Tomblin[2]; [1]Purdue University, [2]University of Iowa* – Children with specific language impairment (SLI) exhibit reduced speed and capacity for grammatical processing compared to children with normal language development (e.g., Miller et al., 2001; Weismer & Evans, 2002). Further, electrophysiological findings in young children with SLI indicate atypical ERPs for grammatical aspects of visual sentence processing (Neville et al., 1993). The aim of the current study was to determine whether atypical linguistic processing persisted into adolescence and how neural activity patterns reflect different language developmental profiles. We studied adolescents, aged 14-18 years, diagnosed with: 1) SLI (N=17), 2) non-specific language impairment (NLI) displaying reduced abilities in both verbal and non-verbal skills (N=13), and 3) normal language and non-verbal abilities (N=17). The diagnosis of each participant in these groups was stable from kindergarten through 8th grade. Verb-agreement violations and violations of verb semantics were presented in natural speech. High sentence judgment accuracy and typical N400 and P600 ERPs were elicited in the normally developing adolescents. In contrast, the adolescents with SLI and NLI performed less accurately in detecting grammatical and semantic verb errors. However, while the behavioral performance was similar for the SLI and NLI groups, their ERPs reflected different underlying processes. Atypical N400s to the verb-agreement violations characterized the NLI group. The SLI group exhibited a reduced N400 for semantic verb violations over the RH and an absent P600 to verb agreement violations. These findings indicate that the neural functions mediating linguistic processing in adolescents are closely related to their language and cognitive profiles. [Supported by NIDCD P50DC02746]

E 38

THE STORAGE OF L2 PARSING KNOWLEDGE IN PROCEDURAL MEMORY: AN ERP STUDY *John David Purdy, Karen Froud; Teachers College, Columbia University* – Event related potential (ERP) studies have shown that an early left anterior negativity (ELAN) is generated in response to word-category violations, and that this response occurs earlier than responses to other types of syntactic violations or to semantic anomalies. This corresponds to principle-based sentence processing models that posit an initial parse on the basis of word-category information. The ELAN component has not, however, been detected in studies in which an L2 learner is presented with a sentence containing a word-category violation. In the present study, sentences containing word-category violations were presented to L1 Chinese learners of L2 English. The sentences were presented to L2 learners in two conditions: correct (e.g., The candidate should honestly answer the question) and incorrect (e.g., *The candidate should honest answer the question). The Chinese speakers generated an ELAN-like component in response to word-category violations, although the component peaked about 30 ms later than the native-speaker ELAN. This result suggests that the apparent difficulty Chinese speakers have in adhering to the phrase-structure rules of English is not due to an inability to perform an initial parse on the basis of word category. We propose that L2 learners may be utilizing a domain-general probabilistic learning mechanism to learn rules of the L2, and are storing these rules in procedural memory. However, the parsing knowledge made available by this mechanism may not be treated as linguistic; consequently, activation levels of these non-linguistic responses to word-category violations may not be high enough to generate native-like syntactic structures.

E 39

IMPACT OF PHONOLOGIC MARKERS IN LEARNING SUBJECT-VERB AGREEMENT IN FRENCH AS A SECOND LANGUAGE. EVIDENCE FROM EVENT-RELATED POTENTIALS *Cheryl Frenck-Mestre[1], Haydee Carrasco[2]; [1]Laboratoire Parole et Langage, Centre National de Recherche Scientifique, [2]Université de Provence* – The study aimed to evaluate the impact of the phonological realisation of morpho-syntactic errors in subject-verb agreement in French as a second language. Changes in brain activity were recorded in Hispanic learners of French when reading visually presented sentences that were either correct or contained subject-verb agreement errors which were either phonologically realized (je mangez, etc) or not (je manges). Comparisons between regular and irregular verbs (je vas) were also performed (note, for irregular verbs, morpho-syntactic errors were always phonologically realized). Results from previous studies in second language learners have shown both an N400 and P600 effect to morpho-syntactic errors in sentence contexts (Osterhout et al., 2005). In native French, Largy and Fayol (1999) found that phonological markers facilitate the learning of subject-verb agreement in French children and reduce production errors in French adults. Our previous ERP results with native French speakers show greater sensitivity to morpho-syntactic errors when these errors are phonologically realized than when silent, with a larger P600 response for the former (Frenck-Mestre et al. 2006). The results reported here, for native Spanish speakers learning French show both a LAN and a P600 effect to morpho-syntactic errors. This was true for both regular and irregular verbs, and was independent of phonological realisation, i.e. the processing of subject-verb agreement was not impacted by phonological realisation for these L2 readers. In conclusion, phonological markers might not be relevant cues in acquiring subject-verb agreement for Hispanic learners of French, in contrast to our ERP results obtained for native French readers.

E 40

ERP EVIDENCE ON THE INTERACTION OF METRICAL AND SYNTACTIC PROCESSING: THE CASE OF THE P600 *Sonja A. Kotz, Maren Schmidt-Kassow; Max Planck Institute for Human Cognitive and Brain Sciences* – Based on previous observations that metrical regularities of a given language influence auditory language processing in general and syntactic processing in particular (Schmidt-Kassow & Kotz, 2006), we further investigated the interaction of metrical and syntactic processing. Rather than listening to metrical errors, participants had to detect metrically deviant, but possible syllable stress patterns in a metrically predictable sentence context. In addition, we tested syntactically deviant, metrically and syntactically deviant and metrically and syntactically correct sentences. All sentences included two syllabic words (first syllable stress). Metrically deviant sentences included a tri-syllabic verb with second syllable stress. Syntactic deviation was induced by a morphological inflectional error in the critical verb (syllable stress correct) and a double violation contained a metrically and syntactically deviant verb. Results from a metric judgment task show a P600 elicited by all three deviation types. In a syntactic judgment task only the syntactic and double deviation elicited a P600. Comparable to our previous results, metric deviations elicit a P600, especially when attention is directed towards the deviation. These data underline the importance of metrical information during auditory language processing and suggest that the P600 is not syntax specific per se. The data will be discussed with regard to a language processing model (Friederici & Kotz, 2003) and extended by suggestions from the Dynamic Attention Theory of Large and Jones (1999).

E 41

MONITORING OF LANGUAGE PERCEPTION: P600 EFFECTS OF SENTENCE-PICTURE MISMATCHES *Constance Th Vissers, Herman H. Kolk, Nan van de Meerendonk, Dorothee J. Chwilla; NICI Radboud University of Nijmegen* – We propose that monitoring for errors not only occurs in language production but also in language perception. When a sentence brings forth two incompatible representations, a conflict occurs triggering reanalysis, meant to check for possible processing errors. This monitoring response is reflected in a P600 effect (Kolk et al., 2003; van Herten et al. 2005, 2006). In support of this, Vissers and colleagues (2006) found a P600 effect after misspellings in sentences in which the correct word was highly expected; no such effect was obtained when this word was not expected. Presumably, the subject in the first condition checks whether the misspelled word has been misread. Here, the monitoring theory was further tested. We argued that, when a subject sees a picture and subsequently reads a sentence which does not match the picture meaning, the natural response will be to reprocess the sentence to check whether it has been misread. We presented pictures of spatial arrays (e.g, a triangle above a square), followed by a sentence giving a true or false description of the picture. We predicted that a mismatch between picture and sentence meaning elicits a P600 effect. This was tested by recording ERPs from 27 sites while participants read sentences matching or mismatching a preceding picture. The ERPs for picture-sentence mismatches showed a P600 effect relative to those for the picture sentence matches. This P600 effect was maximal at central/posterior sites. These findings further bolster our claim that monitoring occurs in language perception and is reflected by P600.

E 42

MEG CORRELATES OF GRAMMATICAL PROCESSING IN GERMAN LEARNERS OF DUTCH *Douglas Davidson, Frauke Hellwig, Peter Indefrey; F. C. Donders Centre for Cognitive Neuroimaging, Max Planck Institute for Psycholinguistics* – Previous electrophysiological research on multilingual sentence processing has shown evidence of responses to grammatical violations relatively early during language learning. We examined evoked-field responses to constituent-order violations in adult German learners (n=13) of Dutch early during their acquisition of Dutch. Sentences were presented one word at a time (800 ms/word) followed by a scene in a sentence-picture matching task over a series of three recording sessions at the start, the end, and one month following their L2 coursework. The average evoked field and the planar gradient of the evoked field to word order violations averaged over the three sessions showed a significant violation response on left hemisphere sensors 200:400 ms after the violation onset. The results suggest that responses to grammatical violations can emerge relatively quickly during acquisition of a second language.

E 43

OBJECT SHIFT AND EVENT-RELATED POTENTIALS *Mikael Roll, Merle Horne, Magnus Lindgren; Lund University* – Swedish Object Shift is restricted to unstressed pronouns. Sentences where an object pronoun precedes a sentence adverb, such as Han åt den inte '(lit.) He ate it not', are thus well-formed, whereas sentences with a full noun object preceding a sentence adverb, such as Han åt sylt/sylten inte '(lit.) He ate jam/the jam not', are illformed. Explanations for this word category restriction have been based on either morphosyntactic features involved in Object Shift or semantic/pragmatic features the process is associated with. In an attempt to obtain experimental support for one of these explanations using Event-Related Potentials, the brain reaction to sentences violating the word category restriction was tested. A significantly enhanced Left Anterior Negativity (LAN) was found 300-500 ms after onset of the critical word in sentences where an indefinite full noun object violated the restriction as compared to control sentences. This finding supports a morphosyntactically based explanation of the word category restriction on Object Shift.

E 44

DOES ADJECTIVE PROCESSING IN L2 DEPEND ON LEARNERS' NATIVE LANGUAGE? EVIDENCE FROM ERPS. *Alice Foucart[1,2], Cheryl Frenck-Mestre[3,2]; [1]University of Edinburgh, [2]University of Provence, France, [3]CNRS* – The present experiment is part of an ERP study (Foucart & Frenck-Mestre, CNS 2006), which examines two opposed linguistic models concerning SLA. According to the Failed Functional Features Hypothesis (Hawkins & Chan, 1997; Hawkins & Franceschina, 2004), grammatical features that are not triggered in the native language are no longer available to late L2 acquirers. In opposition, the full transfer full access hypothesis (FTFA) claims that new features present in L2 can be acquired, but require sufficient exposure (Schwartz & Sprouse, 1994, 1996; White, 1989). In the present study, we compared the brain activity of French native speakers, German-French and English-French L2 learners during gender agreement violations on pre-posed and attributive adjectives in French. Native speakers showed a P600 effect in case of gender-concord violations (larger for pre-posed adjectives than for attributive adjectives). German-French learners did not show any effect in case of gender violations. However, it is important to note that in German the plural form of the article and adjective is common both for feminine and masculine words; the nul-effect could be due to an inappropriate transfer from L1 to L2. English-French learners revealed an N400 effect to gender concord violations on pre-posed adjectives, but did not show any effect for attributive adjectives. This suggests that English speakers are sensitive to gender violations in their second language. These results support the FTFA as well as other models claiming that non-native speakers can achieve native-like grammatical processing, even when the L2 is learnt later in life (Herschensohn, 2000).

E 45

AN EVENT-RELATED POTENTIAL STUDY OF THE PROCESSING OF DIFFERENT TYPES OF ANAPHORA *Sarah Callahan[1], Janet Nicol[2], Tracy Love[3], David Swinney[1]; [1]University of California, San Diego, [2]University of Arizona, Tucson, [3]San Diego State University* – One influential linguistic account of anaphora (e.g. Hankamer & Sag, 1976; Sag & Hankamer, 1984) makes a distinction between surface anaphora and deep anaphora based on the observation that surface anaphors require a linguistic antecedent while deep anaphors do not. The current study investigated whether correlates of the surface/deep distinction could be observed in real-time processing using electrophysiological techniques. In addition, this study examined whether the processing of verb phrase (VP) anaphora differed from the processing of noun phrase (NP) anaphora. Participants made plausibility judgments of auditorily-presented sentences involving surface VP anaphora (e.g. The player shuffled the deck at the beginning of the game and the dealer did too.), deep VP anaphora (e.g. ... did it too.), or deep NP anaphora (e.g. ... shuffled it too.). In the implausible version of each sentence, the subject of the second conjunct (e.g. the dealer) was replaced with an inanimate NP (e.g. the fortune). Comparisons of plausible and implausible sentences at the second subject NP (e.g. dealer/fortune) revealed an N400 and a P600 component in implausible sentences. Comparisons of the three types of anaphora at the word "too" showed that the processing of sentences involving both types of VP anaphora was similar, but differed from the processing of sentences involving NP anaphora. Implications for theories of the processing of anaphora are discussed.

E 46

WORKING MEMORY AND SENTENCE COMPREHENSION DURING ARTICULATORY SUPPRESSION *Gregory Hickok, Corianne Rogalsky; UC Irvine* – Broca's area has long been implicated in sentence processing, but its specific role continues to be hotly debated. Early evidence implicated Broca's area in syntactic processing, however recent lesion and imaging data suggest that at least part of Broca's area contributes to sentence comprehension as a verbal working memory resource. The present study focuses on one conceptualization of working memory, namely that the comprehension of complex sentences requires verbal information to be stored in something like Baddeley's phonological loop. If in fact a phonological loop is necessary for sentence comprehension, particularly the comprehension of syntactically complex sentences, comprehension performance should decrease as a function of sentence complexity during articulatory suppression. Subjects were administered a sentence-to-picture matching test during both articulation and manual tasks. Sentences presented were of varying complexity and semantically reversible. An interaction between suppression task and complexity was found. This interaction can be attributed to a significant difference between performance during articulatory and manual suppression for the most complex sentence type, object-relative clause sentences. No significant differences between suppression types were found for active, passive, or subject-relative clause sentences. These behavioral results reflect involvement of a phonological component of working memory, possibly supported by Broca's area, in high-load sentence processing situations. Imaging studies will assess the anatomical locus of this effect.

Perceptual Processes: Multisensory Processing

E 47

AUDIOVISUAL SPEECH INTEGRATION IN AUTISM SPECTRUM DISORDER: EVIDENCE FROM EVENT-RELATED POTENTIALS *Maurice Magnee[1,2], Beatrice de Gelder[2,3,4], Herman van Engeland[1], Chantal Kemner[1,5]; [1]University Medical Center Utrecht, [2]Tilburg University, [3]Massachusetts General Hospital, [4]Harvard Medical School, [5]Maastricht University* – Background: Integration of information from multiple sensory sources is an important prerequisite for successful social behavior, especially during face-to-face conversation. It has been suggested that communicative impairments among patients with Autism Spectrum Disorder (ASD) might be caused by an inability to integrate synchronously presented visual and auditory cues. Methods: We investigated audiovisual integration of speech stimuli among thirteen high-functioning adult patients with ASD and age- and IQ matched controls using electroencephalography, focusing both on early pre-phonological, as well as late phonological integration. Results: We show dissociation in integrational abilities in the patient group, with a deficit specifically related to the late integration of phonological information. Conclusions: Patients with ASD are able to integrate visual and auditory cues at an early level of information processing. However, impairments in the higher order integration of phonological information may very well contribute to the communicative disabilities which are typical for the disorder.

Linguistic Processes: Lexicon

E 48

THE ROLE OF INHIBITION IN LEXICAL SELECTION: EVIDENCE FROM NONFLUENT APHASIA *Jason E. Crowther, Kelly A. Biegler, Randi C. Martin; Rice University* – Previous studies have reported that aphasic patients with frontal lesions demonstrate increasing errors in naming pictures blocked by semantic category compared to pictures drawn from different categories. The present study assessed whether these exaggerated semantic blocking effects should be attributed to a deficit in inhibiting lexical representations during word production or a deficit in inhibiting semantic representations. If the deficit involved semantic representations, then similar results were expected in comprehension. Two nonfluent aphasic patients, ML and AR (showing evidence of a verbal inhibition deficit in other studies), a fluent aphasic patient, LW, and older controls were tested on several semantic blocking tasks. In two picture-naming tasks, controls and patients showed increasing semantic interference in latencies across repeated presentations in the semantically blocked condition, with an exaggerated effect for the nonfluent patients. In two auditory word-picture matching tasks, only the nonfluent patients with an inhibition deficit showed significantly increasing semantic blocking effects across repeated presentations. It was hypothesized that the patients may have used a naming strategy in the comprehension task, that is, matching the name of the picture to the spoken word. To eliminate naming as a strategy in a comprehension task, subjects performed an auditory word-picture associate matching task (e.g., “kennel”- “dog”). Little evidence was found for increasing semantic blocking effects for the nonfluent patients. The results supported the notion that the nonfluent patients’ deficit is specific to inhibiting lexical representations, with the mechanism presumably only involved during production in selecting from among several activated lexical competitors.

E 49

EFFECTS OF FORMAL, LEXICAL AND SEMANTIC PROPERTIES ON BRAIN ACTIVATION IN VISUAL WORD RECOGNITION: A MULTI-PARAMETER FMRI STUDY *Catherine-Marie Longtin[1], Olaf Hauk[1], Mike A. Ford[2], Friedemann Pulvermüller[1], William D. Marslen-Wilson[1], Matthew H. Davis[1]; [1]Medical Research Council, UK, [2]Cambridge University, UK* – We investigated brain activation modulated by different types of psycholinguistic information processing. Using a design similar to a previous ERP study (Hauk et al., NeuroImage, 2006), fMRI data were collected from 15 participants who made lexical decisions on 300 monomorphemic words varying in their formal, lexical, and semantic properties, as well as on matched pseudowords. Eleven psycholinguistic variables were condensed using principal component analysis, yielding five orthogonal factors: word length, orthographic typicality, lexical frequency/familiarity, semantic coherence, and imageability. Multiple regressions with brain activation were performed for each variable and subject. Regression coefficients were then entered into the group analysis to assess the significance of a linear relationship between brain activation and the psycholinguistic variables. Word frequency showed a negative correlation with activation in the left fusiform gyrus and left inferior frontal cortex. These regions also showed stronger activation for pseudowords compared to words. Imageability produced a negative correlation in the left middle temporal gyrus, whereas semantic coherence yielded activation in inferior temporal and parietal lobes. Overall these results are consistent with our previous findings obtained with EEG and source localisation, and suggest that visual word recognition networks are distributed over multiple brain areas modulated by different word variables, and therefore likely reflect distinct but interacting processes.

E 50

AUDITORY PROCESSING OF DIFFERENT TYPES OF PSEUDO-WORDS: AN EVENT-RELATED FMRI STUDY *Tim Raettig, Angela D. Friederici, Sonja A. Kotz; Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – Imaging results on real word and pseudo-word processing have been heterogeneous, allowing only cautious claims about the neuroanatomical loci of lexico-semantic processing. In order to shed more light on this issue, we examined the impact of different procedures used to create non-lexical stimuli on the outcome of comparisons between such items and matched real words. We anticipated that the degree to which a pseudo-word can be lexicalized determines how word-like it is processed. To verify this idea, we tested pseudo-words that were either transparently or opaquely derived from real words or phonotactically illegal in an event-related fMRI paradigm, utilizing a lexical decision task. All types of pseudo-words elicited a stronger hemodynamic brain response than real words in the bilateral superior temporal gyri. Real words produced stronger brain activations than pseudo-words in the bilateral angular gyri, the bilateral posterior middle temporal gyri, the rostral and caudal cingulate gyrus and the precuneus. When contrasted to opaque pseudo-words, transparent pseudo-words elicited a stronger brain response in the same temporo-parietal regions as real words. Our results provide further evidence for an involvement of the bilateral posterior middle temporal and angular gyrus in post-lexical semantic processing. The data also indicate that transparently derived pseudo-words are processed similarly to real words. In contrast, post-lexical semantic operations are blocked when opaquely derived pseudo-words are processed.

E 51

COGNITIVE AND NEURAL CORRELATES OF FAST, EFFORTLESS WORD LEARNING: AN MEG STUDY *Christian Dobel, Markus Junghöfer, Benedikt Klauke, Caterina Breitenstein, Pienie Zwitserlood; University of Münster* – Our study demonstrates how words of a novel language are rapidly and without effort integrated into an existing conceptual-lexical system. Untutored language learning involved coincidental presence of particular sound patterns with a specific object. This procedure was termed statistical learning (e.g. Breitenstein & Knecht, 2002). If words have to be learned, sound and pictures were paired more frequently that in a non-learned condition. Crossmodal priming before and after training revealed that stable connections between newly learned words and objects came into existence. We further explored the nature of these learning processes in an MEG study, comparing M400 responses to native and novel words before and after training. A clear M400 response was visible upon picture presentation, more strongly expressed over the left hemisphere. This response was modulated within the native language by amount of semantic relatedness in both pre and post test. The novel words elicited the strongest M400 response. Most importantly, this response was strongly reduced after the statistical learning procedure in which words and objects were frequently paired. In the non-learned condition no M400 reduction was found. Localizing the responsible brain regions with Minimum Norm methods demonstrated the involvement of the medial-inferior temporal lobe of the left hemisphere. Thus, time-locked brain measures such as M400 thus provide a neural index of rapid integration of novel words into existing networks of lexical and conceptual representations.

E 52

BRAIN MECHANISMS OF WORD VERSUS PICTURE PROCESSING: EVIDENCE FROM A FMRI STUDY IN CHINESE *Xiaoyi Wang[1], Nan Hu[1], Haiyan Zhou[1], Yue Xu[1], Jie Lu[2], Hua Shu[1]; [1]Beijing Normal University, Beijing, China, [2]Xuan Wu Hospital, Capital Medical University, Beijing, China* – The goal of this research was to investigate the neural basis of specific components of word and picture processing and their interaction by a 2(Chinese word versus picture) x 2(dangerous judgment versus covert naming task) design. Subjects were asked to name silently or make dangerous judgment with (1) two-syllable Chinese words (e.g. "老虎", tiger) and (2) the corresponding pictures. The variables such as the category (animals, tools and vegetables/fruits), frequency of words, the familiarity and the age of acquisition, in the materials were counterbalanced and matched among the conditions. All images were acquired using a 1.5 T Siemens scanner. The results showed that compared with picture tasks, the word tasks produced activation mostly in the bilateral occipital lobe, including the fusiform gyrus. The size of activation (BOLD signal) in two picture tasks was equal in the left and right, but strong left lateralization in the word tasks. It indicated the selective specialization for word recognition in left fusiform gyrus (VWFA). Note here we found no activation in the posterior superior temporal lobe in both picture and word tasks, which was always regarded as the vital area responsible for orthography to phonology conversation in alphabetic language. Moreover, a significantly more activation was found in left inferior frontal gyrus (BA45) and insula in judgment task, but not in naming task, which is consistent with the former studies in the semantic judgment tasks. These results suggested that for Chinese readers, word processing was different from those in English, and also from picture processing in the underlying anatomical mechanisms.

E 53

THE ELECTROPHYSIOLOGICAL CORRELATES OF MORPHOLOGICAL PRIMING IN LANGUAGE PRODUCTION *Dirk Koester[1], Rick Giesbers[1], Niels O. Schiller[2,1]; [1]Maastricht University, [2]Leiden University, Leiden Institute for Brain and Cognition* – Knowledge about the (morphological) make-up of words is (can be) essential for speech production of complex words ("hand.appel" [eating apple] not "han.dappel"; dots indicate syllable boundaries). Recently, the production of morphologically complex words in German has been shown to facilitate the subsequent production of picture names that were part of the previously produced complex words (Dohmes et al. [2004]. Brain & Language). The (facilitative) effects were interpreted as morphological priming. In two experiments, we tried to replicate the effect in another language, Dutch, and to determine the electrophysiological correlates of morphological priming. Previous studies in language comprehension suggested that the brains' N400 response may reflect morphological processes. A long-lag word-picture priming design was used to collect behavioural data in Experiment 1 and event-related potentials (ERPs) in Experiment 2. While behavioural priming effects confirmed previous results and extended these to another language, preliminary analyses of Experiment 2 yielded large positive going ERPs before speech onset. The production of morphologically primed picture names seems to be dissociated from the production of unprimed picture names at more frontal electrode sites. These findings suggest a morphological processing component in speech production that cannot be reduced to semantic or form processing. Furthermore, the ERP effects that are related to morphological processes appear to be different for language production and comprehension.

E 54

NEURAL PROCESSING OF RULE-LIKE AND IRREGULAR PATTERNS IN LANGUAGE: AN FMRI STUDY OF PAST TENSE PRIMING *Aneta Kielar[1], Marc F. Joanisse[1], Randy Lynn Newman[2]; [1]University of Western Ontario, [2]Acadia University* – Much of the debate about rule-like patterns in language has focused on the status of regular vs. irregular past tenses in English. While studies have found differences in how such forms are processed, it remains unclear whether such data can provide unequivocal support for a dual-systems model; indeed, such findings are equally compatible with the connectionist view that all forms are processed via semantic, phonological and orthographic constraints. On this theory, differences in past tenses arise as a result of the degree to which verbs rely on information about either form (phonology/orthography) or meaning (semantics). The present study directly tested the predictions of this theory using a crossmodal priming task and fMRI at 4T. Fifteen adult participants were scanned as they performed a lexical decision task. The regularity of prime-target pairs was manipulated in order to identify priming-related fMRI signal suppression associated with regular (baked-bake), irregular (sang-sing) and part regular verbs (slept-sleep), compared to monomorphemic phonologically (army-arm) or semantically (jacket-coat) related pairs and nonwords. A key finding was the observation of priming effects for irregulars in both LIFG and LMTG regions, but a failure to identify similar effects for part-regular forms. We argue this finding contradicts the predictions of a dual mechanism approach, that all irregulars should show equal priming effects. The results are instead consistent with the view that the regular/irregular distinction is graded, such that forms are processed in a distributed set of brain regions that encode form and meaning information that is weighted differently across verb types.

E 55

A FACTOR ANALYTICAL APPROACH TO HEMISPHERE DIFFERENCES IN LEXICAL PROCESSING *Suzanne Welcome[1], Laura Halderman[2], Janelle Julagay[1], Christiana Leonard[3], Christine Chiarello[1]; [1]University of California, Riverside, [2]University of Pittsburgh, [3]University of Florida Brain Institute* – The left and right hemispheres may each contribute to word recognition in somewhat different ways. Large-scale studies afford the opportunity of employing factor analyses to assess whether there might be a different factor structure for words presented to the LVF and RVF. To the extent that each hemisphere is employing different mechanisms to recognize words, RVF and LVF scores should load on different factors. The current study tested 110 individuals (55 female) on seven divided visual field tasks (word and nonword naming, lexical decision, masked word recognition, semantic decision, category and verb generation). Reaction time and accuracy scores for each VF and each task were submitted to a factor analysis using an oblique rotation. A six-factor solution was obtained which accounted for 87% of the total variance. The findings supported both hemisphere differences and similarities in the processing of single words. For RT, the factor structure for both hemispheres differentiated between tasks requiring semantic retrieval, unmasked and masked word identification. However, for accuracy RVF and LVF scores segregated into different factors. For the RVF most of the tasks loaded on a single factor, while for the LVF two factors differentiated between tasks with a single correct response (word naming, lexical decision, masked word recognition, semantic decision) and tasks with more than one correct response (nonword naming, category and verb generation). This suggests that increases in the number of response alternatives affects word retrieval accuracy only within the right hemisphere.

E 56

COMPETITION EFFECTS IN LEXICAL AMBIGUITY PROCESSING *Ekaterini Klepousniotou[1], Vincent Gracco[2], G. Bruce Pike[1]; [1]MNI, McGill University, [2]School of Communication Sciences and Disorders, McGill University* – The present study investigated the meaning/sense competition effects in lexical ambiguity processing. Under the theoretical assumption that lexical ambiguity is not a homogeneous phenomenon, but rather that it is subdivided into homonymy and polysemy, the patterns of meaning activation (and competition) of ambiguous words were explored. The two categories of lexical ambiguity (i.e., homonymy and polysemy) were further subdivided into two types each: balanced (e.g., “panel”) and unbalanced (e.g., “pen”) homonymy; metaphorical (e.g., “lip”) and metonymic (e.g., “rabbit”) polysemy. Single-word priming lexical decision and semantic judgment tasks were used in which the ambiguous words served as primes and were followed by three types of targets: a word associated with their dominant meaning; a word associated with their subordinate meaning; and an unrelated word. It was hypothesized that the greatest competition effects would be observed for balanced homonymous words that have multiple unrelated meanings of approximately equal frequency, leading to competition and delayed reaction times compared to unrelated targets. On the other hand, metonymically polysemous words were expected to show no competition effects given that their multiple senses are interrelated, are stored together and, thus, do not compete for activation. Overall, the results supported our hypotheses that there are stronger competition effects for balanced homonymous words that have multiple unrelated meanings of equal frequency, while for unbalanced homonymous and metaphorically polysemous words, dominant meanings were preferentially activated. On the other hand, for metonymically polysemous words that have multiple interrelated senses, both senses were activated and no competition effects were observed.

E 57

PARAMETRIC STUDY OF VISUAL WORD PROCESSING COMBINING MEG AND FMRI *Asaf Bachrach[1], John Gabrieli[1], Susan Gabrieli[1], Alec Marantz[1,2]; [1]MIT, [2]NYU* – We report the findings of a multi-modal imaging study of visual word processing designed to test the possibility of analyzing single trials of imaging experiments via correlations with continuous stimulus variables (Hauk et al 2006). Subjects performance on a lexical decision task was monitored using Magnetoencephalography (MEG) and trial related Functional Magnetic Resonance Imaging (fMRI) (two separate sessions). We use a parametric design where each item was coded for 'string properties' (length, average bigram count and size of orthographic neighborhood) and 'lemma properties' (token frequency and imagability). Parameters were drawn from The English Lexicon Project (Balota et al 2002) and MRC Psycholinguistic Database (Wilson 1988). Words were chosen to vary continuously along all stimulus dimensions and such that the stimulus variables themselves were maximally decorrelated. The fMRI data provided spatial localization of parameter-related activation while the MEG data was used for temporal localization, with individual trial data correlated with stimulus variables ms by ms. Furthermore, individual subject structural MRI and fMRI data were used to constrain the MEG forward model (MNE software, Martinos Center MGH). Preliminary results suggest that early visual activation (M100, M170) localized at the occipital lobes and left fusiform gyrus (McCandliss et al. 2003) correlates with string properties. Lemma properties seem to correlate with later MEG response components (M350 and others), localized to medial and superior temporal as well as frontal cortices. The analyses support the possibility of correlational parametric designs (continuous variables, no binning) for neurolinguistic research.

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THE VISUAL M170 AND MORPHOLOGICAL DECOMPOSITION *Eytan Zweig, Liina Pylkkänen; New York University* – The effect of morphological complexity on visual word processing was investigated in three MEG experiments where we compared affixed words to orthographically controlled monomorphemic words in a lexical decision task. In experiment 1, we contrasted suffixed words such as ‘farmer’ to orthographic controls such as ‘winter’. Visual stimuli were presented to 16 participants while magnetic fields were recorded with a whole-head MEG system. We found an effect of morphological complexity in the M170, whose left hemisphere generator has previously been associated with letter string processing. Surprisingly however, our M170 effect was right lateral. One explanation of this is that the effect arises because the left side of only the complex words contained an existing English stem. Thus, the effect could have been driven by early stem-recognition in the contralateral (i.e., right) hemisphere. Experiment 2 tested this by comparing prefixed words (`refill’) to orthographic controls (‘resume’), thus flipping the relative placement of the stem and affix in the word. While the results did replicate the effect in the right hemisphere (suggesting it is an effect of morphological complexity), a similar effect also appeared in the left hemisphere (consistent with a stem-recognition effect). This suggests that perhaps both factors interact. To separate them from each other, Experiment 3 uses the same stimuli as Experiment 1 but directly manipulates visual presentation, presenting the words in either the left or right visual fields, and also foveally but rotated 90 degrees clockwise.

E 59

NOUNS VS. VERBS: AN ELECTROPHYSIOLOGICAL INVESTIGATION OF THE PROCESSING OF GRAMMATICAL CLASS INFORMATION *Stavroula-Thaleia Kousta[1], Horacio A. Barb[1], Leun Otten[2], Gabriella Vigliocco[1]; [1]University College London, [2]Institute of Cognitive Neuroscience, University College London* – Is grammatical class information an organising principle of lexical knowledge? Evidence bearing on this question is mixed, compounded by the fact that semantic correlates of grammatical class have often not been controlled for (e.g the fact that verbs tend to denote actions and nouns tend to denote objects). In two experiments, we manipulated grammatical class (noun vs. verb) and semantic (motor vs. sensory) information in order to tease apart semantic and syntactic contributions to grammatical class. Event-related potentials (ERPs) were recorded while native Italian speakers read single words and short phrases (determiner + noun or pronoun + verb). ERPs for single-word reading revealed differences both for grammatical class and semantic distinctions, with voltage amplitudes more positive for verbs and motor words, as compared to nouns and sensory words respectively. Interestingly, these two effects were not dissociable in terms of scalp distribution (posterior sites) or latency (300-450 ms after word onset). Later on (after 500 ms), an interaction between both variables was observed, whereby only motor verbs differed from the other conditions. For phrase reading, early differences (starting at 150 ms) were found between function words (frontal negativity associated with pronouns as compared to determiners), followed by differences between nouns and verbs (verbs more negative than nouns, between 275-375 ms). Overall, these results highlight the role of semantic variables in the distinction between nouns and verbs, as well as the effect of syntactic context in their processing.

E 60

GENDER AGREEMENT TRANSFER DURING SENTENCE PROCESSING IN EARLY LANGUAGE LEARNERS; AN ELECTROPHYSIOLOGICAL STUDY *Katherine J. Midgley[1,2,3], Nicole Y. Y. Wicha[4], Phillip J. Holcomb[1], Jonathan Grainger[3]; [1]Tufts University, [2]Université de Provence, [3]CNRS, [4]University of Texas at San Antonio* – We predicted that at an early stage of English acquisition, L1 French speakers should show sensitivity to L1 gender during L2 sentence processing. To assess this we exploited that fact that French possessive determiners are gender marked and must agree with the gender of the noun they modify and not the gender of the anaphoric referent as in English. We predicted that French speakers might perceive a gender agreement violation on such items as "his shoe" ("his" being masculine and the translation equivalent of "shoe" in French being feminine) and that this could have an effect on the P600, shown in previous studies to be a marker of agreement violations. French speakers in their second year of English studies were presented with grammatically correct RSVP sentences in English and asked to read for comprehension. Critical nouns were preceded by possessive determiners that either agreed with or disagreed with the gender of the translation equivalents in French. (e.g., “Barbara saw her shoe under the bed.” (OK condition) “Peter saw his shoe under the bed.” (perceivable gender agreement violation or PGAV condition)). The electroencephalogram was recorded at 28 scalp sites and event related potentials were computed off-line to the two conditions. A positivity was observed between 400 and 700 ms post stimulus onset to PGAV items. This positivity is more pronounced at anterior sites and over the right hemisphere. Our results suggest that grammatical gender associated with nouns from L1 can influence how these items are processed during sentence comprehension in L2.

Linguistic Processes: Other

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AN ERP STUDY OF PROFICIENCY IN SECOND LANGUAGE *Harriet W. Bowden[1], Cristina Sanz[1], Karsten Steinhauer[2], Michael T. Ullman[1]; [1]Georgetown University, [2]McGill University* – What are the neurocognitive mechanisms of late second language (L2) acquisition and use, and do these differ from first language (L1)? How does L2 experience and/or proficiency affect L2 neurocognition? It is the goal of the current study to shed light on these questions, focusing on Spanish as an L1 and L2. Specifically, we examine the neurocognition of Spanish L2 at different levels of experience/proficiency (low, medium, and very high), as compared to Spanish L1. Low experience/proficiency learners have approximately 2 semesters of classroom Spanish; medium experience/proficiency learners have 6-8 semesters of classroom Spanish plus 1-2 semesters immersion; very high experience/proficiency learners have 6-8 semesters of classroom Spanish plus multiple years of full immersion. Unlike in many other neurocognitive studies, L2 proficiency is not only self-rated, but is also measured with two proficiency assessment instruments: the Simulated Oral Proficiency Interview and the Elicited Imitation task. Event-related potentials (ERPs) are used to examine neurocognitive processing of (visually-presented) Spanish sentences in a violation paradigm, with violations of lexical-semantics, phrase structure, gender, number, and regular and irregular present-tense inflection. Preliminary results suggest that L1 ERP components observed in other L1s (i.e., N400s for lexical-semantic violations and LANs+P600s for phrase structure violations) are also observed in L1 Spanish; L2 Spanish learners at low experience/proficiency, however, show a non L1-like pattern. Implications for neurocognitive models of L2 (e.g., the declarative/procedural model of Ullman, the shallow-structure hypothesis of Clahsen) will be discussed.

E 62

INTERACTIONS BETWEEN LANGUAGE AND ATTENTION SYSTEMS: ATTENTION EFFECTS ON EARLY LEXICAL PROCESSING *Yury Shtyrov[1], Teija Kujala[2], Friedemann Pulvermuller[1]; [1]MRC Cognition & Brain Sciences Unit, Cambridge, UK, [2]Cognitive Brain Research Unit, University of Helsinki, Finland* – The mismatch negativity (MMN) reflects activation of neural memory traces for spoken words. Memory trace activation leads to an enhanced MMN response to meaningful words as opposed to senseless matched pseudowords. This lexical MMN enhancement was found in passive oddball designs and was therefore suggested to be automatic and attention-independent. To test this, we systematically varied the level of attention by using a stimulus detection task and recorded MMN responses to a set of phonologically and acoustically balanced words and pseudowords using a multi-deviant paradigm. Under non-attend conditions, the word-elicited MMN (peaking at ~120 ms after the words could be uniquely recognized) was significantly larger than that to pseudowords, confirming early activation of lexical memory traces. However, when attention was directed towards the stimuli, such word-pseudoword difference in the MMN was not any longer present, even with a trend to pseudoword advantage at ~190ms. Whereas MMNs to words seemed unchanged by attentional variation, the first phase of the pseudoword response was significantly enhanced by attention. At later times, attention significantly modulated a positive deflection at ~230ms and a second negative wave at ~370ms for all stimuli. The data indicate that the early word processing is not affected by attentional demands and may thus indeed be automatic with attention effects on lexical processing accumulating at latencies above ~200ms. Lexical enhancement of the MMN seems specific to conditions where the subjects' attention is directed away from the stimuli. These effects may be explained in terms of the strength of cortical feedback control.

E 63

SELECTIVE DEGRADATION OF LEXICAL AND CROSS-FORMAT OBJECT-TO-WORD PRIMING IN PRIMARY PROGRESSIVE APHASIA *Emily Rogalski, Marsel Mesulam, Fred Rademaker, Sandra Weintraub; Northwestern University Cognitive Neurology and Alzheimers Disease Center* – An object naming impairment is the single most common feature of Primary Progressive Aphasia (PPA). In order to explore the nature of this deficit, repetition priming effects for words and pictures were examined. Nineteen PPA patients and 18 healthy elderly controls classified serially presented words and pictures as natural versus manmade while reaction times were recorded. Results demonstrated that healthy elderly control subjects showed a priming effect for both within-format (word-word, picture-picture) and cross-format (picture-word, word-picture) pairs. Patients and controls demonstrated comparable priming effects for picture-picture identity priming, implying that implicit processing can be relatively unaffected in PPA when the stimuli are non-lexical. In the cross-format trials, PPA patients showed priming effects for the word-picture but not picture-word pairs. PPA patients' failure to elicit a priming effect in the picture-word condition suggests a deficit in constructing automatic (implicit) object-to-lexical associations. A degradation of signal-to-noise ratios at the level of lexical but not object representations can be invoked to explain these results and may provide a general mechanism for word-finding and naming deficits in PPA. This explanation is consistent with the partial and selective loss of neurons within components of the language network.

E 64

CEREBRAL CORRELATES OF PHONOLOGICAL AND VISUAL ATTENTIONAL PROCESSES IN HEALTHY SKILLED READERS. AN FMRI STUDY *Carole Peyrin[1], Monica Baciu[2], Cyril Pernet[3], Laurent Lamalle[4], Cédric Pichat[2], Christoph Segebarth[4], Jean-François Démonet[1], Sylviane Valdois[2]; [1]INSERM U455, Toulouse, France, [2]Laboratoire Psychologie & NeuroCognition, Grenoble, France, [3]Center for Cognitive NeuroImaging, Glasgow, United Kingdom, [3]Center for Cognitive NeuroImaging, Glasgow, United Kingdom* – Functional MRI was used to investigate the functional anatomy of the phonological and visual attentional processes relevant for reading. For this purpose, fourteen French skilled readers were engaged in a task of rhyme detection relying on phonological processing and in two innovative visual attentional tasks: a lateral masking task addressing selective attention during parafoveal flanked letter processing and a global report task highlighting the attentional mechanisms involved in letter string processing (i.e., the visual attention span). Functional MR imaging was performed on a Bruker 3T MR imager, equipped with echo-planar (EPI) acquisition. Each paradigm was designed in an event-related mode. Data analyses were performed by using SPM2 (Wellcome Department of Imaging Neuroscience, London, UK). Lateral masking was associated with activation in the left middle occipital gyrus (BA 19) and left superior parietal lobule (BA 7) suggesting an attention-modulated local processing in these areas. The global report task activated both inferior frontal/premotor cortex and angular/middle occipito-temporal gyri (BA 39/19) suggesting that this task involves divided attention when multiple letters have to be attended to simultaneously for processing the whole letter sequence. Finally, rhyme detection selectively activated a frontal-parietal network extending rostrally to the anterior inferior part of the left frontal gyrus (BA 44/45). These findings provide new insights on the role of parietal regions in the phonological and visual attentional processes related to reading. These processes are impaired in dyslexia so that the present results could be used as control data in future study involving dyslexic participants.

E 65

MORPHO-PHONOLOGICAL AND LEXICAL PROPERTIES OF SPOKEN WORDS AND THE FRONTO-TEMPORAL LANGUAGE NETWORK *Mirjana Bozic[1], Lorraine K. Tyler[2], Carolyn McGettigan[3], Billi Randall[2], William D. Marslen-Wilson[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, UK, [2]University of Cambridge, [3]Institute of Cognitive Neuroscience, University College London* – Previous research has established that bilateral temporal and left frontal systems play a key role in speech comprehension. But there are still major uncertainties about how these systems operate together to support the dynamic process of mapping the speech input onto stored lexical representations. In the current MRI study we aimed to isolate lexical processing from the lower-level auditory processing of speech, and to investigate how it is modulated by the lexical properties of spoken words. Based on previous evidence (Tyler et al 2005), we hypothesised that simple words are processed bilaterally, and that an increase in morpho-phonological complexity should trigger a shift to a more left lateralised fronto-temporal processing network. To test this hypothesis we manipulated the presence of potential embedded stems and inflectional affixes in a set of single spoken words, and contrasted them against a baseline of envelope-shaped 'musical rain'(Uppenkamp et al 2006), which shares the complex auditory properties of speech without triggering speech percepts. We found that simple words activate bilateral temporal regions, anterior and ventro-lateral to the primary auditory cortices. Lexical processing was significantly more left-lateralised for morpho-phonologically complex words. Both the presence of potential embedded stems and inflectional affixes activated the left inferior frontal gyrus, and words with embedded stems also activate its RH homologue. The results confirm that morpho-phonological complexity of spoken words crucially influences the response of the fronto-temporal language processing network. We discuss the findings in terms of structural processing demands due to stem competition and affix decomposition processes.

E 66

N100 AND P300 RESPONSES TO NATIVE AND NON-NATIVE VOWELS IN LATE BILINGUALS *Paula Garcia, Karen Froud; Teachers College, Columbia University* – This study examines the perception of the English vowel contrast /i/ vs. /I/ by native Spanish speakers. Only one of the vowels (/i/) occurs as a phoneme in Spanish. Speech perception studies have revealed that perception of foreign vowels is influenced by the phoneme categories in the native language. Some native Spanish speakers find it difficult to discriminate /i/ and /I/, and they often report identifying both vowels as a single Spanish vowel. In two auditory oddball paradigms, participants were asked (a) to ignore binaurally presented English vowel sounds /i/ and /I/, spoken by different speakers (3 male, 3 female) and watch a silent movie while EEG was recorded; and (b) to attend to the vowels and decide, trial-by-trial, which of the two was being presented. There were no differences in responses to the different speakers, in any condition. Event-related potential analyses revealed a more anterior N100 response to the native than the non-native vowels in the non-attentional condition, though there was no significant amplitude difference between the two (hence, no mismatch negativity effect). This pattern of responses may be consistent with previous research showing that activation of the auditory what stream is involved in analysis of phonological features of the speech stream. In the attentional condition, the P300 showed increased amplitudes in response to the non-native vowels when compared to the native vowels; this amplitude difference was not seen in native English-speaking controls, and may provide an index of allocation of additional attentional resources to a less familiar sound.

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INDIVIDUAL DIFFERENCES IN THE ROLE OF THE RIGHT HEMISPHERE IN CAUSAL INFERENCE COMPREHENSION: AN FMRI INVESTIGATION *Chantel Prat, Robert Mason, Marcel Adam Just; Carnegie Mellon University* – Inferential processes are necessary and prevalent in discourse comprehension. Neuroimaging studies have shown that the right hemisphere (RH) plays an important role in inference generation and integration. Recent research suggests that the role of the RH in discourse processes varies as a function of individual reading skill (Prat, Long & Baynes, in press). In the current fMRI experiment, individual differences in the neural underpinnings of causal inferencing were examined. 18 Carnegie Mellon undergraduates read a total of 40 two-sentence passages. There were 4 conditions, resulting from the orthogonal manipulation of causal distance between sentences (moderate versus distant) and connective word cues (presence or absence of a clause connective like therefore), with 10 passages of each type. Consistent with previous research, greatest RH activation was observed for moderately related sentences. Presence of a clause connective interacted with causal distance, causing decreased RH activation in the moderate conditions and increased RH activation in the distant conditions. Individual differences analyses were conducted, focusing on the moderately related passages with no connectives which consistently elicited RH activation. Reliable negative correlations with Nelson-Denny Reading Test scores were observed in right superior temporal, inferior frontal, and middle frontal gyri. Specifically, individuals with lower reading skill recruited RH homologues of left hemisphere (LH) language areas to a greater extent than did individuals with higher reading skill. No reliable correlations with skill were observed in the LH. These findings extend previous behavioral research suggesting that the role of the RH in discourse processes is modulated by reading skill.

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CONCRETENESS EFFECT IN BILNGUALS: AN ERP STUDY *Alexandra Geyer, Phillip Holcomb; Tufts University* – Our previous ERP studies, involving monolingual participants, suggested dissociation between the processes/representations of words referring to concrete concepts (e.g., truck) and abstract concepts (e.g., thought). Specifically, concrete words elicited a larger, more anterior N400 distribution that, arguably, reflects activity in imagistic processes which are activated by concrete words and pictures. This finding strongly supports multi-representational/processing models, which assume that there are at least two different types of semantic representational systems (linguistic and imagistic) and that the concreteness advantage is due to concrete words tapping knowledge in both systems, while abstract words tapping primarily knowledge in the linguistic system (Paivio, 1986). In the present experiment, we set out to examine whether the same dissociation between concrete and abstract word representations will be present in moderate proficiency bilinguals' second language (L2). Participants performed a concreteness judgment task in two blocks to ensure semantic processing of all words. Our results revealed that, overall, ERPs elicited by L1 words were more negative than ERPs elicited by L2 words. In addition, the N400 component elicited by concrete L1 words starts about 50ms earlier than the N400 component elicited by concrete words in L2. Likewise, the P3 component, likely reflecting the concreteness decision process, started later for L2 than for L1. Our results replicated our previous results in that in L1, concrete words elicited a more anterior N400 distribution compared to abstract words. Importantly, these differences were also seen in L2. The findings will be discussed in terms of recent models of bilingual memory.

E 69

MECHANISMS UNDERLYING SPEECH COMPREHENSION UNDER ADVERSE LISTENING CONDITIONS: BEHAVIOURAL AND FUNCTIONAL NEUROIMAGING DATA *Jonas Obleser[1], Richard J.S. Wise[2], Sophie K. Scott[1]; [1]Institute of Cognitive Neuroscience, University College London, UK, [2]MRC Clinical Sciences Centre, Hammersith Hospital, London* – Speech comprehension is supported by both acoustic signal decomposition and semantic context. We report results from behavioural as well as event-related fMRI studies that look at the psychoacoustic and neural correlates basis of this interaction with two speech manipulations, one acoustic (parametrically varied spectral degradation of the speech signal using noise vocoding) and one linguistic (semantic predictability of the signal). Behaviourally, a quasi-linear increase in comprehension with more spectral detail available was observed amongst low-predictability sentences. In contrast, predictability was most effective on intermediate signal degradation levels (8-band noise vocoded speech). High semantic predictability here led to a ~40% increase in sentence comprehension compared to low semantic predictability in two different experiments. In the fMRI analysis, we therefore directly compared high- to low-predictable speech at intermediate 8-band signal quality and found strikingly left-hemispheric activity increases in the angular gyrus, medial and lateral prefrontal cortex, and the posterior cingulate gyrus. Functional connectivity between these regions appeared also increased, particularly with respect to the left angular gyrus. In contrast, activity in both superior temporal sulci and the left inferior frontal gyrus correlated with the amount of spectral detail in the speech signal, irrespective of predictability. These results demonstrate that the involvement of high-order cortical areas, remote from auditory cortex, and their enhanced functional connectivity facilitate speech comprehension when the clarity of speech is reduced. (supported by Wellcome Trust, UK; MRC, UK; Landesstiftung Baden-Wuerttemberg gGmbH)

E 70

HESITATION HELPS, BUT LISTENERS STILL HAVE WORK TO DO: AN ELECTROPHYSIOLOGICAL INVESTIGATION INTO REPAIRS IN SPEECH *Lucy MacGregor[1], Martin Corley[1], David Donaldson[2]; [1]University of Edinburgh, [2]University of Stirling* – Speakers sometimes revise their speech mid-utterance, occasionally including a hesitation such as "er" at the interruption point between the reparandum (material to be replaced) and the repair. Do repairs cause processing difficulty for listeners? Does an "er" separator affect the ease of processing such a construction? Participants (n=24) listened to utterances which were either fluent, or contained a repair comprising two consecutive verbs [e.g. Even though I hadn't seen him school I [recognised] REMEMBERED him straight away]. Half the utterances contained an "er" before the critical word [e.g. Even though I hadn't seen him since school I [recognised] – er – REMEMBERED him straight away]. EEG was recorded and ERPs formed relative to critical word onsets. We focused on ERPs for repair words relative to identical words in fluent utterances and compared effects for utterances with and without an "er" before the critical word. For utterances without an "er", repairs elicit an early (250-650ms) anterior-frontal negativity which we suggest reflects detection of a syntactic violation. The negativity is followed (650-850ms) by a bilateral, centro-parietal/parietal positivity, which we interpret as a P600 reflecting syntactic reanalysis or integration difficulty. For repairs preceded by an "er" there is no indication of early negativity. However, there is an early onsetting, sustained centro-parietal/parietal positivity (250-850ms) which is topographically identical to the later positivity observed for fluent utterances. We suggest that hesitation prepares listeners for a possible non-syntactic input, but does not reduce the cost associated with syntactic reanalysis.

E 71

SPEAKING WORDS IN THE SECOND LANGUAGE: FROM SEMANTICS TO PHONOLOGY IN 170 MILLISECONDS *Taomei Guo, Danling Peng; Beijing Normal University, Beijing, China* – The present experiment is designed to investigate the time course of semantic and phonological retrieval during the second language production by using the ERP technique. During the experiment, 15 Chinese-English bilinguals were required to name pictures in their second language. Before performing this task, they had to carry out a dual choice GO/NOGO task based on semantic information (i.e., whether the picture was of an object or an animal) and phonological information (i.e., whether the picture's English name starts with the letter C or F). During the time window of 200-700 ms after stimulus onset, nogo trials generated a more negative ERP profile relative to go trials. A clear-cut N200 was obtained from their difference waves. Overall, the latency of N200 elicited by semantic information is earlier than that by phonological information. This is consistent with many previous findings obtain in monolingual studies, and supports the common viewpoint of the discrete two-step theory and the interactive activation model. These findings suggest that the semantic information is also encoded earlier than the phonological information during the second language production.

E 72

PROCESSING PRONOUNS WITHOUT ANTECEDENTS: EVIDENCE FROM EVENT-RELATED BRAIN POTENTIALS. *Ruth Filik, Anthony Sanford, Hartmut Leuthold; University of Glasgow* – Pronouns that occur without an explicit referent in the prior context are typically difficult to process. We investigate a specific case, in which the plural pronoun 'they' has no explicit referent, yet causes no apparent problems, as in 'On the flight, they served really bad food'. Some unspecified set of individuals, ('the stewardesses', or 'the airline') can be inferred as being the referent of 'they', but it is not crucial to determine who specifically is being referred to. Using ERPs, along with word-by-word visual presentation, we investigated how readers process the pronoun in these cases. The pronoun 'they' appeared in contexts that either did or did not contain an explicit referent (e.g., 'the stewardesses'). We compared this to the processing of singular pronouns ('he' or 'she'), for which it is necessary to determine a specific referent. For example, 'On the flight, she served really bad food', in a context that either did or did not mention 'the stewardess'. There were two key findings. Firstly, when the pronoun had no explicit referent, a larger frontocentral positivity was observed 750ms after pronoun onset for 'he/she' than 'they', reflecting the additional difficulty involved in establishing a referent for 'he/she' than for 'they' when no explicit referent is available. Secondly, 'he/she' evoked a larger N400 than 'they', regardless of whether or not there was an explicit referent for the pronoun. This finding adds to a growing body of research suggesting fundamental differences in the way these pronouns are handled by the language processor.

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AUTOMATICITY OF WORD LEVEL SKILLS IN CHILDREN WITH READING COMPREHENSION DEFICITS DESPITE NORMAL WORD READING SKILLS *April Materek[1], Anna Khizanishvili[1], Laurie Cutting[1,2,3]; [1]Kennedy Krieger Institute, [2]Johns Hopkins University, [3]Johns Hopkins School of Medicine* – In order to become a skilled reader, accurate as well as fast and automatic single word reading must be attained; however, some students present with reading comprehension deficits (RCD) despite purportedly having normal word reading accuracy (RCD/NWR). Few studies have comprehensively examined the speed and automaticity of word-level skills in RCD/NWR. In this study, sixty-five children (26 RD, 30 Control, 9 RCD/NWR), ages 10 to 14, completed the Test of Word Reading Efficiency (TOWRE) as well as various lexical decision measures, including automaticity measures requiring divided attention. Results indicated that children with RCD/NWR read just as quickly and accurately as Controls, even on measures of automaticity, and that both Controls and RCD/NWR read isolated words at a faster rate than RD participants. The aforementioned results suggest that deficits in children with RCD/NWR stem from factors other than word-reading skills.

E 74

EFFECTS OF CORTICAL LANGUAGE LATERALIZATION ON THE LATERALIZATION OF THE VISUAL WORD FORM SYSTEM *Qing Cai[1], Michal Lavidor[2], Marc Brysbaert[3], Yves Paulignan[1], Tatjana A. Nazir[1]; [1]Institut des Sciences Cognitives, Bron Cedex, France, [2]University of Hull, UK, [3]University of London, UK* – The present ERP-study was aimed at clarifying to what extent language lateralization and visual expertise affects perception of laterally displayed words. We did so by analyzing performance of readers (Latin alphabet) that were either left or right hemisphere-dominant for language. The results showed that: (I) Visual field effects during word recognition differed between right hemisphere (RH) and left hemisphere (LH) dominant participants, indicating that language organization in the brain has a significant impact on the way words are recognized. (II) While in LH dominant readers the N1 topography was characterized by a left lateralized occipito-temporal negativity, in RH dominant readers the N1 topography was characterized by a right lateralized occipito-temporal negativity. Since the left lateralized occipito-temporal negativity had been interpreted as electrical signature of the visual word form area (VWFA) activity, the VWF system seems thus to develop in the language dominant hemisphere. (III) Despite the mirror reversed VWF system in the two populations, visual field effects in word recognition were not mirror reversed. This indicates that other factors than cortical language lateralization modulate the way laterally displayed words are recognized.

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ELECTROPHYSIOLOGICAL CORRELATES OF REFERENCE PROCESSING AT THE SENTENCE LEVEL *Manfred F. Gugler, Sonja Rossi, Angela D. Friederici, Anja Hahne; Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* – Referential connections within a sentence define the relations between different sentence units. Previous studies investigated referential processes mostly within a discourse context. The present study aimed to monitor reference processing at the sentence level and embedded within syntactically anomalous sentences. Thus, the study directly investigated in a within-subject comparison German word category violations embedded in sentences with and without a reference structure. Reference is achieved by adding a prepositional phrase immediately following a referent, in this case the subject noun. Thus the prepositional phrase directly refers to / specifies the preceding referent. In sentences without a reference structure, on the other hand, the prepositional phrase does not follow the referent and therefore does not directly refer to it. 25 participants listened to the acoustically presented sentences and performed a judgement task while the EEG was recorded. The event-related brain potentials (ERPs) averaged on the verb revealed regarding the word category violation compared to correct sentences an anterior negativity reflecting phrase structure building processes and a P600 indicating processes of reanalysis in both sentences structures. However, only in sentences with a reference structure, an additional negativity was present. Thus, this negativity may reflect disturbed referential integration processes between the referent and the prepositional phrase due to the omission of a highly expected noun. Further the present study could show in a within-subject comparison that reference-related processes do not only occur at the discourse level but play an important role also within a single sentence.

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GAMMA-BAND RESPONSE TO AUDITORY STIMULI OF VARYING TEMPORAL COMPLEXITY. A STUDY IN HEALTHY ADULTS. *Sonja Rossi, Isabell Wartenburger, Susanne Passow, Silke Telkemeyer, Till Nierhaus, Hellmuth Obrig; Charité University Medicine, Berlin, Germany* – Extraction of temporal and spectral information from complex auditory material requires differential specialization of the processing neural ensemble (Zatorre et al., 2002). In accord with this principle studies have demonstrated a superior ability of the left hemisphere for detection of rapid temporal transitions while the right hemispheric auditory pathway may be superior in processing slowly varying segments and spectrally complex stimulus properties (Boemio et al., 2005; Schönwiesner et al., 2005). Here we investigate this very issue by means of EEG, exploiting the potential of gamma-band analysis. The study investigates the neural predisposition for the interhemispheric specialization of language processing, since it is well known that linguistic input contains information in different time domains: While transitions between formants require rapid sampling, syllables or prosodic aspects are processed on a much slower time scale. This most likely founds the strong lateralisation of specific aspects of language processing (Wartenburger et al., 2006). In the present study we presented slowly (transitions > 100 ms) and fast modulated acoustic stimuli (transitions < 50 ms) (stimuli were taken from Boemio et al., 2005) while the EEG were recorded. Our preliminary data indicate an increase in transient gamma band activity for fast modulated stimuli. This may suggest that the gamma band reflects the neuronal activity in secondary auditory cortices relevant to normal language processing, the latter involving fast input variations. We currently investigate the lateralisation since formant transitions should require faster sampling when compared to prosodic aspects.

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LEARNING NOVEL WORDS: AN FMRI STUDY EXAMINING MODULATIONS IN ACTIVATION RELATED TO WORD FAMILIARITY *Amy Clements-Stephens[1], Pooja Gaur[1], April Materek[1], Laurie Cutting[1,2,3]; [1]Kennedy Krieger Institute, [2]Johns Hopkins University, [3]Johns Hopkins School of Medicine* – Studies have examined how the brain responds to various types of word stimuli. One area that has been of increasing interest is an area in the left fusiform gyrus, often referred to as the "visual word form area" (VWFA), which has been hypothesized to be important for word recognition. While some have suggested that this area is important for word recognition because it subserves pre-lexical processing, others have hypothesized that this area is sensitive to the familiarity of words, with greater activation associated with less familiarity. To examine this issue, 10 adult normal readers learned to attach meaning to pseudowords via two different training methods. Modulations in signal activity in response to trained pseudowords, untrained pseudowords (which matched the trained pseudowords in terms of syllable type, consonant clusters, etc), and high and low frequency words were then measured via functional magnetic resonance imaging (fMRI). The highest mean activation was for the most unfamiliar words (untrained pseudowords), followed by low frequency words, trained pseudowords, and high frequency words. Results also indicated that while the activation associated with trained pseudowords was not significantly different than for words (high and low frequency), it was significantly lower than for untrained pseudowords ($p < .03$). Additionally, untrained pseudowords showed significantly more activation than high frequency words ($p < .01$), but not for low frequency words. Results suggest that the VWFA is sensitive to word familiarity.

E 78

OBSERVING AN ANIMATED TONGUE SLIP. *Iemke Horemans[1], Niels O. Schiller[2,1]; [1]Maastricht University, The Netherlands, [2]Leiden Institute for Brain and Cognition, The Netherlands, Maastricht University, The Netherlands* – Observing others is regarded as an important way of learning. Another way to learn is by making errors and consequently adjust the system to not make the same error again. This also holds for errors made by others. The current event-related potential (ERP) study examined the processes involved in detecting speech errors made by others. Participants viewed animations of a dot moving through a network. Simultaneously, they listened to a description of the path of the dot. The descriptions were recorded during a previous experiment in which participants were asked to describe the path of the dot. Each network consisted of eight colored line drawings that were connected to each other with straight or curved lines. Participants were asked to press a button whenever they detected a speech error in the network description. The speech errors studied were color (e.g., rode tafel instead of groene tafel), determiner (e.g., het stoel instead of de stoel) and direction errors (e.g., naar boven instead of naar onder). Both color and direction errors elicited, after the acoustic onset of the error, a centro-parietal negativity around 300 ms and a centro-parietal positivity around 800 ms. However, the determiner errors elicited a fronto-central negativity around 300 ms after the acoustic onset of the error. These data show that processes involved in detecting determiner errors differ from processes involved in detecting color and direction errors. This might implicate that the speech monitoring system is a specialized system which might play an important role in observational learning.

E 79

EFFECTS OF STRESS AND CONTEXT ON VERBAL SELF-MONITORING *Lesya Ganushchak[1], Niels O. Schiller[2,1]; [1]Maastricht University, The Netherlands, [2]Leiden Institute for Brain and Cognition, The Netherlands* – During speech production, in order to prevent or correct errors we continuously monitor what we say. In stressful circumstances when making a speech error has more severe consequences, e.g., giving a talk during conference vs. casual conversation, it is plausible to assume that a verbal self-monitor must work harder in order to prevent errors. In the current event-related-potential (ERP) study, we used the semantic blocking paradigm to investigate whether stress affects participant's performance and measured the Error Related Negativity (ERN). The semantic blocking paradigm manipulates the context in which pictures to be named appear. Participants were required to name pictures that appear in semantically related blocks (e.g., table, chair, and closet) and semantically unrelated blocks (e.g., table, apple, and car). We have shown that the stress manipulation had no effect on error rate; however, the amplitude of the ERN increases in the stress condition, compared to the no stress condition. This indicates that the monitor was more active in the stress than no-stress condition. Furthermore, participants showed semantic interference effects and made more errors while naming semantically blocked pictures. Interestingly, the amplitude of the ERN observed after overt speech errors was also larger during semantically related than semantically unrelated blocks. We suggest that semantically related blocks led to more conflict between possible responses, thereby increasing reaction time and the amplitude of the ERN.

E 80

LANGUAGE AND ACTION: COMMON NEURAL SUBSTRATES FOR ACTION WORD PROCESSING AND MOTOR CONTROL *Véronique Boulenger, Alice C. Roy, Beata Y. Silber, Yves Paulignan Marc Jeannerod, Tatjana A. Nazir; Institut des Sciences Cognitives CNRS/UCBL, Bron, France* – Recent studies demonstrate that aspects of language understanding rely on the sensori-motor system. The present aim determined whether processing of action words engages cortical areas that are also involved in motor control, and evaluated the role of these regions in word retrieval. The first experiment employed electrophysiological and kinematics measures to assess the influence of subliminal presentation of action verbs and concrete nouns on the simultaneous preparation of a reaching movement. Twenty-five, right-handed, French native speakers completed one session. Results revealed that, compared to nouns, the readiness potential amplitude decreased significantly when action verbs were presented. The kinematics results substantiated this, as wrist acceleration peak amplitude reduced following an action word compared to a noun. This indicates that unconscious perception of action verbs interferes with the preparation and execution of a movement. The second experiment evaluated the role of the motor system in action word processing, by comparing masked repeated priming effects for nouns and verbs in patients with Parkinson's Disease (PD), using a lexical decision task. Ten PD patients completed two sessions (with and without L-Dopa treatment); 10 controls completed one session. The results showed that while priming effects for nouns were similar for patients (irrespective of treatment) and controls, no priming effect for action verbs in patients deprived of treatment was found. However, with L-Dopa, priming effects for action words were similar to controls. In conclusion, action word processing and motor action share common neural substrates, and motor cortical regions appear to contribute to action word processing.

E 81

LANGUAGE COMPREHENSION IN PATIENTS WITH APHASIA IS AMELIORATED BY TEMPORAL-PROCESSING TRAINING *Elzbieta Szelag[1,2], Aneta Szymaszek[1], Monika Lewandowska[1], Joanna Seniow[3], Martina Fink[4], Pamela Ulbrich[4], Jan Churan[4], Marc Wittmann[4]; [1]Nencki Institute of Experimental Biology, Warsaw, Poland, [2]Warsaw School of Social Psychology, Warsaw, Poland, [3]Institute of Psychiatry and Neurology, Warsaw, Poland [4]Generation Research Program, Ludwig-Maximilian University, Bad Tölz, Germany* – Experimental studies have reported a close association between temporal information processing and language comprehension. Language-learning impaired (LLI) children and brain-injured patients with aphasia show elevated thresholds in the detection of temporal order (TO) as compared to control subjects. The present study aimed at improving auditory speech comprehension (ASC) in aphasics with a specific training in TO perception. We tested 25 patients having deficits in both ASC and the perception of TO. ASC was assessed employing phoneme discrimination tests on the word and the sentence level as well as using the Token Test. The TOT was measured in two conditions using either two 1ms clicks presented monaurally one to each ear or two 10 ms tones (400, 3000Hz) presented binaurally. All patients who displayed elevated TOTs in comparison to healthy controls participated in eight 45-minutes sessions of the specific temporal training aimed to improve the perception of sequencing abilities, or they participated in a non-temporal control training (n=7) on volume discrimination. The temporal training yielded an improvement in TO perception in both the click and the tone conditions. Moreover, a transfer of improvement was observed from the time domain to the language domain, which was untrained during the training. The control training did not improve either the perception of TO or ASC in any language tests. These results are in agreement with previous studies from the literature which proved ameliorated ASC following the temporal training in LLI children.

E 82

EVENT-RELATED POTENTIAL STUDY OF ANAPHORIC RESOLUTION IN SENTENCES AND DISCOURSE *Veena A. Nair, Amit Almor, Jennifer M. C. Vendemia; University of South Carolina* – We examined ERP waveforms underlying the processing of repeated name and pronoun anaphors in sentences and discourse using the 128 channel "Geodesic sensor net". Previous behavioral studies have shown that repeated proper name reference to a previously mentioned salient entity leads to increased reading times (the repeated name penalty) relative to a non-repetitive or pronoun reference to the same entity. Antecedents were either single noun phrases (NPs) as in "John finished exam and John/he went to the movies" or part of conjoined NPs as in "John and Mary finished exams and John/he went to the movies". Replicating the results of an earlier study by Swaab et al. (2004) we found a larger N400, in the sentence condition, in response to repeated name anaphors when the antecedent was a single NP than when it was part of a conjoined NP. In contrast, with discourse items, we found a larger N400 in the conjoined NP relative to the single NP condition. We also found larger anterior negativity for discourse than sentences and for conjoined NPs than for single NPs. The difference between the N400 response to sentence and discourse items accompanied by the anterior negativity suggest that the increased N400 reflects the difficulty in antecedent identification that precedes the integrative discourse processes underlying the repeated name penalty.

E 83

PROSODY AND INFORMATION STRUCTURE: AN FMRI STUDY *Tessa van Leeuwen, Monique Lamers, Karl Magnus Petersson, Carlos Gussenhoven, Toni Rietveld, Benedikt Poser, Peter Hagoort; Radboud University Nijmegen, Nijmegen, the Netherlands* – Words in spoken language contain semantic, syntactic and phonological information, for each of which knowledge is retrieved from memory and then dynamically unified during sentence comprehension (Memory-Unification-Control model, Hagoort, 2005). Here, we focus on prosody and its contribution to sentence information structure. In Dutch, new information in a sentence (the focus) generally receives prosodic emphasis (an accent), while given information does not. The contribution of prosody to information structure depends on the way lexical items are combined into larger structure; therefore we refer to this as phonological unification. In our fMRI study, subjects listened to two grammatical sentences that each described an object on the screen. The second object differed from the first in either shape (shape-word focus) or colour (colour-word focus). In the second sentence the accent was on the focus-word (focus-accent agreement) or on a non-focus word (focus-accent disagreement). Stimuli were presented while the scanner was silent to avoid acoustic interference. Preprocessing and data analysis were performed with SPM2 and time-locked to critical word onset. We hypothesized that in the focus-accent disagreement condition phonological and also semantic unification of the sentences require more effort due to the incorrect prosodic accent in the sentences. Indeed, when contrasting focus-accent disagreement with focus-accent agreement we find stronger activation in BA 47 (semantics) in the anterior left inferior frontal gyrus (LIFG) and in BA 6/9 (phonology) in posterior LIFG. Manipulating prosody thus leads to a higher load for phonological as well as semantic unification, illustrating the parallel nature of unification.

E 84

BRAIN LESION ANALYSIS OF AUDITORY COMPREHENSION IN PEOPLE WITH APHASIA *Jeffrey Solomon[1], Whitney Anne Postman[2], Therese Kling[3], Allen Braun[2]; [1]Medical Numerics, Inc., [2]National Institute of Deafness and Other Communication Disorders, National Institutes of Health, [3]University of Maryland* – It is hypothesized that independent brain regions subserve lexical and syntactic processing and that these processes can be differentially disrupted by brain damage (Vermeulen, 1982). In our study, 32 subjects with left hemisphere stroke-induced aphasia received MRIs and were given auditory comprehension tasks from the WAB, PAL and PALPA batteries. Specific tasks from these batteries were selected to assess lexical and syntactic processing. Summing across all subjects, the brain lesions affected the entire MCA territory. We developed the Analysis of Brain Lesion (ABLe) software to delineate the lesions, spatially normalize the MRI brains and perform voxel-based lesion-symptom mapping (Bates et al, 2003). We incorporated the Automated Anatomic Labeling (AAL) brain atlas (Tzourio-Mazoyer et al, 2002) to determine brain regions putatively causing deficit in an automated fashion. Our goal was to use a data-driven method to find areas common to all auditory comprehension tasks and to differentiate areas associated with lexical versus syntactic processing. Our results indicate the following gyri correlated with deficit in all auditory comprehension tests: middle frontal, precentral, postcentral, inferior and superior parietal, angular, supramarginal, and middle occipital. The following areas were found to be associated with lexical but not syntactic tests: superior frontal, middle and inferior frontal orbital, inferior frontal triangular, superior temporal pole and insula. The middle temporal gyrus was associated more with deficits in syntactic processing. Our findings confirm some areas commonly associated with auditory comprehension and suggest overlap as well as uniqueness to the neural substrates underlying lexical and syntactic processing.

E 85

SEEKING THE NEURAL BASIS OF THE LEFT HEMISPHERE SUPERIORITY FOR READING USING MEG *Laura Barca[1,2], Uzma Urooj[1], Michael Simpson[1], Andrew W. Ellis[1]; [1]York Neuroimaging Centre (YNiC), University of York, York, UK, [2]Institute for Cognitive Science and Technologies, ISTC-CNR, Rome, Italy* – Words are recognised more quickly and more accurately when presented to the right of a central fixation point than when presented to the left. The most common explanation of this effect is based on the assumption that words presented in the right visual field (RVF) are projected initially to the left hemisphere (which is dominant for language in most right-handers) while words presented in the left visual field (LVF) are projected to the right hemisphere and must be transferred across the corpus callosum to the left hemisphere for identification. That process of identification is thought to involve the 'visual word form area' (VWFA) in the left mid fusiform gyrus. Cohen et al. (2002) found stronger BOLD responses in the VWFA to words in the RVF than in the LVF. The present study used magnetoencephalography (MEG) to investigate the spatiotemporal evolution of cortical activity during the processing of words and scrambled words presented 1.5° from fixation in the LVF or RVF. Synthetic Aperture Magnetometry (beamforming) was used to localize changes in power within selected frequency bands as a function of time. We then used virtual electrode analysis to interrogate the time-frequency behaviour within regions of interest to brain responses to words and patterns and to better understand the neural basis of the left hemisphere superiority for visual word recognition.

Perceptual Processes: Auditory Processing

E 86

SOUND DURATION PROCESSING IN HUMAN AUDITORY CORTEX OF AGING ADULTS *Joel S. Snyder[1], Bernhard Ross[2], Kelly McDonald[2], Rotman ReMeaghan Aalto[2], Bruce A. Schneider[3], Claude Alain[2]; [1]VA Boston Healthcare System/Harvard Medical School, [2]Rotman Research Institute, Baycrest Centre, Toronto, [3]University of Toronto, Mississauga* – Processing temporal changes in sound of brief duration is important for phoneme discrimination. Deficits in temporal processing may underlie age-related speech-processing problems. In the present study, we examined the effects of age on processing brief sound durations. To observe temporal processing in primary and secondary auditory cortex, we recorded middle- and long-latency auditory evoked fields (AEFs) using magnetoencephalography while young, middle-aged, and older adults were presented with pure tones of varying duration (34, 46, 64, and 76 ms). During the recordings, participants were asked to ignore the stimuli and watch a muted subtitled movie of their choice. For each participant, the AEFs were modeled with a pair of dipoles in the superior temporal plane and the effects of sound duration and age on the amplitude and latency of the resulting source waveforms of cortical activity were examined. For the middle-latency AEFs, sound duration had little effect on amplitude or latency. For the long-latency AEFs, increasing sound duration was paralleled by a decrease in P2 amplitude and this effect was comparable in all three age groups. Middle- and long-latency AEFs were delayed in older than in younger adults. Moreover, middle- (i.e., Pa wave) and long-latency (i.e., P1 wave) AEPs amplitude increased with age. This observed age-related increases in amplitude might be partly related to inhibitory deficits occurring at different relays along the ascending auditory pathway and in auditory cortex. These data demonstrate preserved auditory temporal encoding in auditory cortex of normal aging adults.

E 87

HUMAN INTRACRANIAL INVESTIGATION OF AUDITORY P2 GENERATORS *Pejman Sehatpour[1], Sophie Molhol[1], Theodore Schwartz[2], Ian Fiebelkorn[1], Ashesh Mehta[2], John Foxe[1]; [1]Nathan Kline Institute, [2]Weill Cornell Medical College* – The auditory P2 component is a positive peak in the auditory evoked potential (AEP) occurring between 150-300 ms post stimulus onset. It shows a dipolar scalp distribution with the positivity at the vertex. The P2, and the underlying neural processing it represents, is important because it has been implicated in functions such as the conscious perception of sounds, musical expertise, speech sound training, and study of auditory system maturation and short-term plasticity. To date, the underlying generators of the P2 have only been estimated from scalp-recorded data and the precise cortical loci are not yet established. Nonetheless, a pair of locations in the supratemporal plane, and bilateral temporo-parietal cortices have been implicated in its generation. Other studies have described the N1-P2 as a functional complex with common generators. Here, using human intracranial recordings we directly characterized the generators of the N1 and P2 components. Patients with intractable epilepsy were presented with 1000 Hz tones of 60 ms duration while recordings were made from 64 to 128 subdural electrodes. Both common and distinct generators for the N1 and P2 AEP components were found. P2 generators were found in both the prefrontal and anterior temporal cortical regions.

E 88

NEURAL CORRELATES OF DYNAMIC ATTENDING TO SYNCOPATED RHYTHMS *Theodore Zanto[1], Heather Chapi[1], Edward Large[1], Scott Kelso[1], Fred Steinberg[2]; [1]Florida Atlantic University, [2]University MRI* – We conducted a study to evaluate the role of attending in the perception of syncopated rhythms. Sixteen participants were tested behaviorally to determine their ability to tap the beat of ten highly syncopated patterns. Participants returned for one EEG and one fMRI session. In these sessions, they were instructed to attend to a syncopated pattern, mentally rehearse the pattern during a retention interval, and then reproduce the pattern. During a control condition, subjects heard the rhythmic patterns, however, they were instructed to study a list of words, remember the words during the retention interval, and then recall as many words as possible. We measured evoked beta-band and gamma-band activity while participants attended and ignored the rhythmic patterns. Evoked activity anticipated the beat of the rhythm in both conditions, however power was attenuated when ignoring the rhythmic stimulus. Functional brain activation was observed in the right medial frontal gyrus (BA 9) and anterior cingulate gyrus (BA 32) when attending, versus ignoring, the rhythmic patterns. Implications for dynamic allocation of attention are discussed.

E 89

AUDITORY EVOKED POTENTIALS TO INTERAURAL TIME DIFFERENCES IN 500 AND 4000 HZ CLICK TRAINS. *Ilse Wambacq, Faith Parker, Lauri Romei, Joan Besing, Janet Koehnke; Montclair State University* – This study was designed to measure auditory evoked potentials (AEPs) in response to interaural time differences (ITDs) in 500 and 4000 Hz click trains. Adults with normal hearing listened under earphones to octave-band filtered click trains at 500 and 4000 Hz. The trains included five, 1-ms clicks, separated by 9 ms silent intervals. The standard stimulus was a diotic 50 ms click train. Stimuli were presented in a passive oddball paradigm. There were two target stimuli; one was a dichotic, 50 ms click train with a 0.9 ms interaural time difference (leading to the left ear), and the other was a diotic, 50 ms click train that was frequency-shifted by 15% compared to the frequency of the standard stimulus. Separate runs were presented for each frequency (500 versus 4000 Hz) and target-stimulus type (ITD versus frequency-shift). Visual observation of the AEP waveforms of four adults shows amplitude differences between standard and target stimuli in AEP components between 80 and 400 ms post stimulus onset. In this time window, frequency related AEP differences are present with the 500 Hz stimuli evoking larger AEPs than 4000 Hz stimuli. Clear morphological differences are also observed in AEPs to ITD-targets versus frequency-shift-targets in all of the subjects. This suggests that AEPs reflect differences in processing of ITD and frequency-shift stimuli. Data collection is continuing; AEP analysis of ten subjects will be presented.

E 90

SPATIOTOPIC ORGANIZATION IN CORTICAL REPRESENTATION OF AUDITORY STIMULI *Santani Teng, David Whitney; University of California, Davis* – Localizing the source of sounds in space is a crucial function for navigating and internally representing our environment. Animal studies have described subcortical spatiotopic maps in owls and some mammals (e.g. Knudsen, 1982; Brugge et al., 1998). Lesion studies have also implicated mammalian auditory cortex in the localization of sounds (e.g. Jenkins & Merzenich, 1984); however, although afferent visual and somatosensory information is represented spatiotopically in cortex, no such map of auditory space has yet been described in humans. In this fMRI study, we scanned subjects while presenting pink-noise moving auditory stimuli to subjects through headphones. The stimuli simulated the effect of presentation from one of eight positions in a free-field environment and were calibrated individually to subjects' ears. Preliminary analysis indicates greater correlation between voxels reflecting BOLD response to adjacent or overlapping stimuli than voxels reflecting response to more spatially separated stimuli. In addition, spatially specific BOLD responses to frontal auditory stimuli were found in visual cortex, despite the absence of visual stimuli. The correlations suggest a measure of spatiotopic organization in the cortical representation of auditory stimuli.

E 91

MONOLINGUAL AND BILINGUAL CHILDREN'S BRAIN ACTIVATION IN VOWEL PERCEPTION *Nancy Vidal, Hia Datta, Tatiana Liisa Laine; The Graduate Center City University of New York* – We examined how monolingual English and bilingual Spanish-English, 8 -10 year old children allocate attention in discriminating American-English vowels using Event-related potentials (ERPs). Learning a first language is hypothesized to lead to greater automaticity in processing native language phoneme categories (Jusczyk, 1997; Bialystok 2004; Werker & Curtin, 2005; Strange 2006). ERPs were recorded to the /I/-/E/ contrast, which is phonemic in English and not Spanish, in an oddball paradigm designed to elicit the Mismatch negativity (MMN) and Late Negativity (LN). Targets interspersed among the vowels were used to manipulate attention in three conditions: a) ignore all sounds and watch a silent movie with close captions (Passive), b) press a button to the higher frequency of two tone targets (Tone Task) and, c) press a button to the /ba/ of two speech targets (Speech Task). Preliminary results indicate a robust

LN-like negative activity between 300 – 600 ms in the frontal channels that invert at the mastoids in all three experimental conditions and for both language groups. The only difference was that the bilingual group had a slightly smaller LN in the Speech Task than the monolingual group. The absence of a clear MMN in children around 200 ms, which we find in adults to these stimuli, suggests that speech processing of these stimuli under these conditions is difficult for them.

E 92

PRE-ATTENTIVE PROCESSING OF AUDITORY STIMULI: A HUMAN INTRACRANIAL STUDY OF MISMATCH NEGATIVITY GENERATORS FOR PHONEMIC AND NONPHONEMIC SOUNDS *Ian Fiebelkorn[1], Pejman Sehatpour[2], Pierfilippo De Sanctis[2], Thomas Thesen[3], Orrin Devinsky[3], Sophie Molholm[2], John J. Foxe[1,2]; [1]City College of New York, [2]Nathan Kline Institute, [3]New York University* – Hemispheric specialization of speech was first reported during the second half of the 19th century by Paul Broca and Karl Wernicke. The findings of these early lesion studies have since been confirmed by fMRI and PET imaging; however, the stage of auditory processing at which this hemispheric specialization first emerges is still the subject of investigation. The mismatch negativity (MMN), an event-related potential (ERP) component elicited by the disruption of a repeated auditory stimulus, has been used to investigate the pre-attentive processing of phonemic and nonphonemic sounds. Previous studies have hypothesized that speech stimuli elicit two MMNs in the left temporal lobe, one phonemic and one nonphonemic. Given the poor spatial resolution of scalp recordings, further evidence is needed to confirm or reject this hypothesis. Human intracranial recordings, which provide superior spatial resolution, offer a unique opportunity to investigate MMN generators. Here we use an oddball paradigm with stimuli developed by Liebenthal and colleagues (2005) to localize MMN generators for phonemic (familiar consonant-vowel syllables) and nonphonemic sounds (acoustically matched control sounds). Preliminary data suggest common MMN generators in the left superior temporal gyrus and the left inferior frontal cortex, two cortical locations previously reported by intracranial recordings to contribute to the MMN component. These data contradict earlier ERP studies that hypothesized separate MMN generators for phonemic and nonphonemic sounds. More data must be collected to explore the existence of additional MMN generators.

E 93

SPEECH-LIKE PROCESSING OF NONSPEECH SOUNDS FOLLOWING EXTENSIVE CATEGORIZATION TRAINING *James L. Keidel[1], Einat Liebenthal[2], Jeffrey R. Binder[2], Keith R. Kluender[1], Mark S. Seidenberg[1]; [1]University of Wisconsin-Madison, [2]Medical College of Wisconsin* – Many studies have attempted to address whether speech has a unique cortical representation, qualitatively different from other types of auditory information. However, direct comparisons of speech and nonspeech processing are confounded by participants' overwhelmingly greater experience with speech. Further, speech processing requires extensive abstraction over both intra- and inter-speaker variability to recover the intended message, in contrast to more general forms of auditory perception. To address these issues, we imaged participants using fMRI during ABX discrimination of speech and complex nonspeech sounds both before and after categorization training on the nonspeech sounds. During training (20 hrs. total), participants played a modified version of Tetris in which nonspeech stimuli (generated from filtered and spectrally rotated speech) provided information that players could use to improve performance. Contrast of pre- and post-training scans of nonspeech processing revealed recruitment post-training of a left-lateralized network comprised of both traditional auditory and speech processing areas as well as association cortices. These areas included foci in bilateral superior and middle temporal gyri, predominantly in the left hemisphere. Behavioral testing indicated that after training participants displayed speech-like processing for the nonspeech sounds such as reduced within-category discrimination. We suggest that, as in the parallel case of face and greeble perception, auditory expertise gained through experience leads to the development of a "specialized" neural network to process the trained sounds.

E 94

REPRESENTATION OF VOWEL SOUNDS IN POSTERIOR SUPERIOR TEMPORAL CORTEX *Adam Tierney, Marty Sereno; UC San Diego* – Imaging studies have consistently shown that listening to speech stimuli leads to activation of left posterior superior temporal cortex. The representation of information in this area and its role in speech processing, however, remain an open question. Based on the importance of the position of the first and second formants in distinguishing between different vowels, we hypothesized that posterior superior temporal cortex might contain a topographic map of the position of one or both of the first and second formants. To test this idea, we asked subjects in the fMRI scanner to listen to a series of computer-generated vowels and respond whenever they heard one of two English vowels. During the scans, the second formant was repeatedly ramped from 980 to 2260 (or vice versa) while the first formant varied randomly between 300 and 620. In order to detect activation associated with particular second formant values we computed the fourier transform of the time series at each vowel, compared the power at the frequency of the stimulus presentation to the power of the other frequencies, and painted the resulting data onto the reconstructed cortical surface. The phase angle of significant voxels, then, reveals the second formant value to which each was maximally responsive. The results show a region in the posterior superior temporal sulcus containing a range of different phases suggesting that a map of second formant position might exist there.

E 95

ENHANCING PERCEPTUAL LEARNING OF A PRACTICED TARGET TASK BY PRACTICING AN IRRELEVANT TASK *Beverly A. Wright, Andrew T. Sabin, Roselyn M. Wilson; Northwestern University* – Human adults can improve their ability to discriminate between stimuli with practice, indicating that sensory systems are not rigid, but rather can be changed through experience. In most cases, such improvements occur only if the to-be-learned (target) task is actually practiced. However, there has been no consideration of whether target-task performance is necessary throughout the entire course of training. Here we report evidence that it is not. We compared learning on a target auditory frequency-discrimination task across listeners who were trained with one of four regimens. In all cases, the training consisted of repeated threshold measurements, over 6-10 sessions on separate days, using an adaptive (3-down/1-up), two-interval forced-choice procedure with a 1-kHz pure-tone standard. Neither listeners who practiced the target frequency-discrimination task for 360 trials/session (n=8), nor those who practiced duration discrimination (a non-target task) for 900 trials/session (n=6) improved significantly more than untrained controls on frequency discrimination (p> .529). In contrast, listeners who practiced 360 trials of frequency discrimination immediately followed by 360 trials of duration discrimination in each session did (n=8; p=0.034). Showing that this learning enhancement on the frequency task due to practice on the duration task was time dependent, it did not occur in listeners who had a four-hour break between practicing the two tasks in each session (n=8; p=0.476). These results suggest that stimulus exposures associated with the trained target task can contribute to learning, even if a non-target task is being performed, as long as both tasks are practiced within a restricted time window.

E 96

THE RETURN FROM SYNCHRONY IN 40-HZ OSCILLATIONS IN HUMAN SENSORY SYSTEM *Bernhard Ross; Rotman research Institute, Baycrest Centre, Toronto, ON, Canada* – Oscillatory activity around 40 Hz in sensory systems is widely discussed in relation to feature binding and object encoding. 40-Hz oscillations are small in amplitude and difficult to extract from ongoing background EEG or MEG. However, large amplitude responses can be evoked with periodic stimulation at the rate of 40

Hz in visual, auditory, or somatosensory modality. We recorded 40-Hz auditory steady-state responses (ASSR) with MEG using 40-Hz amplitude-modulated sound presented binaurally at 60 dB above sensation level. Sources were localized with a pair of equivalent current dipoles in bilateral primary auditory cortices. The oscillatory brain activity was interpreted as strong representation of the auditory input at cortical level. The stimulus was modified by sudden changes in the interaural phase difference (IPD), which was perceived as change in the spatial characteristic of the sound. The IPD changes resulted in sudden decrease of the 40-Hz amplitude and return to full amplitude within 200 ms. The response phase shifted by about 90 degrees and returned also within 200 ms to the steady state. The ASSR phase response could even be observed close to the discrimination threshold for interaural phase differences below 1500 Hz. The data corroborated our previous findings that the ASSR could be reset by a concurrent stimulus. The results were interpreted as general mechanism of reset of synchrony in cortical networks induced by any change in the stimulus. The reset of synchrony resolves the problem of strong binding and allows detection of small changes in the auditory environment.

E 97

MODULATING COGNITIVE PERFORMANCE USING TRANSCRANIAL DIRECT CURRENT STIMULATION *Nora Schnider, Bradley Vines, Gottfried Schlaug; Music and Neuroimaging Lab, Harvard Medical School* – Previous studies have shown that transcranial direct current stimulation (tDCS) can modulate regional brain excitability which in turn may lead to behavioural and cognitive performance changes if the behavior/cognitive performance tested draws on the region being modulated. Neuroimaging and behavioral studies have implicated the left supramarginal gyrus (SMG) as a nodal point in the short-term storage of auditory material. We recently demonstrated that cathodal tDCS applied over the left SMG lead to a significant decline in accuracy in a pitch memory task which was not seen when cathodal tDCS was applied over the right SMG. In the present study we tested whether anodal tDCS applied over the left SMG would enhance performance in this pitch memory task. We controlled for the possibility of a general enhancing effect by using a visual memory task as control. The performance scores for the pitch memory task significantly improved after a period of anodal stimulation to the left SMG which was not seen after sham stimulation. This effect was specific for the pitch memory task and was not seen for the visual memory control task which performance did not significantly change. Furthermore, mood assessments were not significantly changed after anodal tDCS stimulation and can thus not explain the enhanced pitch memory effect. These results underscore the role of the left SMG in as a short-term auditory storage region. Furthermore, our experiments also demonstrate the potential of tDCS to positively influence behavioral and cognitive performance through modulation of regional brain excitability.

Perceptual Processes: High-Level Vision

E 98

THE N170 RESPONSE TO VISUAL WORDS IS LEFT-LATERALIZED AND EXPERIENCE-DEPENDENT IN BOTH JAPANESE AND ENGLISH *Urs Maurer, Jason D. Zevin, Eva Hulse, Bruce D. McCandliss; Weill Medical College of Cornell University* – Fast visual brain processes engaged in reading are indexed by an occipito-temporal negativity occurring between 150 and 200ms after stimulus onset (the N170). Left-lateralization of the N170 for word stimuli compared to visual control stimuli has been frequently observed and may be related to visual expertise. Cross-linguistic studies with Japanese and English provide an opportunity to study, whether left-lateralized N170 effects of visual expertise are modulated by other linguistic factors such as second-language learning and the consistency with which a script maps onto phonology. In Experiment 1, native Japanese speakers living in the U.S. and native English speakers participated in a one-back task with kanji and hiragana stimuli (Tanji et al., 2005). Whereas hiragana characters correspond consistently to a single phonological unit, this mapping is relatively arbitrary for kanji characters. The N170 was left-lateralized for native Japanese speakers compared to native English speakers, indicating an effect of visual expertise. This effect, however, was not further modulated by the consistency of the phonological mapping (kanji vs. hiragana). In Experiment 2, the same subjects viewed English words and visually matched symbol strings. A left-lateralized N170 for words compared to symbols was observed in both groups, indicating an effect of visual expertise. This effect was not further modulated by native language experience (English vs. Japanese). Taken together, the results suggest that left-lateralized specialization for visual words in the N170 is general across scripts that vary widely in their spelling-to-sound and spelling-to-meaning mappings and across scripts that are learned at different times in life.

E 99

EFFECTIVE CONNECTIVITY DURING VISUAL FEATURE BINDING *Christopher Summerfield, Etienne Koechlin; Ecole Normale Superieure, Paris* – A central problem in the cognitive neurosciences is how sensory information is integrated (the 'binding problem'). Some theories have proposed that visual binding occurs when new links are formed between feature-specific neurons within the visual cortices, whereas others argue that integration occurs between representations at higher levels, in the frontal or parietal cortices. These theories lead to opposite predictions about the flow of neural information between posterior and anterior association cortices during visual binding. We used dynamic causal modelling (DCM), a direction-specific effective connectivity analysis technique, to assess how extrastriate visual regions exchanged information with the prefrontal and parietal cortices during a task in which subjects selected targets on the basis of color, form, motion (1d condition) or a combination of these features (2d condition). Selecting information on the basis of 2 visual dimensions reliably enhanced bottom-up but not top-down interactions between the color-, form- and motion-sensitive regions and more anterior regions, relative to the 1d condition. These results offer support for a feedforward model of visual binding.

E 100

THE POSTMAN RINGS ONCE. MEASURING THE TIME COURSE OF FEAR RECOGNITION IN MOVIES *Corné van Heijnsbergen[1], Hanneke Meeren[1], Julie Grèzes[2], Beatrice de Gelder[1,3]; [1]Tilburg University, Tilburg, The Netherlands, [2]CNRS - Collège de France, Paris, France, [3]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, USA* – When the doorbell rings and we prepare to open we are primed for different kinds of encounters depending on who will be there. On some occasions the unexpected visitor inspires fear and loathing. On such occasions a rapid reaction is called for. The goal of this study was to measure how fast the brain reacts to the specific emotional content of an instrumental action like opening the door. The temporal aspects of processing dynamic emotional body actions were investigated in an EEG study using short video clips (920ms, 25Hz) of neutral and emotional (fear) instrumental actions. Video fragments were preceded by a 700ms neutral still image to avoid stimulus onset waveforms in the ERPs triggered at the onset of movement. After correction for basic visual features the condition-specific ERPs were analysed by paired t-tests at consecutive sample points. Enhanced amplitudes for fear were found at 190-230 ms after movie onset on occipito-temporal electrodes and from 300-900ms ms on occipito-temporal and centro-frontal electrode sites. The time window and topographical distribution of the earliest emotion effect corresponded to the ERP-component distribution associated with the N170 component, similar to what has previously been observed with still bodies (Stekelenburg & de Gelder, 2004; Meeren et al., 2005). The sustained effect, which is exclusive to dynamic stimuli, corresponded to a topographical N170/VPP-distribution. We argue that these sustained effects reflect prolonged neural activity elicited by the continuous stream of incoming dynamic information signalling fear which helps to trigger appropiate behavior in the observer.

E 101

NEURAL MECHANISMS OF "STRUCTURES FROM MOTION" PERCEPTION IN CHILDREN UP TO THE SCHOOL AGE *Peter Klaver, Janine Lichtensteiger, Thomas Dietrich, Thomas Loenneker, Ernst Martin; Children's University Hospital Zurich* — The visual detection of pattern and motion is a striking example of cognition-influenced perception. Motion information, following initial, local, directional analysis in brain area V1, undergoes higher-level processing. These processes may involve integration with other types of information. E.g., "structures from motion" processing must interact with shape-based information to enable the recognition of 3D rotating objects, and thus, participates in the integration of processing by brain areas that are specialized in shape detection. Tasks involving these different motion-based discriminations are known to activate distinct specialized brain areas in adults, including visual processing specialized areas in the occipito-temporal lobe and visuomotor processing related areas in the parietal lobule. Whether they do so in young normally developing children is unknown. Here, we investigated the neural development of normally developing children up to the school age using functional magnetic resonance imaging (fMRI). Imaging data showed comparable brain activity for random motion processing between ten adult control subjects (age 20-30 years) and ten children (age 5-6 years) in motion processing areas human middle temporal area (MT+), lateral occipital sulcus (LOS) and visual area 3a (V3a). Structures from motion induced increased activity in adults compared to children in the left inferior parietal lobule (IPL) and reduced activity in the right occipital lingual gyrus (LO). These findings suggest that neural development in the dorsal pathway (IPL) is not mature at the age of 6, whereas deficits in maturation are compensated with increased activity in shape processing related area LO.

E 102

GUIDED FIXATIONS MODULATE FACE- AND BODY-SPECIFIC RESPONSES IN THE OCCIPITOTEMPORAL CORTEX DURING SOCIAL PERCEPTION *James P. Morris[1], Steven R. Green[1], Brian Marion[2], Gregory McCarthy[2]; [1]Duke University, [2]Yale University* — Functional magnetic resonance imaging (fMRI) has revealed distinct foci of activation for faces and for bodies in ventral occipitotemporal cortex (VOTC) and lateral occipitotemporal cortex (LOTC). Recent work from our laboratory has shown that activations by bodies are attenuated when a face is present in the scene. We hypothesized that this attenuation may be related to the scanpaths subjects use to view the scene. Here, we experimentally manipulated subjects' fixations while they viewed a static picture of a virtual character. Each run consisted of alternating blocks in which the subject made successive fixations upon a small crosshair that made discrete jumps to a new location every 500 ms. We varied the location of the crosshair so that it would move between the face and torso of a virtual character. Confirming our hypothesis, we found reduced activity in the LOTC when subjects tracked the fixation cross over the face relative to tracking the fixation cross over the torso. The results in the ventral occipitotemporal cortex (VOTC) were not as clear. Within the functionally predefined face area, we found no difference in activation evoked by fixations made over the face relative to those made over the torso. However, a full-brain voxel-based analysis revealed voxel clusters in the VOTC in which greater activation was evoked for fixations made on the face relative to those made on the torso. These results illustrate the potential confounding influence of uncontrolled eye movements for neuroimaging studies of social perception.

E 103

TIME-COURSE OF AWARENESS FOR FACIAL IDENTITY *Melanie Genetti, Severine Heinzer, Asaid Khateb, Alan Pegna; Geneva University Hospitals, Geneva, Switzerland* — Subliminal perception studies have led to consider awareness as a continuum of states ranging from unaware to complete awareness. In this study, we addressed the question of the time-course of activation of visual awareness in relation to facial identity. Fifteen healthy subjects were presented with a celebrity's face (CF) or an unfamiliar face (UF) followed by a mask composed of an unfamiliar face. Stimuli were displayed at the centre of a screen, at five durations ranging from 16 to 266ms. Subjects were asked to respond whether the CF was present or not. Event-related potentials (ERPs) were recorded using 125-channel EEG. A topographic analysis showed different segment maps emerging between 220 and 460ms that were linked with the level of awareness. The increase in levels of awareness with longer presentations was mirrored by the progressive appearance of a specific scalp topography beginning at about 220ms, at the expense of distinct topographies present at low levels of awareness. The analysis did not reveal any specific topography associated with facial identity, but was correlated with an enhanced response of the P1 component. These results bring further proof of the existence of an electrophysiological correlate of awareness that occurs on a gradual scale.

E 104

EMOTIONAL GIST OF CONTEXTS RAPIDLY INFLUENCES RECOGNITION OF FACIAL EXPRESSIONS AN ERP STUDY *Ruthger Righart[1], Beatrice de Gelder[1,2]; [1]Tilburg University, [2]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown* — Recent evidence clearly indicates rapid effects of scene contexts on object recognition. In a similar vein we recently showed that recognition of a facial expression is influenced by scene contexts in which the face is presented (Righart & de Gelder 2006). The aim of the present study was to examine how these early stages are affected when individuals discriminate facial expressions (fear, happy) accompanied by congruent, incongruent or neutral contexts. We observed a general effect of context information as shown by the fact that the N170/VPP amplitudes were smaller when faces were accompanied by meaningful as compared to meaningless contexts (i.e., scrambled images). Furthermore, an emotion specific effect was found for the N170 component. The N170 amplitudes for faces, particularly fearful faces, were larger when contexts were fearful as compared to happy and neutral contexts. These findings suggest that information from the emotional gist of a scene context is integrated with facial expressions in the an early stage of face encoding.

E 105

THE PRIMACY AND FREQUENCY EFFECTS IN MASKED PRIMING OF VISUAL IDENTIFICATION *Alexander Sokolov[1], Pietro Guardini[1,2], Marina Pavlova[3,4]; [1]Ulm University Medical School, Ulm, Germany, [2]Padua Univ, Padua, Italy, [3]Cognitive Social Development Neuroscience Unit, Children's Hospital, University of Tuebingen, Germany, [4]Institute of Medical Psychology & Behavioral Neurobiol, University of Tuebingen, Germany* — Psychophysical and neurobiological theories of perceptual priming take account solely of within-trial events like prime-target congruency and their temporal arrangement (Henson 2003, Prog Neurobiol 70 53-81; Eimer and Schlaghecken 2003, Biol Psychol 64 7-26). Here, in a series of masked-priming experiments we examine if the frequency and serial order of congruent and incongruent trials affect visual target identification. Participants pressed a respective key, promptly deciding whether or not a target square (duration, 106.4 ms) had gaps in its outline. In a trial, either a congruent or incongruent prime (same or different square, respectively; 26.6 ms) and a mask (a square with dotted outline; 79.8 ms) preceded the target. In between-subject designs, we varied the frequency of congruent and incongruent trials in the series (1:1, 1:3, and 3:1) and the serial order of their presentation (either congruent or incongruent trials were more, or equally, likely to occur at the series outset). The results indicate a reliable response time, RT, and error-rate priming (enhanced congruent trials) in series with equal-frequent trials. RT, unlike error rate, is generally reduced with mainly congruent trials presented at the series outset. In series with different frequent trials, frequent congruent trials augment priming effect while frequent incongruent trials completely abolish priming (a frequency by congruency interaction). RT, unlike error rate, is generally reduced with frequent trials presented at the series outset. The findings suggest that the primacy (serial-order) and frequency effects on priming are dissociable and that both within-trial and between-trial neural processing modulate perceptual priming.

E 106

THE TIME COURSE OF FUSIFORM CORTEX ACTIVATION DURING THE PERCEPTION OF FEARFUL BODY EXPRESSIONS ASSESSED WITH MEG *Hanneke Meeren[1], Nouchine Hadjikhani[2], Seppo Ahlfo[2], Matti Hämäläinen[2], Beatrice de Gelder[1,2]; [1]Tilburg University, Tilburg, The Netherlands, [2]Athinoula A. Martinos Center, Massachussetts General Hosipital/MIT/Harvard Medical School, Charlestown, MA* — We used magnetoencephalography (MEG) to investigate the time course of brain activation of perceiving emotional body language. Recent work has demonstrated that the perception of human bodies selectively activates a region in the middle part of the fusiform gyrus (mFG) associated with face processing ("the fusiform face area ("FFA"). In addition, this region enhances its activity when the perceived body expresses fear. The underlying neural mechanism of this fear-related enhancement however, is unclear. It has been suggested that this may result from feedback projections from the amygdala. So far, information about the time course of FFA activation, essential to shed further light on this issue, has been lacking. The goal of present study was to investigate the temporal dynamics of fear-related body processing in the mFG. Pictures of neutral and fearful bodies were shown to participants while measuring MEG, and the responses were analyzed with the method of anatomically constrained minimum norm estimate. Consistent with earlier fMRI studies, we found enhanced amplitudes for fear in the mFG of both hemispheres. Small early differential responses were found around 120 ms after picture onset. In addition, a strong fear-induced enhancement was found at 230 ms post-stimulus in the left mFG only. These timecourses suggest that the sensitivity of the FFA for fearful body expressions partly arises from feedforward visual input. In the left hemisphere however, it appears predominantly to result from strong feedback after extensive processing by other regions, possibly the amygdala.

E 107

DEVELOPMENT OF HIGHER VISUAL-COGNITIVE ABILITIES INVESTIGATED BY BIOLOGICAL MOTION PERCEPTION: AN FMRI STUDY. *Janine Lichtensteiger[1], Peter Klaver[1], Thomas Loenneker[1,2], Ernst Martin[1]; [1]University Children's Hospital, Zurich, Switzerland, [2]University of Zurich, Zurich, Switzerland* — Humans can efficiently detect another living being in the environment and are able to retrieve many features directly from its kinematics. The detection of this kind of motion (biological motion = BM) is a striking example of cognition-influenced perception. Cognitive procedures that are connected to visual perception can be used to follow the progress of brain development in children. In this study, children and adults are examined using functional magnetic resonance imaging (fMRI) and behavioral testing. We investigated perceptual performance in BM detection task in which targets (BM), which are displays of a point-light figures that moved coherently (walking, jumping, or waving), and nontargets (random motion) are masked or unmasked by scrambled motion. Functional brain images were collected on a 3T whole-body scanner. Stimuli were presented using video goggles. Preliminary results of 13 adults indicate that the right posterior superior temporal sulcus (pSTS), which is known to play a crucial role in the perception of BM, is significantly activated while adults attended to BM and BM in noise. In two six year old children we found reduced activation for BM in pSTS as compared to adults.

E 108

ROLE OF PREFRONTAL CONTROL IN VISUAL OBJECT CATEGORIZATION: BEHAVIORAL AND FMRI EVIDENCE FOR OBJECT MODEL VERIFICATION THEORY *Giorgio Ganis[1,2,3], Haline E. Schendan[4,3], Stephen M. Kosslyn[2]; [1]Harvard Medical School, [2]Harvard University, [3]MGH/Athinoula Martinos Center, [4]Tufts University* — The visual system rapidly categorizes objects seen under optimal viewing conditions. However, the categorization of objects seen under impoverished viewing conditions (e.g., partial occlusion by other objects) not only requires more time but may also depend more on top-down processing, as hypothesized by object model verification theory. Two experiments, one with functional magnetic resonance imaging (fMRI) and one behavioral with the same stimuli, tested this hypothesis. FMRI data were acquired while people categorized more impoverished (MI) and less impoverished (LI) line drawings of objects. FMRI results revealed stronger activation during the MI than LI condition in brain regions involved in top-down control (inferior and medial prefrontal cortex, intraparietal sulcus), and in posterior, object-sensitive brain regions (ventral and dorsal occipitotemporal, and occipitoparietal cortex). The behavioral experiment indicated that taxing visuospatial working memory, a key component of top-down control processes during visual tasks, interferes more with the categorization of MI stimuli (but not LI stimuli) than does taxing verbal working memory. Together, these findings provide evidence for object model verification theory and implicate greater prefrontal cortex involvement in top-down control of posterior visual processes during the categorization of more impoverished images of objects.

E 109

OBJECT REPRESENTATIONS FOR MULTIPLE VISUAL CATEGORIES OVERLAP IN MEDIAL FUSIFORM CORTEX *Gilles Pourtois[1], Sophie Schwartz[1], Mona Spiridon[1], Roberto Martuzzi[2], Patrik Vuilleumier[1]; [1]University of Geneva, Switzerland, [2]University Hospital, Lausanne, Switzerland* — How representations of visual objects are maintained across changes in viewpoints is a central issue in visual perception. We used event-related fMRI in 16 healthy volunteers to map visual cortical areas responding to a large set (156) of exemplars from three distinct visual categories (faces, houses, chairs), each repeated once after a variable time lag (3-7 intervening stimuli). Exemplars were repeated with the same (but different retinal image-size) or different viewpoint. The task was kept constant across object categories (modern vs. old judgments). We identified adaptation effects on neural responses (repetition suppression) by comparing the first presentation vs. repetition of each individual exemplar. We found that adaptation effects closely overlapped with category-selective responses (as identified using a separate localizer scan). These included the lateral fusiform gyrus (FG) for faces, para-hippocampal gyrus for houses, and lateral occipital complex for chairs. In face-selective FG, adaptation effects occurred only for faces repeated with the same viewpoint, but not with a different viewpoint, replicating our previous study using faces alone. Moreover, a region in right medial FG, adjacent to but non-overlapping with lateral FG, showed significant repetition suppression for faces as well as for other objects, regardless of changes in viewpoint or in retinal image-size. Our results reveal a common neural substrate in the medial FG underlying view-invariant recognition for multiple object categories. Such a shared system in the medial FG for multi-part object representations challenges the traditional view of abstract/3D face-specific representations in the FG.

E 110

EVENT-RELATED BRAIN POTENTIAL CORRELATES OF VISUAL AWARENESS IN CHANGE DETECTION *Hartmut Leuthold; University of Glasgow, Centre of Cognitive Neuroimaging, Glasgow, Scotland, UK* — The relationship between visual awareness and attention is a controversial issue in change detection research. Event-related brain potential (ERP) studies have shown an early negative ERP deflection maximal over posterior electrodes (N2) to depend on the awareness of visual change. However, change detection performance is also related to modulations of the N2pc potential, a posterior-lateralized ERP component that is typically taken to index spatially selective attentional processing of relevant items. To address whether or not N2 and N2pc are linked to visual awareness, the present ERP study employed color and shape change detection paradigms, in which memory and test items (set size = 2 vs. 5) were successively presented (delay = 1,000 ms) to the left and right of fixation. A cue indicated the location of task-relevant items (left vs. right). Replicating previous reports, detected changes as compared to undetected and no-changes triggered a parieto-occipital N2 deflection 200 ms after test array onset. Crucially, an N2pc component was elicited even on trials for which item changes were undetected and N2 was absent. In contrast to N2pc, a lateralized ERP marker of visual-short term memory (VSTM) indicated that fluctuations in VSTM encoding and maintenance during the delay period relate to change detection performance. In conclusion, the present study strengthens the view that the posterior ERP negativity (N2) provides a sensitive neural correlate of processes associated with changes in visual awareness. By contrast, N2pc appears to reflect a functionally distinct attentional process that is only indirectly linked to change awareness.

E 111

CHILDREN'S EVENT-RELATED RESPONSES TO SINGLE LETTERS *Anthony Herdman; Simon Fraser University* – Because most children frequently view letters, neural networks likely reorganize to allow for fast recognition of such visual objects. Thus, early cortical event-related responses (ERPs) might peak earlier and with greater amplitude to a letter (an experienced object) than to a non-letter (an inexperienced object). To investigate this, I recorded behavioural responses and ERPs from children while they judged visual stimuli to be a letter or a non-letter. Reaction times were 28 ± 26 ms faster for correctly identifying a letter than a non-letter. Analyses of variance of stimulus types (letter vs. non-letter) by hemispheres (left vs. right) were performed on the N170 amplitudes and latencies at an occipital electrode site that had the largest N170 response. ANOVA results didn't show significant N170 amplitude differences between stimulus types or hemispheres. However, the N170 peaked 7 ms earlier to a letter than a non-letter (p=.01) and 5 ms earlier in the left than right hemisphere (p=.07). N170 latency differences between letter and non-letter stimuli were significantly correlated with reaction time differences (r= 0.72; adjusted r2 = 0.45; p = .029). This latency effect demonstrates that early perceptual processing in children is faster for frequently experienced letters than non-letters, which is conceivably a result of reading experience.

E 112

CONCEPTUAL TUNING CURVES IN THE HUMAN BRAIN REVEALED THROUGH FMRI-ADAPTATION *Stephen J. Gotts, Shawn C. Milleville, Patrick S.F. Bellgowan, Alex Martin; NIMH/NIH, Bethesda, MD* – Rapid stimulus repetition in fMRI experiments commonly leads to a stimulus-specific reduction in the BOLD response, referred to as fMRI-Adaptation. It has been argued that the degree of recovery from adaptation to a subsequent, related stimulus reveals critical information about the tuning preferences of cells in affected brain regions (Piazza et al., Neuron, 2004). We conducted a rapid event-related fMRI-adaptation experiment (N=18 participants) with pictures of animals in which we identified brain regions sensitive to conceptual similarity. We manipulated the conceptual relationship between adaptation and deviant probe stimuli over five levels: identical image, different exemplar of the same animal, close semantic associate (e.g., cow-horse), same animal class (e.g. mammals: cow-tiger), and different animal class (e.g., mammal vs. fish: cow-shark). We observed fMRI-Adaptation broadly throughout dorsal and ventral visual pathways, as well as in prefrontal regions and thalamus. Recovery to deviant stimuli following an adaptation sequence was observed within these same regions. For much of visual cortex, recovery from adaptation was nearly complete to a different exemplar image, consistent with retinotopic tuning. In contrast, continued adaptation to identical pictures, exemplars and close semantic associates was found in bilateral fusiform, inferior frontal, insula, posterior parietal, and cingulate cortices. The recovery curves that we have measured can be thought of as conceptual tuning curves that may be used to dissociate different functional components of visual object processing in the brain, as well as to study alterations in tuning with practice.

E 113

THE TIME COURSE OF THE FACE INVERSION EFFECT *Bruno Rossion, Olivier D'Arripe, Corentin Jacques; Universite Catholique de Louvain,* – Human faces look more similar to each other when they are presented upside-down, leading to an increase of error rate and response time during individual face discrimination tasks. This inversion effect is one of the most robust finding in the face processing literature. Recent neuroimaging studies using adaptation to face identity have shown that the 'fusiform face area' was the primary neural source of the behavioral face inversion effect (FIE). However, the time course of the FIE – i.e. when inversion affects the coding of facial identity in the human brain - remains unclear. Here we addressed this question by recording event-related potentials (ERPs) on the scalp during an adaptation paradigm with upright and inverted faces. Subjects were presented with a first (adapting) face stimulus for about 3000 ms, followed by a second face of either the same identity or a different identity. The ERP response to the second face stimulus was markedly reduced over occipito-temporal electrode sites when it was identical to the adapting face, starting at about 160 ms. When the exact same stimuli were presented upside-down, the reduction of signal was smaller, and took place about 30 ms later, in line with the behavioral effect of inversion. This result shows that the effect of face inversion on individual face discrimination takes place during early face perceptual processes in the occipito-temporal cortex. It also strongly suggests that individual face configuration is extracted as early as 160 ms following stimulus onset.

E 114

"WHAT HAPPENS WHEN A FACE RINGS A BELL?" AN ERP BACKWARD-MASKING STUDY. *Julie Coutya[1,2], Caroline Langer[1,2], Anthony Hosein[1], Boutheina Jemel[1,3]; [1]Hôpital Rivière-des-Prairies, Montréal; [2]Concordia University, Montréal, [3]Université de Montréal, Montréal* – Familiarity of faces have been shown to affect early and late event related potentials (ERPs) components. This supports the theory that perception is permeable to cognitive processes. This study uses a backward masking paradigm to investigate the extent of that permeability. By varying the timing between stimulus offset and mask onset, visual processing can be controlled, allowing a step-by-step analysis of neurophysiological correlates of conscious recognition. ERPs were collected with 64 EEG channels while participants (N=17) performed a familiarity judgment on pictures of familiar and unfamiliar faces. Each picture was viewed at five durations (ranging from 11 ms to 319 ms), interposed between two masks. The five presentation durations of each picture plus mask were first presented sequentially (4 blocs) and then randomly (4 blocs), the order of which was counterbalanced across subjects. On average, faces were first recognized at 44ms for sequential and 121 ms random. The ERP data reveal larger amplitude of the N170 face-sensitive component to masked stimuli at 44 ms (recognition threshold) than at lower presentation durations. Later ERPs, namely the N400 familiarity component, was the largest at recognition level, smaller at 1-level before recognition and absent at 2-levels before recognition. These findings implicate conscious perception, and probably re-entrant feedback processes in the elicitation of the N170 face component which is consistent with the cognitive penetrability of face perception. The gradual increase of later ERPs with recognition level supports a gradual activation mode of face representations.

E 115

REDUCTION IN WHITE MATTER CONNECTIVITY, REVEALED BY DTI, MAY ACCOUNT FOR AGE-RELATED CHANGES IN FACE PERCEPTION *Cibu Thomas[1], Linda Moya[1], Galia Avidan[2], Kate Humphreys[3], Kwan-jin Jung[1,4], Mary Peterson[5], Marlene Behrmann[6,1];*

[1]Carnegie Mellon University, [2]Ben Gurion University, Beersheva, Israel, [3]Birkbeck College, UK, [4]University of Pittsburgh, [5]University of Arizona, [6]University of Toronto, Canada — The age-related reduction in the ability to recognize faces has often been attributed to changes in memory or learning abilities in older individuals. Recently, however, difficulties in the perceptual discrimination between faces has also been reported, suggesting a perceptual contribution to the decrement in face perception as a function of age. To explore the neural basis of this age-related alteration, we measured the structural integrity of two major posterior-anterior white matter tracts that pass through the pre-eminent face processing area, the fusiform gyrus, in a large group of individuals ranging from 18 to 86 years of age, using diffusion tensor imaging. Additionally, we documented the behavioral performance of these individuals on fine-grained discrimination tasks in which the stimuli (pairs of cars or pairs of faces) were morphed to yield varying levels of perceptual difficulty. Performance on the behavioral tasks was slowed and less accurate as a function of age, and to a greater degree for faces than for cars. There was also a significant reduction in the number and fractional anisotropy in the white matter tracts as a function of age and, moreover, this was correlated with the behavioral profile. These findings target a specific neural mechanism, which might mediate the age-related changes in face perception.

E 116

FACE RECOGNITION AS A SPECIAL COGNITIVE ABILITY: AN INDIVIDUAL DIFFERENCES STUDY *Christopher F. Chabris[1], Margaret E. Gerbasi[2], Melissa Liebert[1], Ken Nakayama[1], Bradley C. Duchaine[3]; [1]Harvard University, [2]Princeton University, [3]University College London* — Evidence that computational processes required for face recognition may be localized in areas of the ventral visual pathway has supported the claim that faces are "special." However, the ability to engage such processes and recognize faces accurately could depend on general cognitive ability (g) or on other abilities, such as memory or attention. To test the hypothesis that face recognition is a special cognitive ability, we administered to 1700 individuals the Cambridge Face Memory Test (CFMT), which has been shown to discriminate between prosopagnosic and control subjects and to engage face-specific processes, plus several tests of other cognitive abilities. We found that the CFMT was reliable (6-month test-retest stability, $r = .70$) and that it predicted performance on an unrelated test of face memory ($r = .47$). However, only 2% of the variance in CFMT accuracy could be predicted from performance of a short-form Raven's Advanced Progressive Matrices (RAPM), the single best test of g ($r = .14$, $N = 98$). In a separate but demographically similar sample ($N = 111$), RAPM predicted at least 4% of the variance in each of six cognitive measures comparable in difficulty to the CFMT. Also, CFMT was substantially unrelated to measures of facial emotion recognition, verbal recognition memory, or vigilance (all $r < .14$). Taken together, these results support our hypothesis, they illustrate the value of cognitive neuroscience insights in studying individual differences, and they suggest that an individual differences approach may illuminate questions about the neural architecture of cognition.

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DOES RECALL OF A FAMILIAR FACE EVOKE A PERSON-SPECIFIC FFA RESPONSE? AN FMRI ADAPTATION STUDY. *Mark J.E. Macdonald, Jennifer Goldschmied, Sharon Thompson-Schill, Geoffrey K. Aguirre; University of Pennsylvania* — The Fusiform Face Area (FFA) has been proposed to store distributed representations of facial identity, although it has been debated whether the link between this representation and semantic knowledge regarding a specific person resides within the FFA or more anterior temporal regions. We tested the hypothesis that access of visual memory for a face adapts the neural response within the FFA to the subsequent presentation of that face. The specificity of the response was further evaluated by testing if mental imagery of a face would produce partial adaptation for the face of someone with a similar appearance. Subjects were trained over the course of ten days to recognize and name two sets of artificially created faces. Faces within one set were designed to share more visual similarity than the other. During each scanning trial, either Face-Face, or Name-Face pairs were presented serially, and subjects performed unrelated tasks designed to elicit mental imagery of the faces. Levels of neural adaptation were then compared between conditions. Within the FFA bilaterally and the R LOC, significant adaptation for repeated visual face presentation was observed, as were larger responses to visually distinct as compared to similar faces. In no region was adaptation observed in response to presentation of the name of a face. Thus, this experiment does not support a role for the FFA or LOC in linking facial identity with visual memory of an individual. Further analyses of these data will focus upon more anterior regions within the temporal lobe.

E 118

RECURRENT LOOP MODEL OF FLANKER EFFECTS ON RECOGNITION *Tsvi Achler, Ana Torralbo; University of Illinois at Urbana-Champaign* — In our recurrent loop model of recognition, each input feature is regulated as to how much influence it can have on the network representations through pre-synaptic competition via input shunting. This model provides a rich set of predictions for the efficiency of recognition in a variety of tasks. To test this model, we performed the flanker task, where the distractor can be response compatible or incompatible with the target, and in some conditions the flankers were surrounded by irrelevant letters that appear to compete with the flanker representation. Our human experiential results show that the interference produced by the flankers is modulated by interactions of the surrounding irrelevant letters. Our model of the visual cortex suggests that these effects occur due to the competitive mechanisms involved in recognition which are sensitive to manipulations such as the flanker task. These same mechanisms are also sensitive to the manipulation of the flankers by surrounding distractors. Thus all of these manipulations are predicted with the general mechanisms of recognition within our model.

E 119

THE INFLUENCE OF NUMBER OF EYE FIXATIONS ON FACE RECOGNITION *Janet Hsiao, Garrison Cottrell; UCSD* — Researchers have shown that eye movements during visual perception are linked to the underlying cognitive processes. In face recognition, it has been reported that we have one or more preferred fixations and a tendency to use a regular sequence of eye movements for specific tasks (e.g., Walker-Smith, Gale, & Findlay, 1977). In the current study, we conduct a face recognition experiment to examine the influence of number of fixations in face recognition. Participants were presented with face images at the study phase and asked to recognize the same faces at the test phase. We restricted the number of fixations on the face image randomly at the test phase to one, two, three, and no restriction. We show that participants are able to recall the faces with just a single fixation, and they have better performance when two fixations are allowed. Nevertheless, there is no further improvement with more than two fixations. It may suggest that we only need two fixations to recognize a face. We also show that when comparing the first two fixations that participants made during training and testing, the second fixations for the training and testing are significantly different but the first fixations are not; also, the first two fixations for the training set are significantly more divergent than those for the testing set. The results suggest that different eye movement strategies are used for training and testing, and the first two fixations in face recognition may have a functional role in retrieving informative facial information.

E 120

CATEGORIZATION IN THE VISUAL CORTICOSTRIATAL LOOP. *Carol A. Seger[1], Dan Lopez-Paniagua[1], Joseph M. DeGutis[2], Corinna M. Cincotta[1]; [1]Colorado State University, [2]Veterans' Affairs Hospital, Martinez, California* — We used fMRI to examine how brain regions in the visual corticostriatal loop (including inferior temporal cortex and the body and tail of the caudate nucleus) are recruited and interact during categorization learning. On each trial, subjects viewed a face or house, pressed a button indicating whether it belonged to category A or category B, and received feedback. Faces and houses were arbitrarily assigned to categories and category assignment could not be learned via identification of any rule or pattern. Eight houses and eight faces were learned; of each, six were deterministic (3 belonged to category A, 3 to category B), and 2 were random (category A for half the trials, B for the other half). A mixed design was used, with stimulus type (faces and houses) manipulated on a block basis and accuracy and feedback valence examined on a post hoc event related basis. Subjects also performed a localizer task for the fusiform face area (FFA) and parahippocampal place area (PPA) during which they viewed blocks of faces, houses, animals, and tools while performing a 1-back task. The bilateral body and tail of the caudate was recruited during correct categorization of deterministic stimuli (both houses and faces). In contrast, the head of the caudate and ventral striatum (which participate in the executive and motivational corticostriatal loops) were modulated by feedback valence. We also examined functional connectivity between FFA and PPA and the body and tail of the caudate using coherence and partial coherence methods.

E 121

THE INVERSION EFFECTS FOR CHINESE CHARACTERS *Man-Ying Wang[1], Bo-Cheng Kuo[2]; [1]Soochow University, [2]National Taiwan University* – The inversion effect exhibited for face stimuli refers to the disproportionate decrement in recognition performance as compared to nonface stimuli and the effect is attributed to the disruption of configural properties. The effect of inversion on the recognition of Chinese characters was examined in this study. To the extent that the configural property also plays a role in the recognition of Chinese characters, sizeable inversion effects would be expected. The inversion effect for one-component unique characters and two-component compound characters were compared with that of faces. Unique characters produced an inversion effect similar in size with faces that was only half as large as compound characters. Experiment 2 recorded scalp EEG (37 channels) in 14 participants performing the lexical/face decision task for real vs. pseudo-characters and real vs. scrambled faces. Decision time data replicated that of Experiment 1. Robust N170 components were elicited at right occipital/temporal sites for both characters and faces. Unique characters produced a larger N170 than compound characters and that, in turn, was larger than faces. The direction of the effect of inversion was different for faces and characters – it enhanced the amplitude of N170 for characters but reduced N170 for faces. The large N170 effect in unique characters was interpreted as the result of a stimulus structure that facilitates configural processing and inhibits part-based processing (Sagiv & Bentin, 2001).

Memory: Memory Systems

E 122

NEURAL CORRELATES OF PHONOLOGICALLY CONSTRAINED RETRIEVAL CUE PROCESSING: AN FMRI INVESTIGATION *Kayoko Okada, Michael D. Rugg; University of California, Irvine* – Previous research suggests that, depending on the goal of a memory search, subjects differentially process retrieval cues to maximize the probability of retrieval success. The present fMRI experiment investigated the neural correlates of differential cue processing by employing identical cues to probe memory in two different tasks. For both tasks, study items comprised visually presented words. In the simple recognition task, subjects (N=19) discriminated between new and studied words, whereas in the homophone recognition task, they discriminated between new items and homophones of studied words. Thus, whereas the recognition cues potentially overlapped study items at all representational levels, overlap in the homophone task could occur only at the phonological level. Contrasts of the activity elicited by unstudied items in the two tasks revealed greater activity in left dorsal inferior frontal cortex in the homophone task relative to simple recognition, and greater right anterior temporal activity for the reverse contrast. These findings lend further support to the notion that retrieval cue processing is modulated by retrieval goal, and that subjects generate cue representations most likely to overlap with salient attributes of the sought-for memories. In addition, successful retrieval was associated with enhanced activity in a network of lateral and medial parietal regions, but a cross-over interaction in the anterior medial temporal lobe (hippocampus/amygdala), such that new items elicited greater activity than old items in simple recognition, and vice-versa in the homophone task. This latter finding may reflect the differing roles played by familiarity in supporting performance in the two tasks.

Perceptual Processes: Low-Level Vision

E 123

NEURAL SUBSTRATES OF VISUAL PERCEPTUAL LEARNING IN CARDINAL AND OBLIQUE ORIENTATION DISCRIMINATION *Yan Song, Yi Zhang, Jing Kang, Xiaolan Li; Beijing Normal University, Beijing, China* – The two experiments described here used event-related potentials (ERPs) to investigate the neural mechanisms of visual perceptual learning in cardinal and oblique orientation discrimination in human adults. Reaction times and ERPs were recorded during four consecutive training sessions in which subjects discriminated the orientation of gratings. Psychophysical threshold measurements were performed before and after the training. We investigated the learning-induced behavioral and ERP changes and whether these changes were orientation specific. For cardinal orientations, reaction times and thresholds were not changed across training sessions. ERP results showed that a non-specific N1 decrement over the posterior areas. For oblique orientations, however, reaction times and thresholds were significantly decreased across training sessions. In addition, training resulted in a non-specific N1 decrement and specific P2 and P3 increment over the posterior areas. In sum, the two kinds of orientation discrimination learning are different not only in behavioral performance, but also in brain activity. Compared with cardinal orientations, more visual processing stages, later ERP components were involved in learning oblique orientations. Our findings further indicate that the two kinds of orientation discrimination learning have different neural substrates.

E 124

ENHANCED VISUAL DETAIL PERCEPTION IN AUTISM SPECTRUM DISORDER: AN IMBALANCE BETWEEN FEEDFORWARD, HORIZONTAL AND FEEDBACK PROCESSING *Myriam W. G. Vandenbroucke[1,2], H. Steven Scholte[1], Victor A. F. Lamme[1,3], Herman van Engeland[2], Chantal Kemner[2,4]; [1]University of Amsterdam, [2]University Medical Center Utrecht, [3]Netherlands Institute for Neuroscience, [4]Maastricht University* – Autism Spectrum Disorder (ASD) is described by several behavioural abnormalities, including a strong tendency to detail perception. In the current research, an explanation for this aspect of ASD is proposed and investigated based on insights in the role of visual feedforward, horizontal and feedback connections. Whereas by feedforward and horizontal processing global features are extracted, feedback activity from higher to lower visual areas leads to the incorporation of details in a visual scene. An imbalance between these mechanisms could cause an imbalance between global and detail processing in ASD. To test this we used both psychophysical and EEG data from a new texture discrimination task, where surface segregation was varied independently from texture boundaries. Good performance in the task strongly relied on feedback processing and subtraction ERP's could distinguish between feedforward, horizontal and feedback activity. The results showed that subjects with ASD (N = 13) had lower performance scores compared to controls (N = 31) which was supported by the EEG data. The ERP related to horizontal connection activity was absent in the ASD group. In contrast, the consecutive feedforward activity to extrastriate cortex was enhanced compared to control subjects and, finally, there was a delay in the feedback related ERP signal. From the current results we can conclude that aberrancies in early, low-level visual mechanisms in subjects with ASD indicate an imbalance between feedforward, horizontal and feedback processing. This might be the underlying cause of enhanced detail perception in these patients.

E 125

VISUAL FIELD ASYMMETRIES IN EARLY VISUAL PROCESSING: AN ERP STUDY OF PERCEPTUAL LEARNING *Karsten Raus, Gilles Pourtois, Christoph Michel, Patrik Vuilleumier, Sophie Schwartz; University of Geneva, Switzerland* – Previous research has demonstrated retinotopic learning effects in visual texture discrimination tasks, suggesting that learning may involve functional reorganization in primary visual cortex (V1). We hypothesized that lasting changes in early visual processing should affect electrophysiological brain responses. Visual-evoked potentials were recorded from 20 healthy volunteers following intensive training on a texture discrimination task in one visual quadrant. Our aim was to establish whether perceptual learning can alter the first retinotopic response in visual cortex, as reflected by the C1 component, which is generally regarded as impervious to manipulations of higher cognitive processes. Results obtained 24h after training in the upper visual field corroborated this hypothesis, with C1 amplitude significantly reduced in the trained as compared to the untrained quadrant. These results provide the first direct evidence for a modulation of neural responses occurring at the earliest cortical stage of visual processing following perceptual learning. However, the same effect was not observed for subjects trained in the lower visual field. Differences in scalp distribution of C1 and its overlap with later VEP components following activation of dorsal versus ventral aspects of the calcarine sulcus may account for this discrepancy. Critically, behavioral measures revealed lasting performance improvement only for the subjects trained in the upper visual field, which is in agreement with previous reports of functional differences across upper and lower hemifields. We conclude that post-training improvement on a visual task implicates neural changes within V1, reflected here by a modulation of the earliest cortical response recorded with EEG.

E 126

ELECTRICAL STIMULATION IN LATERAL OCCIPITO-TEMPORAL CORTEX INDUCES FORM-FROM-MOTION BLINDNESS *Manuel Mercier[1], Margitta Seeck[2], Olaf Blanke[1]; [1]LNCO - BMI - EPFL, [2]University Hospital of Geneva* – The ability to extract the form of objects defined entirely by visual motion cues (form-from-motion or FfM perception) is a remarkable achievement of the human visual system. Studies in brain damaged patients and recent neuroimaging studies suggest that FfM perception and more elementary motion perception (motion direction perception) are carried out in distinct extrastriate regions. The detailed anatomical mechanisms remain largely unresolved. Here we tested FfM perception during direct electrical cortical stimulation (ECS) in extra striate human cortex and recorded intracranial event related potentials (iERP) during FfM perception in a 27 year-old, right-handed patient undergoing pre surgical epilepsy evaluation for pharmaco resistant epilepsy. ECS and iERPs were carried out with 80 subdural electrodes implanted over parietal, temporal and occipital cortex of the right hemisphere. We applied a previously used ECS protocol (Blanke et al., 2002) using absolute FfM discrimination thresholds prior to ECS trials at 20 sites in lateral occipito-temporal cortex. Severe FfM blindness in the central visual field was induced at 2 sites in lateral occipital complex. At these 2 sites the patient was not at all able to discriminate the FfM stimulus, but performed normally for motion direction discrimination. ECS at other sites led to milder impairments. iERPs peaking at ~100 ms and at ~170 ms revealed large amplitude responses selective for FfM stimuli in lateral occipital cortex partially overlapping with the 2 sites where ECS induced severe FfM blindness. Our data provide intracranial electrophysiological evidence for the key role of right lateral occipital cortex in FfM vision.

E 127

PERCEPTUAL REVERSAL OF A BISTABLE AMBIGUOUS STIMULUS IS PRECEDED BY ACTIVITY IN INFERIOR PARIETAL LOBE: AN ELECTRICAL SOURCE IMAGING STUDY *Juliane Britz, Theodor Landis, Christoph Michel; University of Geneva, Switzerland* – Bistable ambiguous figures like the Necker cube induce involuntary perceptual alternations between two mutually exclusive views of a physically unique stimulus. Previous EEG studies addressing this phenomenon have identified both changes in the spectral power in the period preceding a perceptual alternation and different visual evoked potentials following the alternation. In the present study, we hypothesized that the momentary functional microstate of the brain just before stimulus presentation predicts reversal of the perception. 256-channel EEG was recorded while subjects were presented with a complex version of a Necker cube which was repeatedly flashed on a computer screen for 800 ms followed by a blank for 600 ms and were asked to report a change in perception relative to the preceding presentation by means of a button press. Scalp potential maps just before the stimuli were grouped in those preceding stable and those preceding change trials. A k-means cluster analysis identified statistically different map topographies between the two conditions. Statistical comparison of the source estimations identified activity in the right inferior parietal lobe, immediately preceding the stimulus as a predictor of a reversal of the perception. While previous studies identified this area to be involved in discrimination of direction changes of translational motion, we here show that an activation of this area before the stimulus leads to perceptual reversal of a static stimulus.

E 128

FUNCTIONAL NEUROIMAGING EVIDENCE THAT VISUAL INPUT TO THE PREFERRED RETINAL LOCATION IN PATIENTS WITH MACULAR DEGENERATION ELICITS CORTICAL REORGANIZATION *Keith L. Main[1], Kevin P. Moloney[1], Erin N. Kinzel[1], Jimmy Ginn[1], Susan A. Primo[2], Julie A. Jacko[1,2], Eric H. Schumacher[1]; [1]Georgia Institute of Technology, [2]Emory University* – Research with non-human primates suggests that deafferentation of visual pathways can result in reorganization of the primary visual cortex. Under some circumstances, neurons in the disconnected cortex may begin to respond to stimulation outside their original receptive fields (Kaas et. al., 1990). Recent research has shown that cortical reorganization occurs in humans with macular degeneration (MD), an eye disease that results in the loss of central vision. Baker and colleagues (2005) reported that activation in the lesion projection zone occurred for visual stimuli presented to patients' preferred retinal location (PRL) (i.e., the intact retinal area used to fixate in place of the diseased macula). From these results it is unclear whether cortical reorganization is associated with PRL stimulation exclusively or if it is a general phenomenon of the disease. To examine this question, the current study first used microperimetry to map the visual field and PRL of six MD patients and age-matched controls, and then used fMRI to measure brain activity while presenting visual stimuli to different regions of each participant's visual field. We found evidence for cortical reorganization, as indicated by heightened activity in the posterior calcarine sulcus during PRL stimulation. Reorganization was more pronounced for stimulation of the PRL compared to retinal areas at the same eccentricity and those possessing the same photosensitivity. These findings both support and extend existing research, indicating that cortical reorganization may be driven, in part, by visual or attentional processes specific to the development and use of a PRL.

E 129

TEMPORAL PROPERTIES OF MONOCULAR AND DICHOPTIC CROWDING *Paul F. Bulakowski, Robert B. Post, David Whitney; University of California, Davis* – Identification of an object in the peripheral visual field is impaired when it is crowded by surrounding, non-overlapping objects. Several studies have reported two unique characteristics of crowding. First, optimal crowding for binocularly presented stimuli occurs with very brief stimulus onset asynchronies (SOAs); thus the crowding effect is temporally dependent. Second, crowding occurs when a target and its flankers are both presented to one eye (monocular presentation) or when each is presented to a different eye (dichoptic presentation). Thus, crowding may occur at a single stage in the visual system. To test this, we measured the temporal dependence of crowding when the target and flanker stimuli were presented monocularly or dichoptically. A method of constant stimuli task revealed that crowding varied as a function of the target-flanker SOA for both monocularly and dichoptically presented stimuli. Crowding across conditions was optimal at an SOA of ~25 ms and there was a slight (~10-15 ms) asynchrony in the time courses of monocular and dichoptic crowding. The magnitude of crowding was ~30% greater for monocular than dichoptic crowding at 0 SOA. Crowding's unique time course rejects flash suppression, rivalry as well as metacontrast, pattern, and object substitution masking as explanations for the results. Our data suggest that crowding operates over a relatively broad temporal window and raise the intriguing possibility that there are independent monocular and binocular stages of crowding.

E 130

THE ROLE OF CUE TYPE AND CUE DURATION IN THE PERSISTENCE OF A BOUND FORM IN VISION *Szymon Wartak, Evan F. Risko, Derek Besner; University of Waterloo* — Several recent studies using shape-from-motion displays have investigated binding processes involved in vision. Typically, shape-from-motion paradigms have used segmented line drawings and a motion cue to distinguish figure from ground. After removal of the cue the shape persists in consciousness for a short time. This persistence has been used as an index of binding processes in vision and is said to be supported by the lateral occipital cortex. In the present investigation, we manipulated cue type and cue duration in order to assess the influence of the specific segregating cue on the duration of persistence. Results demonstrate that cue type does indeed influence persistence. Discussion focuses on the nature of the segregating cue in binding processes and the function of the lateral occipital cortex.

Perceptual Processes: Other

E 131

PSEUDONEGLECT FOR THE BISECTION OF MENTAL NUMBER LINES *Andrea Loftus[1], Michael Nicholls[1], Jason Mattingley[1], Heidi Chapman[1], John Bradshaw[2]; [1]University of Melbourne, Australia, [2]Monash University, Australia* — Patients with left neglect bisect mental number lines to the right. This study determined whether individuals with an intact brain show 'pseudoneglect' for mental number lines. In Experiments 1 - 4, participants saw number triplets and determined whether the numerical distance was greater on the left or right side of the inner number. Despite changing the spatial configuration of the stimuli, or their temporal order, the numerical length on the left side was consistently overestimated - indicating the bias is based on a mental representation. The leftward bias was also observed for sets of negative numbers (Experiment 5) – demonstrating that the bias is not the result of an arithmetic distortion caused by logarithmic scaling. Using numbers prone to large or small rounding-down errors, Experiment 6 showed that the bias was not the result of rounding-down. The task demands were changed in Experiment 7, so that participants determined whether the inner number was the true arithmetic centre or not. Participants overestimated the left side by mistaking numbers shifted to the left to be the true numerical centre. The task was applied to three patients with right parietal damage. A rightward bias was observed, which depended on the severity of neglect symptoms. Together, the data demonstrate a robust leftward bias for mental number line bisection, which reverses in neglect. The bias mirrors pseudoneglect for physical lines and reflects an expansion of the space occupied by lower leftward numbers and a contraction of space for higher rightward numbers.

E 132

NEURAL BASIS OF TIMING PROCESSING ACROSS VISUAL AND AUDITORY MODALITIES *Lynn Y.L. Shih[1], Wen-Jui Kuo[1], Tzu-Chen Yeh[2,3], Ovid J.L. Tzeng[4,1], Jen-Chuen Hsieh[2,1]; [1]Institute of Neuroscience, School of Life Science, National Yang-Ming University, Taipei, Taiwan, [2]Taipei Veterans General Hospital, Taipei, Taiwan, [3]Institute of Brain Science, School of Medicine, National Yang-Ming University, Taipei, Taiwan,[4]National Yang-Ming University, Taipei* — Timing processing is a primordial component of human behaviour, especially on the scale of milliseconds. However, no consensus has been reached about whether timing processing is specialized, distributed or localized. Some studies had been systematically manipulated the time scale of duration discrimination to probe for the mechanism of timing processing, but few was done on the perceptual modalities. In the present study, we sought to compare the neural networks underlying auditory and visual duration discrimination by using 3-T fMRI in order to have a sophisticated understanding about the mechanism of timing processing in the brain. Eighteen right-handed subjects participated in this study. Two tasks, auditory and visual duration discrimination, were studied. In auditory duration discrimination, two intervals were presented via headphone. Subjects were asked to discriminate which one of these two intervals was longer. In visual duration discrimination, two gray circles were presented on the screen successively, and the subjects were instructed to determine which of the circles staying on the screen longer. Our data suggests a distributed timing network, including both amodal and modality-specific brain regions. Amodal areas for timing processing include frontal-temporal-striatal networks which are responsible for information encoding and maintenance. Modality-specific area depends on the sensory modality used to register the timing information. Except audition, timing processing in other sensory modalities may require extra process to transfer the information into auditory manner, because of the superiority of audition over others in timing processing.

E 133

PREFRONTAL LOBE CONTRIBUTION TO GLOBAL PERCEPTION *Elisa Ciaramelli[1], Fabrizio Leo[2], David Burr[3], Michela Del Viva[3], Elisabetta Ladavas[2]; [1]Rotman Research Institute, Toronto, Canada, [2]Universita' di Bologna, Italy, [3]Universita' di Firenze, Italy* — Recent research suggests a role of top-down modulatory signals on perceptual processing, particularly for the integration of local elementary information to form a global holistic percept (e.g., Piccini et al., 2003). In this study we investigate whether prefrontal cortex may be instrumental in this top-down modulation in humans. We recruited 6 patients with prefrontal lesions. Four out of the 6 patients showed impaired performance in standard neuropsychological tests requiring perception of a global structure from local cues (e.g., Street Completion Test, Overlapping Figures subtest of the BORB). We then conducted a psychophysical experiment aiming to quantify the limits of perceptual grouping in our patients. A control group of 4 patients with temporal lesions and a control group of 17 age-matched healthy individuals were also tested. We measured detection thresholds for perceiving a circle defined by a closed chain of Gabor patches over a noisy background (e.g., Field et al., 1993). Crucially, the number of patches defining the circle was manipulated across experimental conditions, hence varying the inter-element distance values. Performance of patients with prefrontal lesions was far worse than that of patients with temporal lesions and normal controls when the patterns were sparse, requiring integration across relatively extensive regions of space. In contrast, for denser patterns performance of prefrontal patients was similar to that of the control groups. These results implicate the prefrontal cortex in the process of integrating elementary features into a holistic global percept, when the elements do not form a "pop-out" display.

E 134

INVESTIGATING THE AGING EFFECTS OF VISUALLY-GUIDED MOVEMENTS IN IPSILATERAL, MIDLINE AND CONTRALATERAL SPACE *Karen Lau, Eric Roy, Amanda Skakum, Genevieve Desmarais; University of Waterloo* – Visual aiming movements are often used to gauge the consequences of age-related slowing of motor processes. Movements made in the ipsilateral side of space are typically faster and more accurate than movements made at midline and in contralateral space. These effects may occur because target information is processed more efficiently within the same hemisphere rather than across hemispheres, and there are favourable biomechanical kinematic properties within ipsilateral movement. However, the differences in these ipsilateral advantages are unclear when comparing healthy young and elderly individuals. To assess this issue, we asked healthy young and elderly participants to focus on a fixation point, while targets appeared near or far away from participants. These targets appeared at midline, at 30 degrees, or at 60 degrees to the right or left from midline. When a tone was heard, participants pointed towards the location of the target. Younger participants were quicker when reaching for ipsilateral and midline targets than for contralateral targets in near conditions. However, for targets further away, contralateral and midline reaches appeared to be equivalent in terms of movement time, with ipsilateral targets being significantly quicker than the other two. In contrast, elderly participants displayed this latter pattern for both near and far targets. It was also found that the elderly participants' ipsilateral trials had a quicker movement time when compared to their younger counterparts. This suggests that elderly adults may be more proficient in ipsilateral movements, perhaps due to an increased preference to perform ipsilateral movements as they grow older.

E 135

THE BASAL GANGLIA ARE NOT CRUCIAL TO INTERVAL TIMING: A CASE REPORT. *Martin Wiener, H.B. Coslett, Anjan Chatterjee; University of Pennsylvania* – The ability to perceive time in the range of seconds to minutes, known as interval timing, is a vital dimension of cognition. However, the neurobiological mechanisms underlying interval timing remain poorly understood. Recent investigations have suggested that the basal ganglia play a major role in the ability to remember temporal durations and respond to stimuli in a temporally-controlled manner (Meck, 2006). We report a patient, WF, with bilateral destruction of the entire basal ganglia secondary to hypoxia. Neurologic examination revealed basal ganglia deficits without visual or memory impairment. WF was tested on a variety of timing tasks including: interval production, estimation and reproduction in the 2-12 second range; a psychophysical temporal discrimination task with intervals of 300, 600, 2000, and 8000 ms; and the "peak procedure" at 8 and 21 seconds. WF performed normally on the psychophysical tasks and the production, estimation and reproduction (except for a tendency to underestimate at longer intervals). He performed normally on the peak procedure at 8 seconds but underestimated 21 seconds. There was no migration effect (Malapani et al., 1998). These data do not support the claim that the basal ganglia are crucial for interval timing.

E 136

THE ROLE OF THE LATERAL PREFRONTAL CORTEX IN ACTION COMPREHENSION *Patric Bach[1], Marius Peelen[2], Steven Tipper[1]; [1]University of Wales, Bangor, [2]Neurology and Imaging of Cognition (NIC), Geneva* – The outcome of human transitive actions depends not only on the motor act that is performed but also on the objects that are used. A theory of action comprehension therefore needs to account for how both of these aspects shape the understanding of an action (e.g., Bach, et al., 2005). We investigated which neuronal systems represent the motor act and the function of the objects during action observation. In the experiment, the participants watched everyday actions of tool use (e.g. cleaning a plate with a sponge). A between-block task manipulation was used to isolate the brain structures that derive the motor act and the areas deriving the function of the objects. In one block they judged whether the motor act was performed correctly. In another block they judged whether a particular outcome was associated with the use of the objects. Our results reveal a dissociation between the brain areas involved in action understanding. Areas in the parietal and premotor cortex (typically associated with 'mirror' processing) primarily represent the motor act that is performed. The function of the objects, however, is not represented by these areas, but by an area in the lateral prefrontal cortex. The understanding of human transitive actions relies on processes in both of these sytems.

E 137

ON THE ROLE OF ATTENION FOR MOTOR ACTIVATION BY ACTION OBSERVATION: A MU RHYTHM STUDY *Stefanie Schuch, Andrew P. Bayliss, Steven P. Tipper; School of Psychology, University of Wales, Bangor, UK* – There is now ample evidence that the human motor system is activated by perceiving another individual's actions. An open question is, however, whether the motor system is being activated automatically, or whether attending to the perceived action is necessary for motor system activation to occur. One means by which activation of the human motor system can be investigated is by assessing oscillatory activity in the EEG, particularly activity in the 8-13 Hz band (mu rhythm). A decrease in mu rhythm activity has been shown to be correlated with both execution of an overt movement and perception of a movement performed by another individual. The present study investigated changes in mu rhythm activity when subjects passively observed videos of grasping actions. At the end of each block, subjects had to make a judgment. In one of the two conditions, they had to estimate how many times the grasping actions they saw had involved a precision vs. power grip. In the other condition, they had to estimate how many times a colour change, which occurred in the background of the grasping action on every trial, had involved a particular color. Because the visual input is identical in the two conditions, any differences in mu rhythm desynchronization must be due to the different tasks the participants engaged in, that is, attending to the grasping action vs. attending to the color change in the background.

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POP-OUT EFFECTS IN COLOR-GRAPHEMIC SYNESTHESIA *Veronica Gross[1], Catherine Harris[1], Sandra Neargarder[2], Alice Cronin-Golomb[1]; [1]Boston University, [2]Bridgewater State University* – Color-graphemic synesthesia is a unique phenomenon in which printed stimuli produce a secondary visual photism, a color, in the visual field or "mind's eye" of the synesthete. Previous studies have suggested that certain color-graphemic synesthetes experience visual pop-out when examining printed stimuli that trigger their synesthesia. We hypothesized that if pop-out occurs, it could enhance speed and accuracy on tests that require discrimination between letter and non-letter stimuli as previously noted in several case studies. We also wished to determine how this pop-out might be affected by the letter's placement in the simulus. We presented to eight color-graphemic synesthetes and eight control participants a masked, word-like array of five letters and pseudoletters (nonsense shapes made of letter components) for 125 ms and asked them to make judgments about the stimuli. In the "detect" condition, participants were asked whether a letter was present in this array. In the "locate" condition, they were asked where the letter was located in the array. We found no significant group differences for number correct or reaction time on the "detect" condition. There was a trend towards better performance of synesthetes than the control group (p=.076) on the locate condition, but no differences in reaction time. These results indicate that the presence of pop-out in color-graphemic synesthesia may be more limited than previously suggested. Further analysis of the effect of placement may hint as to the contribution of stimulus location in this form of popout.

E 139

SPATIAL ORIENTATION IN THE BLIND : ARE THEY A-MAZE-ING? *Madeleine Fortin[1], Patrice Voss[1], Maryse Lassonde[1], Constant Rainville[2], Dave Saint-Amour[1], Franco Lepore[1]; [1]Université de Montréal, [2]Universitaire de Gériatrie de Montréal* — Vision obviously plays a key role in the development of spatial representations, as no other sensory modality can provide as much information about our surrounding environment. One can therefore wonder how the absence of visual input might affect the proper development of complex spatial abilities. A previous study conducted in our lab showed that blind individuals were able to properly develop virtual topographical orientation skills. We wanted to further investigate the orientation skills of blind individuals in a more ecological environment. We therefore submitted one group of blind individuals (n=19) and one group of paired sighted blindfolded individuals (n=19), to an orientation task involving locomotion in a real-scale maze. The participants were guided once by the experimenter in the labyrinth along a predetermined path and were invited to freely explore each corridor along the way in order to learn and memorize the specific path taken. Afterwards, they were asked to follow the same path by themselves while the experimenter, walking behind, pointed out and corrected their errors. The errors made by the participants were noted by the experimenter. This procedure was repeated five times with four different paths increasing in complexity (6, 8, 10 and 12 decision points). An overall orientation score was then computed. Results show that blind individuals made fewer errors then the sighted blindfolded participants while performing this task, suggesting that blind individuals can acquire a more accurate sense of space when this learning relies solely on egocentric cues.

E 140

TRIGGERED PERCEPTIONS AND VISUAL PRIMING IN GRAPHEME-COLOUR SYNAESTHESIA *Catherine Mulvenna, Neil Muggleton, Vincent Walsh; UCL, London* – Evidence shows that grapheme-colour synaesthetes experience positive and negative priming effects related to their triggered colour experiences in colour-naming tasks. However, it has not been shown that the same effects occur in circumstances without explicit colour-naming, or whether lexical activation has a greater role in synaesthetic processing than typical sensory processing. This is also important in estimating the extent to which the presence of synaesthesia can affect an individual in everyday cognitive tasks. Here, using a variation of a colour-priming paradigm, priming effects from the synaesthetic colour percept were isolated and the semantic element present in previous studies was absent. Nine classified synaesthetes carried out the experiment twice a minimum of 14 days apart; once when asked to complete the task as quickly as possible, and once when asked to attend to their synaesthesia in addition to completing the task as quickly as possible. Results showed a significant positive priming effect only when subjects attended to their synaesthetic colour. The presence of synaesthesia in an individual therefore produces colour priming effects by significantly influencing reaction time in non-colour cognitive judgements. However, this effect occurs only when the individual attends to the secondary experiences.

E 141

A MAGNETOENCEPHALOGRAPHY STUDY OF GLOBAL AND LOCAL FEATURE PROCESSING OF FACES *Jennifer N. Barrie[1], Brian Luus[1], Anthony Herdman[1], Jim Tanaka[2], Mario Liotti[1]; [1]Simon Fraser University, [2]University of Victoria* – Adults can more accurately identify faces of low (LSF) than high spatial frequency (HSF), which supports the concept that face perception relies on more global than local feature processing (Deruelle et al., 2004). The purpose of this study was to determine if varying the spatial frequency of faces modulated the face-specific M170 response. We recorded magnetoencephalography (MEG) from 12 participants while they made face/object discriminations. Stimuli included LSF and HSF faces and objects. In the sensor domain, Regions of Interest were defined over left and right occipito-temporal scalp regions and grand-averaged responses were computed over the 4 conditions. Results indicated a Stimulus x Spatial Frequency interaction for latency ($F(1,11)=18.6$, $p<0.001$) with the M170 to LSF faces occurring earlier than the M170 to HSF faces (M=148, M=173ms) and no effect of spatial frequency for objects. Analyses of source waveforms were consistent with sensor data results ($F(1,11)$-interaction=46.0, $p<0.001$). The M170 was localized in the left and right fusiform gyri. Preliminary results from time-frequency analyses indicate that power in the alpha (7-13 Hz) and gamma (30-50Hz) bands peaked earlier to LSF than to HSF faces, LSF objects and HSF objects between 100-150 ms and 175-200 ms. These findings indicate that the M170 is sensitive to spatial frequency modulations. The Stimulus x Spatial Frequency interaction supports the notion that global aspects of a face are perceived before more local aspects.

E 142

"FILLED IN" LETTERS EVOKE SYNESTHETIC COLORS *Mikhenan Horvath, V. S. Ramachandran; University of California, San Diego* – We presented common words such as deaf with the middle letters missing (d--f) and replaced with a nonsense shape, or visual noise. At a suitable distance subjects usually "fill in" the missing letter – seeing "ea" in the d--f for example. We then showed similar words to three grapheme color synesthetes, whom each reported seeing the synesthetic color associated with the letter. The effect did not occur if there was simply a gap instead of "noise" between the flanking letters. This suggests that "filled in" letters that do not exist on the retina can nonetheless evoke synesthetic colors.

Perceptual Processes: Somatosensory Processing

E 143

MIRROR-TOUCH SYNAESTHESIA AND EMPATHY *Michael J. Banissy, Jamie Ward; University College London, UK* – Previous studies have indicated evidence of a tactile mirror-system in which actual and observed touch results in activity in similar areas of primary and secondary somatosensory cortices (Keysers et al., 2004; Blakemore et al., 2005). In the later study, a single case of a vision-touch interaction (mirror-touch synaesthesia) was reported, whereby observed touch to a human was experienced as tactile stimulation in a somatotopic location on the observer's body (Blakemore et al., 2005). Building upon these findings, this group study investigated behavioural correlates of mirror-touch synaesthesia by using two spatial congruity paradigms in which touch was applied to participants face or hands while participants observed another person or object being touched on a congruent or incongruent site. Participants were requested to detect the site of actual touch while ignoring observed touch (and the synaesthetic touch induced from it). Consistent with self-reports, mirror-touch synaesthetes were significantly faster at identifying a site touched on their own face or hands when observed touch to another person was congruent with their synaesthesia compared to incongruent trials. No significant differences were observed for control participants. Furthermore, the relationship between mirror-touch synaesthesia and empathy was investigated. Empathic ability was measured using the empathy quotient (Baron-Cohen & Wheelwright, 2004). Mirror-touch synaesthetes showed significantly higher scores on the emotional reactivity subscale of the empathy quotient compared to controls. These findings were partially consistent with the notion that we understand and empathise with others by a process of simulation (Gallese & Goldman, 1998).

E 144

NOW YOU'LL FEEL IT – NOW YOU WON'T: PRE-STIMULUS ROLANDIC MU RHYTHM PREDICTS EXTINCTION OF SUPRATHRESHOLD SOMATOSENSORY STIMULI *Ruth Schubert[1], Stefan Haufe[2], Felix Blankenburg[3], Arno Villringer[1], Gabriel Curio[1]; [1]Charité - University Medicine Berlin, Germany, [2]Technical University*

Berlin, Germany, Fraunhofer Institute First, Berlin, Germany, [3]University College London, London, United Kingdom – A recent electrophysiological study revealed that parieto-occipital alpha-power correlates with conscious perception of near-threshold (50% detection rate) visual stimuli (Babiloni et al., 2005). In the somatosensory system, conscious perception of a clearly supra-threshold target stimulus applied at the left index finger can be suppressed in a high proportion of trials when followed by a higher-intensity mask stimulus at the right index finger. Previously, we showed that this somatosensory "extinction" in healthy subjects is reflected in decreased post-stimulus mid-latency ERP components (Schubert et al., 2006). Here, we analysed how pre-stimulus EEG rhythms correlate with these different perceptive states (conscious perception vs. extinction) of clearly supra-threshold somatosensory stimuli. We conducted a time–frequency EEG analysis for perceived and extinguished stimuli in the time interval of 500 ms immediately preceding stimulus onset. For perceived compared to extinguished target stimuli, the power of the pre-stimulus rolandic mu-rhythm, i.e., the alpha-band (8–12 Hz) and lower beta–band (12–18 Hz), decreased significantly ($p<0.001$). The effect was dominant over right sensorimotor regions, contralateral to the target stimulus. The results suggest that a modulation of low-frequency bands (<20 Hz) is related to conscious perception of also supra-threshold somatosensory stimuli and may imply a general mechanism for conscious perception. We propose that pre-stimulus suppression of the neuronal "baseline" oscillatory activity in the somatosensory cortex (mu-rhythm) facilitates conscious somatosensory perception. Top-down control from higher-order attentional systems may produce a transient suppression of rhythmic activity in sensory receiving areas and provide a selective preparedness for processing of incoming stimuli.

E 145

DO REPRESENTATIONS OF FACIAL EXPRESSIONS FORM AN INTEGRAL PART OF EMOTIONAL EXPERIENCE? *Joshua Ian Davis[1], Ann Senghas[2], Kevin Ochsner[1]; [1]Columbia University, [2]Barnard College of Columbia University* – How are facial expressions represented in emotional processing? Are facial expressions integral parts of emotional experiences, or are they only communicative outputs? To examine whether representations of facial expressions are integral to emotional experience, it is necessary to restrict expressions and observe whether emotional experience decreases in strength as a result. In order to rule out expectancy effects about how expression and emotion should be linked, all participants were instructed that the study pertained to memory and attention and a majority of the questions they answered supported this claim. All participants wore dummy electrodes on their faces. Those in the experimental group were informed that we were monitoring brain wave activity. Any muscle movement under the electrodes, they were told, would render the data unusable. They were compared to 2 groups who were not instructed that they could not move. Video records were used to ensure participant cooperation. Debriefing interviews revealed that participants did not guess at the hypothesis. In order to rule out the possibility that the distracting effects of restricting one's facial movement was the only cause of any decrease in emotion that might occur, one of the control groups was given an alternative distracting task, to count backwards by threes. Participants rated counting backwards by threes as more distracting than restricting one's own facial muscles. Nonetheless, participants who restricted their facial movement reported significantly less negative emotional experience in response to stimuli than either of the control groups, who did not differ from each other.

E 146

CALORIC VESTIBULAR STIMULATION; A NOVEL TREATMENT FOR THALAMIC AND OTHER CENTRAL PAIN SYNDROMES *V. S. Ramachandran, P. D. McGeoch, Lisa E. Williams; Center for Brain and Cognition, UCSD* – Chronic thalamic pain syndrome develops in the contralateral limbs, body and face soon after a stroke. The pain is relentless and the slightest touch - sometimes even a whiff of air- can trigger excruciating pain. The disorder is generally permanent and incurable. Other types of chronic pain, such as phantom pain result mainly from central reorganization of thalamic and cortical pathways (Ramachandran and Hirstein, 1998) causing discrepant sensory input. Thalamic pain might represent a pathological amplification of the thalamic/posterior insular response to pain signaled by discrepant sensory input. Given the substantial vestibular input to the insula we wondered if thalamic pain might be relieved by caloric/vestibular stimulation. We tested this conjecture on two patients. We asked the patients to rate pain on a scale of 1 to 10, on a chart. We then performed a left cold water (zero degrees) caloric irrigation over a 30s period until nystagmus appeared. There was a striking reduction in pain in both patients, which lasted (at least) two weeks in one case. Placebos (e.g. lukewarm water; ice cubes on the ear etc) were completely ineffective. Insular cortex receives both vestibular and pain signals. We postulate the vestibular modulation of pain is mediated here. We are investigating whether permanent remission can occur and whether other types of chronic neuropathic pain may respond similarly.

E 147

THE EXPECTATION TO MOVE CAUSES ATTENUATION OF SENSORY INPUT *Martin Voss[1,2], James N. Ingram[3,2], Daniel M. Wolpert[3,2], Patrick Haggard[4]; [1]St. Hedwig Hospital & Charité University Hospital, Humboldt University, Berlin, [2]Institute of Neurology, Queen Square, London, UK, [3]Cambridge University, Cambridge, UK, [4]Institute of Cognitive Neuroscience and Department of Psychology, London, UK* – When a part of the body moves, the sensations evoked by a probe stimulus to that body part are attenuated. Two mechanisms have been proposed to explain this robust and general effect. First, feedforward motor signals may modulate activity evoked by incoming sensory signals. Second, reafferent sensation from body movements may mask the stimulus. Here we delivered probe stimuli to the right index finger just before a cue appeared instructing subjects to make rapid left or right index finger movements. In a two-alternative force choice paradigm, subjects judged the intensity of the probe stimulus in comparison to a reference stimulus. The point of subjective equality was determined. When the cues were unpredictable, sensory attenuation occurred for tactile stimuli applied to the right index finger just before this finger was cued (and subsequently moved). However, there was no attenuation in the right finger just before the left finger was cued. This result suggests that sensorimotor events occurring after the probe caused attenuation 'postdictively'. When movement cues were predictable (right cues four times more frequent than left cues), we found attenuation in the right index finger even when the left finger was cued and moved. This attenuation linked to a movement that was likely but did not in fact occur, suggests a new expectation-based mechanism, distinct from both feedforward motor signals and postdictive masking.

Memory: Memory Systems

E 148

ELECTROPHYSIOLOGICAL CORRELATES OF CONTENT-SPECIFIC RECOLLECTION *Jeffrey Johnson, Brian Minton, Michael Rugg; University of California, Irvine* – Several functional neuroimaging studies have demonstrated that the neural correlates of episodic retrieval ('recollection') differ according to the content of retrieved episodes. It has been hypothesized that these content-specific differences reflect the 'reinstatement' of encoding-related processes or representations at the time of recollection. It remains unclear, however, whether these effects are a direct manifestation of the retrieved content that supports the recollection of an episode, or whether they are associated with processes engaged subsequent to retrieval. The present study addressed this issue by employing event-related potentials (ERPs) to investigate the temporal dynamics of content-specific differences in the neural correlates of recollection. Subjects studied a series of words that were each presented in the context of one of two encoding tasks. The 'scene' encoding task required imagining the object corresponding to each word as appearing within the pictorial landscape scene on which it was superimposed, whereas the 'sentence' task required the covert generation of a sentence incorporating the word. Memory for the words was subsequently tested with a 'remember/know/new' procedure. Consistent with the reinstatement hypothesis, the ERP correlates of recollection differed topographically according to the encoding history of the test word. The content-specific ERP differences were maximal at midfrontal sites and, importantly, onset concurrently with the recollection effects. These findings suggest that the reinstatement of encoding-related processes or representations may provide the basis for recollection, rather than reflecting content-specific processes that are employed subsequent to retrieval.

Poster Session F

Attentional Processes: Visual

F1

FEATURE PRIMING IN UNMEDICATED SCHIZOPHRENIA PATIENTS: IS LOCATION SPECIAL? *Ruth Salo[1], Susan Ravizza[1], Thomas Nordahl[1], Lynn Robertson[2]; [1]UC Davis Imaging Research Center, [2]UC Berkeley and VA Northern California Health Care System* – The distractibility that schizophrenia patients display may be the result of a deficiency in filtering out irrelevant information. The aim of the current study was to assess whether patients with schizophrenia exhibit greater effects of changes to task irrelevant features compared to healthy participants. Fifteen outpatient schizophrenia patients who were currently drug-free as part of an investigational drug study and fifteen controls participated in the study. Subjects identified targets whose features could repeat or switch. The task-relevant feature of the target was letter identity whereas color and/or location were always task-irrelevant. Each trial consisted of a brief presentation of a target and distractor letter. Participants responded by pressing the appropriate key associated with the target letter. Of primary interest in this experiment were the effects of switches in the irrelevant features (color and location), when target identity remained constant. All participants were slower when color and location switched, however, schizophrenia patients tended to show a bigger location switching effect than controls ($p < .01$) when differences in age were taken into account. In contrast, color switching effects were no greater than controls ($p > .05$). These results suggest that unmedicated schizophrenia outpatients do not exhibit global impairments of feature processing. Instead, impairments appear to be restricted to situations in which task-irrelevant location features vary. These findings are consistent with other studies that have reported deficits in spatial processing in schizophrenia. Keywords: schizophrenia, feature processing, cognitive control, spatial attention [K01DA16293-01 to RS].

F2

AGE-RELATED CHANGES IN EARLY PROCESSING OF VISUAL NOVELTY ODDBALL STIMULI AS INDEXED BY THE P2 ERP COMPONENT *Jenna Riis[1,2], Hyemi Chong[1,2], David Wolk[3], Scott McGinnis[1,2], Phillip Holcomb[4], Dorene Rentz[1,2], Kirk Daffner[1,2]; [1]Harvard Medical School, [2]Brigham and Women's Hospital, [3]University of Pittsburgh School of Medicine, [4]Tufts University* – Relatively little is known about information processing correlates of the P2 component. We investigated the extent to which the P2 to visual stimuli is sensitive to novelty, 'targetness', rareness, direction of attention, and changes over the adult lifespan. Old, middle-aged, and young subjects ($n = 92$), relatively well matched for demographic variables and current level of cognitive performance compared to age-matched peers, participated in a visual novelty oddball paradigm under an Attend and an Ignore condition, which included standards, targets/rares, and novels. P2 difference waves (novels – standards and targets/rares – standards) were analyzed. We found the P2 to novels > targets under the Attend condition for old and middle-aged, but not young subjects. The P2 to novels > rares for all age groups under the Ignore condition. The P2 to novels was larger in old and middle-aged than young subjects under the Attend condition. In old, but not middle-aged or young subjects, the P2 to novels was larger under the Attend than Ignore conditions. The P2 to targets under the Attend condition was larger than to rares under the Ignore condition for all age groups. Our results suggest that the P2 component is more responsive to novelty than targetness or rareness in old and middle-aged subjects and more sensitive to targetness than rareness in all age groups. We found an age-related increase in P2 amplitude to visual novels detectable by middle age. Also, in old, but not middle-aged and young subjects, the P2 to novelty is modulated by direction of attention.

F3

THE UNIQUE POWER OF NEW OBJECTS TO CAUSE DISTRACTION: BEHAVIORAL AND FMRI EVIDENCE FROM A NOVEL CONTINUOUS PERFORMANCE TASK *So-yeon Kim, Joseph B. Hopfinger; University of North Carolina at Chapel Hill* – Previous behavioral studies have debated whether abruptly appearing new objects have a unique ability to capture attention or whether salient luminance changes alone capture attention. In the present study, we investigated whether the neural activity triggered by a task-irrelevant luminance change differed depending on whether or not it defined a new object. We measured the distracting effects of such stimuli on behavior and neural activity using a new continuous performance task. Participants discriminated the orientation of a centrally-located ever-present red 'T' that rotated but never disappeared. In the experimental condition, a task-irrelevant gray square abruptly appeared or disappeared (every 5-16 seconds) in the peripheral visual field. In the control condition, the same luminance changes occurred, but an outline of the square remained on the screen throughout the block, resulting in an object always being present there. FMRI data revealed that visual areas coding the location of the peripheral gray square were significantly activated only to the abrupt onset of a new object (i.e., the luminance increment only in the experimental condition). Furthermore, only this abruptly appearing new object caused distraction, as measured in behavior and neural activity. Performance on the central task suffered only when the luminance change was associated with a new object, and activity in the visual areas coding the central target location was significantly reduced only following the appearance of a new object. These data provide new evidence for the unique ability of new objects to capture attention and for the neural correlates of distraction.

F4

NEURAL SYSTEMS OF COVERT ORIENTING USING DIRECTIONAL CUES AND EYE GAZE *Yoko Nagata[1,2], Sarah Bayless[1], Margot Taylor[1]; [1]Hospital for Sick Children, [2]Komazawa University* – The neural networks implicated in the attentional effects following eye-gaze cue are not yet specified. We investigated whether eye-gaze represents a special cue and whether the neural mechanisms involved in processing eye-gaze cues are different from non-eye-gaze cues in the context of covert visual orienting. A modified Posner paradigm was used, in which a photograph of a face was presented centrally. In the eye-gaze condition, left or right averted eye-gaze served as the directional cue. In the non-eye-gaze condition, the straight gaze was presented with a small cue stimulus appearing either side of the face. Cue-to-target SOA was 300ms, valid and invalid cues were evenly distributed. Recordings were made on a 151 channel CTF/MEG system while participants performed the task; anatomical scans were obtained using 1.5T MRI. Source analyses were completed with an event-related spatial filtering technique (erSAM). Behavioural results indicated faster overall responses in the eye-gaze condition, and validity effects observed only in the eye-gaze condition. Four peak MEG activations to cue-onset were analysed. The earliest peaks (85ms, 140ms) were localized occipito-temporally and did not differ between conditions. At 215ms the fields showed a right anterior cingulate source that was greater for the eye-gaze condition, suggesting greater inhibitory effort to eye-gaze compared to non-eye-gaze cues. At 255ms the STS activation was more anterior for the non-eye-gaze condition. During the earliest stages of processing the cue-type did not differ, but by 215ms, cortical activation was differentiated between eye-gaze and non-eye-gaze cues.

F5

EXOGENOUS CUEING DURING BINOCULAR RIVALRY INVOLVE EARLY MODULATIONS OF VISUAL CORTEX *Wayne Khoe[1], Jude Mitchell[2], John Reynolds[2], Steve Hillyard[3]; [1]University of California, La Jolla, California, [2]The Salk Institute for Biological Studies, La Jolla, California, [3]University of California, San Diego, La Jolla, California* – Mitchell, Stoner and Reynolds (2004) observed that exogenously cuing one of two virtual surfaces, defined by superimposed rotating dot patterns, resulted in a perceptual bias for the cued surface image during binocular rivalry. Observers were impaired in judging the direction of a translation on the uncued surface. We investigated the event-related potential (ERPs) evoked by translations of the cued and uncued surfaces during binocular rivalry and monocular viewing in a similar paradigm. Subjects compared the direction of the first (T1) and second (T2) dot translation. T1 was viewed binocularly while T2 occurred under dichoptic (deleting one surface of differing rotation direction from each eye resulting in binocular rivalry) or monocular viewing (deleting both surfaces from one eye). Subjects were impaired in making the comparison when the translations occurred on different surfaces. The magnitude of the impairment was approximately equivalent comparing monocular to dichoptic presentation of T2. Though in both viewing conditions the posterior N1 component (160-210 ms) elicited by T2 of the cued surface was found to be larger than for the uncued surface, only during dichoptic viewing condition was the posterior P1 component (110-160 ms) evoked by T2 on the cued surface larger compared to the uncued surface. The N1 surface selection modulation perhaps reflects a surface-based selection mechanism, whereas the earlier P1 modulation represents a biasing of interocular competition prior to the stage of surface selection under conditions of rivalry. These results provide evidence that object based selection mechanisms interact with eye-of-origin selection mechanisms.

F6

MEG REVEALS SYNCHRONIZED NEURAL NETWORK FOR VISUOSPATIAL ATTENTION *Sam Doesburg, Lawrence Ward; University of British Columbia* – A central problem for cognitive neuroscience is determining how the brain is able to dynamically rearrange its functional connectivity to produce transient networks to support the universe of perceptions and tasks of which it is capable. Local neural synchrony has been demonstrated to be relevant for perceptual binding and large-scale synchronization has been proposed as a mechanism for the selection of task/percept relevant neural populations and their integration into a brain-wide network that defines the contents of consciousness. Selective attention is ideal for the investigation of this hypothesis since attended information is (i) more effectively integrated with information in other sensory modalities and processing in higher cognitive areas; (ii) biased for inclusion in consciousness. In an earlier study we calculated long-distance phase synchronization between EEG electrodes as subjects deployed their attention to a particular location in the visual field and found that covert deployment of endogenous attention to one hemifield induced transient long-range gamma-band synchronization between the contralateral visual cortex and other, widespread cortical areas. Our current repetition of this paradigm using MEG sensor recordings reveals lateralization of long-range high-alpha-band synchronization sustained throughout the period of attentional maintenance. This suggests that oscillatory neural synchronization in the gamma-band is relevant for the establishment of a large-scale network of functionally integrated brain areas, while alpha-band synchronization is required for maintenance of this network. We have localized sources of oscillatory MEG activity and calculated phase-locking between them in order to elucidate the large-scale network of functionally integrated brain areas underlying visuospatial selective attention.

F7

SPATIAL TOPOGRAPHY AND ATTENTIONAL MODULATION IN THE HUMAN PULVINAR *Jason Fischer, David Whitney; UC Davis* – The lateral and inferior pulvinar have widespread connections with visual cortex and are often implicated in visual attentional processing. Highly specific pulvinar lesions in humans can result in spatial neglect (Karnath, 2004) and attenuation of crowding phenomena (Michael & Desmedt, 2004), suggesting that the pulvinar plays a critical role in allocating attention and in spatial vision. However, little functional data exists to support this directly. Similarly, while single-unit studies have shown retinotopic topography in some sub-regions of the monkey pulvinar (Bender, 1981), such topography has not been established in the human pulvinar. Here we used fMRI to test for attentional modulation of human pulvinar responses and for visual topography in the pulvinar. In one experiment subjects attended to flickering Gabor stimuli which were located in one of five positions. Compared to when subjects passively viewed the same stimuli, there was significantly greater BOLD response in the pulvinar bilaterally. Consistent with previous studies, attention increases the magnitude of pulvinar responses. More interestingly, when subjects attended at the fixation point (passively viewing flickering Gabors that were located in one of five positions), patterns of pulvinar activity discriminated among the five Gabor positions. Cross-correlating patterns of BOLD response within the pulvinar for the different stimulus positions revealed that the right hemisphere pulvinar was able to discriminate objects separated by less than 2 degrees visual angle (at ~10 deg. eccentricity). These results indicate that human pulvinar is modulated by visual attention, and it also carries extremely precise topographic information about object position.

F8

FROM WITHIN, FROM WITHOUT: AN FMRI STUDY OF INTERNALLY-GENERATED AND EXOGENOUSLY-CUED SHIFTS OF ATTENTION *C. Christine Camblin, Joseph B. Hopfinger; University of North Carolina, Chapel Hill* – A number of fMRI studies have identified a fronto-parietal network which corresponds to both endogenously-cued and exogenously-cued shifts of attention, indicating that endogenous and exogenous attention may be subserved by overlapping brain regions. In order to more precisely isolate the neural correlates of attentional shifting, per se, we created a novel paradigm wherein participants reported voluntary shifts of attention that were not associated with any external cue. Using this task as a baseline, we were able to examine the additional processes triggered by external cues. In a previous study, we found that voluntary shifts of attention that are cued by a centrally-presented arrow produced more frontal and parietal activity than voluntary shifts that are not prompted by an external stimulus. These differences were strongest in the left hemisphere occurring even when the attentional effects in visual processing regions were the same for both conditions, suggesting the greater left hemisphere activity for arrow cues may have been related to processing the symbolic cue, not simply moving attention. In the present study, we compared internally generated shifts of attention with non-predictive exogenously-cued attention shifts. The greatest difference between these types of shifts occurred in the right hemisphere; in particular, the right parietal lobe was significantly more active for exogenously-cued shifting compared to internally-genereated voluntary shifts. Both types of shifts produced typical attention effects in visual processing regions, however, suggesting the greater right parietal activity in the exogenous cue condition may relate to the need to disengage attention from a salient external stimulus.

F9

USING EEG CLASSIFICATION TO TRACK COMPETITION IN NEGATIVE PRIMING *Ehren Newman[1,2], Ken Norman[1,2]; [1]Princeton University, [2]Center for the Study of Brain Mind and Behavior* – Competition in cognitive processing has lasting consequences for the subsequent accessibility of competing representations. Negative priming (NP) demonstrates that, when representations compete, the representations that lose the competition are subsequently harder to access. To better understand the competitive dynamics that generate these effects, we developed a method of tracking the activation of the competing representations at the sub-trial time scale. Our methods rely on a pattern classification analysis of EEG data. We found that when a subject views an image, we were significantly above chance at classifying which one (of four) image types the subject is viewing based upon the EEG signal. We show here, the specific time course, within a trial, that we were able to classify over. We also show that when images from different categories (e.g. a face over a house) are superimposed the classifiers were significantly above chance at predicting the class of both images. Using this, we tracked the activation of each stimulus in a negative priming task. We then tested for connections between how much the to-be-ignored stimulus is processed (as detected by the classifiers) and how fluidly it is processed in the future. We present preliminary evidence that images that are processed more when they are marked to-be-ignored are subsequently processed less fluidly.

F10

NEURAL ACTIVITY DURING INHIBITION OF RETURN *Troy A. W. Visser[1], Jason B. Mattingley[2], Mark A. Williams[3]; [1]University of British Columbia - Okanagan, [2]University of Melbourne, [3]McGovern Institute for Brain Research, Massachusetts Institute of Technology* – Behavioral inhibition plays a key role in a variety of human activities. In visual search, this is evidenced by a phenomenon known as inhibition of return (IOR) in which target detection is slower at a previously-cued location than at an uncued location when the interval between a non-predictive cue and target exceeds about 200 ms. Studies have shown that target discriminability is reduced at cued locations during IOR, implicating low-level inhibitory processes. However, the neural locus of this effect has not been directly examined. To this end, we used fMRI to measure activation in the occipital and parietal cortices (including V1 and V2) during a visual cueing paradigm. Participants viewed a display consisting of a central fixation flanked by two placeholder boxes slightly above and to the left and right. On each trial, a non-predictive cue was presented briefly directly below one of the placeholders, followed by a target inside one of the placeholders. The cue-target onset asynchrony was 200 or 800 ms. Participants pressed a key to indicate the onset of the target. Results showed that while cued targets were responded to faster at the short SOA, the reverse occurred at the longer SOA, indicative of robust IOR. These behavioural effects were accompanied by changes in brain activity in visual processing areas.

F11

THE TIMECOURSE OF THE DIVISION OF THE ATTENTIONAL SPOTLIGHT *Edmund Lalor[1,2], Simon Kelly[1], Barak Pearlmutter[3], Richard Reilly[2], John Foxe[1,4]; [1]The Nathan Kline Institute for Psychiatric Research, New York, [2]The School of Electrical, Electronic and Mechanical Engineering, University College Dublin, Ireland, [3]The Hamilton Institute, National University of Ireland, Maynooth, Ireland, [4]The Cognitive Neuroscience Program, The City College of the City University of New York* – Current models of visuo-spatial attention are dominated by the concept of an attentional "spotlight" that facilitates the processing of stimuli falling within its boundaries. While the traditional view has been that this spatial spotlight has a unitary beam, recent evidence has suggested that it is more flexible and can be divided into multiple beams that can facilitate processing in spatially non-contiguous regions without including intervening regions containing irrelevant or distracting information. This "split spotlight" attention has been shown to be expressed as both enhanced activation in specific brain regions, using fMRI, and enhanced processing of the steady-state visual evoked potential (SSVEP), using EEG. However, neither fMRI nor the SSVEP can provide detailed information on the timecourse of split-spotlight attentional modulation. A detailed analysis of the temporal profile of modulation has to date not been possible due to the inability to measure separate VEPs from simultaneously presented stimuli. Such an analysis has recently been shown to be feasible using the novel VESPA technique developed by our group. In the current study, a mosaic of interposed stimuli were presented, some to be ignored and others to be attended and a VESPA was determined for each location. Data from 15 subjects show that a strong modulation of the VESPA ($F(1, 14) = 9.32$, $p < 0.01$) is evident at 90-100ms (during the visual P1 component) demonstrating that the split attentional spotlight is expressed in modulation of activity at a level as early as has been found to date in the literature.

F12

EFFECT OF OBSERVED GAZE ON ORIENTING BEHAVIOR AND BRAIN AREA LIP. *Stephen V. Shepherd[1], Robert O. Deaner[1,2], Jeff T. Klein[1], Michael L. Platt[1]; [1]Duke University, [2]Grand Valley State University* – Both humans and macaques shift our attention in the direction we see others look. Furthermore, attention cuing by observed gaze follows a common stereotyped time course in both humans and macaques (Deaner & Platt 2003), suggesting primates use a common neural mechanism to reflexively share attention. Here we investigate the effects of social gaze cues on macaque behavior and neuronal activity within macaque lateral intraparietal area (LIP). We first mapped the response field (RF) of each neuron using standard memory saccade trials. Subjects then performed a peripheral target detection task: to receive reward, they (1) fixated a central disc (2) followed by a centrally-presented picture of a familiar macaque looking toward or away from the neuron's RF, then (3) shifted gaze to a peripheral target appearing unpredictably either within or directly opposite the RF. Social gaze cues appeared for a variable duration of 100, 200, 400, or 800 ms; supporting previous results, gaze-following was observed most often at the 200ms cue duration. Neurons discriminated gaze cues, even in the absence of visual stimulation within or saccade toward the classical RF. We further found that the magnitude of later visually evoked and saccadic activity in the RF depended on gaze direction of previously observed social cues. Finally, we compared the time course of these neuronal effects to the time course of saccadic reaction time shifts in order to infer the causal relationship between neurometric and psychometric cue responses. Poster available at http://www.duke.edu/~svs/research/CNS2007.pdf for conference duration.

F13

THE EFFECTS OF ATTENTION UPON FACE-SPECIFIC ERPS RECORDED FROM SUBDURAL ELECTRODES IN THE FUSIFORM GYRUS *Gregory McCarthy, Brian Marion, Truett Allison, Ken Vives; Yale University* – We investigated the influence of attention upon the time course of face processing in the fusiform gyrus using ERP recordings from subdural electrodes. Fifteen patients provided informed consent, all of whom were being evaluated for surgical treatment of epilepsy. A screening task was used to identify face-specific sites. Subjects viewed a series of pictures depicting tools, fruits, flowers, letterstrings, and faces while detecting infrequent targets. A face-specific site was one in which the negative potential at ~200 ms (N200) in the ERP elicited by faces was at least twice as great in amplitude as the ERP to any other stimulus category. Twenty-three face specific sites were identified in and near the fusiform gyrus. For the primary task, a series of stimuli were briefly presented, each consisting of two houses and two faces arranged around a fixation cross. On half of the trials, the two faces were identical. The houses were identical on the remaining half. The subject made a choice response indicating whether the faces were identical, or whether the houses were identical, in separate runs. There were no significant differences in the amplitude of the N200 at the predetermined face-specific sites as a function of whether the subjects were attending to faces or houses. However, when faces were attended, a large negative slow potential was evoked beginning at about 230 ms and peaking at 800-900 ms. These results suggest that the face-specific N200 ERP is insensitive to attention, but that attended faces evoke additional long duration neural activity.

F14

SLIGHTLY NOISY BRAINS SEE BETTER: PRESTIMULUS DYNAMICS IN EEG AND PERCEPTUAL PERFORMANCE *Lauren Emberson[1], Keiichi Kitajo[2], Lawrence Ward[3]; [1]Cornell University, [2]RIKEN Brain Science Institute, [3]University of British Columbia* – In a complex, dynamic, and undeniably non-linear system like the brain, there are constant fluctuations of noise, where noise is characterized as background neural activity with random phase and an absence of spectral peaks. In this study, we relate this a priori concept of noise measured in prestimulus EEG signals to performance in a simple visual task. Subjects detected small luminance changes while 64 channel EEG was recorded. After determining each subject's threshold for the stimuli, the experimental stimuli and the environment were held constant allowing for undisturbed endogenous fluctuations in brain activity. Moreover, the task was carefully designed to thwart subject prediction of stimulus presentation thus avoiding anticipation effects. The prestimulus EEG recordings were extracted for one second epochs ending with stimulus presentation on hit trials only. Noise was quantified in these epochs and related to the performance, measured in reaction times. An intermediate level of endogenous neural noise gave rise to the fastest responses in the detection task confirmed by a significant non-linear cubic relation of reaction time to noise level. This noise-performance relationship is similar to the phenomenon of stochastic resonance where a non-zero level of noise is necessary for optimum processing of threshold stimuli in a non-linear system. These findings imply that endogenous neural noise could be a major contributing factor in how our brains respond to information. This study also informs questions of how dynamic brain states relate to attention, perception, and phenomenal awareness.

F15

INVESTIGATING THE RELATIONSHIP BETWEEN THE ATTENTIONAL BLINK EFFECT AND INCREASED TASK LOAD USING REAL WORLD PICTURES *Aaron T. Karst[1], Eric S. Clapham[1], Jana Kainerstorfer[2,3], Andrei Medvedev[3], John VanMeter[3], C. Mark Wessinger[1]; [1]University of Nevada, Reno, [2]University of Vienna, [3]Center for Functional and Molecular Imaging, Georgetown University Medical Center* – The current study investigated the characteristics of the attentional blink effect by manipulating attentional task load and stimulus complexity. By substituting real world pictures into the attentional blink design we were able to increase stimulus complexity in an attempt to better understand this phenomenon. Varying complexity of stimuli allowed us to vary complexity of task. One experiment utilized a simple stimulus as target 1 (T1), differing from the distracters and the second target (T2) in color and complexity. T1 varied randomly between letters and numbers; all were blue in color. T2 was always a real world colored bike, with distracters also being real world colored pictures. At the conclusion of each trial participants were instructed to indicate whether T1 was a letter, number, or absent. Next participants were to indicate how many targets were presented during the trial. Another experiment followed the same attentional blink design using more complex stimuli for T1. Well-characterized real world color pictures were used. However, the participant's task was to indicate whether T1 was animate, inanimate, or absent. Distracters and T2 (bike) were gray scale real world pictures. Again participants were to indicate how many targets were presented during the trial. Behavioral findings across these experiments indicate that increasing attentional task load strengthens the attentional blink effect. Additionally, functional magnetic resonance imaging data collected utilizing related paradigms are being used to help identify brain regions mediating the relation between task load and the attentional blink effect.

F16

MALE SUPERIORITY IN ASPECTS OF DYNAMIC VISUAL-SPATIAL ATTENTION *KatieAnn Skogsberg[1], Lucica Iordanescu[2], Marcia Grabowecky[1], Satoru Suzuki[1]; [1]Northwestern University, [2]Northwestern Universitiy* – Gender differences in visual-spatial skills are primarily found for mental rotation. Mental rotation, however, may involve a number of sub-processes such as mentally rotating and tracking the vertices and planes of the item, and shifting attention between the rotated and test items. Although neuroimaging studies have found that men and women produce different brain activation patterns while engaged in mental rotation tasks, surprisingly few studies have investigated whether or not there are gender differences for these sub-processes. Our study aimed to elucidate this question by testing 166 participants (66 male, 100 female), using tasks evaluating relevant sub-processes: multiple-object tracking, attending to rotational direction and attention shifting. Compared to women, men were more accurate at multiple-object tracking, more successful at sustaining an intended direction when the motion signal was ambiguous, and faster at rapidly shifting attention between locations. These results suggest that there are indeed behavioral differences between men and women on the sub-processes that may be involved in mental rotation. Therefore, gender may be an important factor to control in experiments using tasks that involve these sub-processes, including but not limited to mental rotation.

F17

AN UNIFIED THEORY OF BOTTOM-UP AND TOP-DOWN ATTENTIONAL CONTROL *Michael Mozer, Matthew Wilder; University of Colorado* – Although diverse, theories of visual attention generally agree in positing that attention is guided by some combination of three distinct strategies: (1) Bottom-up guidance arises from distinctive or locally-contrasting visual features, such as abrupt onsets or color singletons (e.g., Itti & Koch, 2001). (2) Top-down gain modulation of bottom-up processes has been proposed to explain how attention can be driven primarily by task relevant feature dimensions (e.g., Wolfe, 1994). (3) Top-down contextual effects are believed to operate on scene gists to identify likely locations of interest given a task (e.g., Torralba et al., 2006). Because the three strategies can make conflicting suggestions, theories include rules for combining or arbitrating among the strategies. We propose an alternative conceptualization consisting of a single unified mechanism. We show that the previously proposed strategies -- and their combinations -- can be viewed as instances of our unified mechanism. The unified perspective offers advantages, which include: avoiding the sometimes arbitrary rules used for combination of strategies, simplifying the operation of control, and producing a parsimonious and principled framework for understanding attentional control.

F18

SHARPENING OF NEURAL REPRESENTATIONS: A MECHANISM OF TOP-DOWN CONTROL OVER INFORMATION PROCESSING BY SELECTIVE ATTENTION *Anthony J.-W. Chen[1,2], Michael Britton[1], Todd W. Thompson[3], Mark D'Esposito[1]; [1]University of California, Berkeley, [2]VA, San Francisco, [3]MIT* – How is top-down control by selective attention implemented in the human brain? Modulation of the magnitudes of localized neural responses has been emphasized as a mechanism of attentional control. However, these models do not take into account the organization of information representation in distributed, overlapping cortical networks. Organization in networks implies possible variability in levels of representational fidelity, with more distinctive vs. more overlapping network representations of information processing. We hypothesize that an important mechanism of selective attention may be the modulation of levels of fidelity in order to improve processing for task-relevant information. Using event-related functional MRI methods, this may be measured as selectivity of responses in localized brain regions and the degree of overlap of spatially distributed activity corresponding to processing of stimuli. Healthy human subjects (n=32) selectively attended to one of two competing image categories (ignoring the competing category) or non-selectively attended to both. Selective attention to a category resulted in high selectivity for that category in regions of the visual association cortex (VAC) compared to ignoring the same category. In some individuals, a reversal of selectivity towards the competing attended category was apparent. Non-selectively attending to both resulted in an intermediate level of selectivity. Patterns of voxels activated by the different categories showed less overlap during the selective attention conditions compared to the condition that did not require selectivity. These results support the hypothesis that selective attention may be implemented as a sharpening of information representation in the networks of the visual association cortex.

F19

SPATIAL UPDATING IN THE ABSENCE OF THE CORPUS CALLOSUM IN HUMANS *Elisha Merriam[1], Maryse Lassonde[2], Christopher Genovese[3], Carol Colby[4]; [1]New York University, [2]University of Montreal, [3]Carnegie Mellon University, [4]University of Pittsburgh* – With each eye movement, stationary objects in the world change position on the retina yet we perceive the world as stable. Spatial updating is one neural mechanism by which the brain compensates for shifts in the retinal image. The brain circuits that produce updated spatial representations remain unknown. We tested the hypothesis that the corpus callosum is required for updating visual information from one hemisphere to the other in humans. We used fMRI to measure activity related to spatial updating in four neurologically intact individuals and one split-brain subject (ML) who had undergone a complete callosotomy fifteen years prior to the study. Subjects performed a single-step saccade task that we have used previously to demonstrate spatial updating in human parietal cortex. In this task, the subject fixates a cross while a salient visual stimulus flickers in the periphery. The stimulus is then extinguished and a tone cues the subject to make a horizontal saccade to a second cross. The size and direction of the saccade are selected so as to bring the location of the preceding stimulus into the opposite hemifield. Spatial updating is observed as the shift in activity from one hemisphere to the other in conjunction with the saccade. We observed robust spatial updating in parietal cortex in ML and in the neurologically intact individuals. This result demonstrates that spatial representations can be updated across visual hemifields in the absence of the corpus callosum in humans.

F20

THE EFFECT OF LUMINANCE CHANGES ON THE ALLOCATION OF SPATIAL ATTENTION *Kathryn Fischer[1], Christopher Gore[2]; [1]Indiana State Unversity, [2]Unversity of Bergen* – Evidence from "pseudoneglect" has suggested that the hemispheres of the brain asymmetrically allocate attention to the contralateral side of space with a slight bias towards the left side of space. The present study further explored this attentional bias in healthy adults using a computer adapted version of the clinical confrontation task. Participants were required to detect a single stimulus briefly presented (17 milliseconds) in the left or right visual field or two stimuli presented simultaneously (one in the left and one in the right visual field). Brightness of the stimuli changed from trial to trial. Some stimuli were very easy to detect (high brightness), others were barely detectable (medium brightness), and some were not detectable at all (low brightness). There was no difference in accuracy for left versus right stimuli during conditions of high brightness and low brightness. However, there was a clear preference for left stimuli during conditions of medium brightness as accuracy was greater for these stimuli compared to those appearing on the right. The results suggest that attention is slightly biased to the left side of space when stimuli are difficult to detect. The present findings extend those found in the pseudoneglect literature and support the idea that spatial attention may be lateralized in the brain. Additionally, this lateralization may be modulated by stimulus parameters.

F21

MEASURING ATTENTION IN BOTH THE UPPER AND LOWER AND THE LEFT AND RIGHT VISUAL FIELDS *Deanna J. Greene, Nancy Sin, Eran Zaidel; University of California Los Angeles* – The Attention Network Test (ANT) is a brief computerized battery measuring three components of attention: Conflict resolution, spatial Orienting, and Alerting. The ANT stimuli consist of a leftward or rightward pointing target arrow flanked by congruent or incongruent arrows, presented above or below fixation. Trials are preceded by spatial and/or temporal cues: center, double, valid, invalid, none. We constructed a lateralized version of the task (LANT), which rotates the ANT stimuli by 90° and presents them tachistoscopically. We found differences between the upper and lower visual hemifields in the ANT and between the left and right visual hemifields in the LANT. Consequently, we constructed a version of the ANT that presents the stimuli in each of four quadrants (QANT): upper left, upper right, lower left, lower right. We ran the QANT on 41 right-handed undergraduate students, and measured Conflict (incongruent vs. congruent flankers), Orienting Cost (center vs. invalid cues), Orienting Benefit (center vs. valid cues), and Alerting (double vs. no cues). There were significant estimates of each network in each quadrant. Conflict and Orienting did not interact with quadrant, but Alerting did. Alerting was largest in the upper left, smallest in the lower left, and similarly intermediate in the upper and lower right. This suggests an attentional bias in Alerting for extrapersonal space in the right hemisphere.

F22

VIGILANCE TRAINING VS. SEARCH TRAINING IN COGNITIVE REHABILITATION OF PATIENTS WITH HEMISPATIAL NEGLECT *Joe DeGutis[1], Thomas Van Vleet[2]; [1]University of California, Berkeley, [2]Department of Veterans Affairs, Martinez VA* – Currently there exists no generalizable, long-lasting treatment for the debilitating spatial and non-spatial deficits exhibited in patients with chronic neglect. While several experimental interventions have utilized methods to induce increased scanning of neglected space (e.g., optokinetic stimulation, self-cueing) or enhanced vigilance (e.g., sustained attention training), there has been no direct comparison of spatial and non-spatial interventions in the same patients. In the current study we compared a novel scanning intervention and a vigilance training intervention within the same patients with chronic neglect. The scanning intervention consisted of training patients to search for a disappearing/reappearing object in a complex, natural scene. A sound was randomly presented on the left side of the scene on 50% of trials and was not predictive of target location. The vigilance intervention consisted of training patients to detect a target scene in a continuous stream of distracter scenes presented at fixation. Patients improved performance on both intervention tasks which generalized to improvements on assessments of attention. Scanning and vigilance interventions produced similar improvements in object-based attention. However, they had differential effects on visual search: scanning training increased search efficiency whereas vigilance training promoted a greater balance between searching right and left space. Also, scanning training promoted longer-lasting effects than vigilance training. These results suggest that training both spatial and non-spatial mechanisms of attention may provide beneficial and unique improvements in patients with neglect.

F23

CHOLINERGIC ENHANCEMENT INCREASES REPRESENTATION SELECTIVITY IN VISUAL ASSOCIATION CORTEX *David Fegen[1], Anthony J-W Chen[1,2], Aaron Koralek[1], Joshua Hoffma[1], Adam Gazzaley[2,1], Mark D'Esposito[1]; [1]Henry H. Wheeler Jr. Brain Imaging Center at the Helen Wills Neuroscience Institute, University of California, Berkeley, [2]University of California at San Francisco* – Whereas increased acetylcholine levels have been shown to enhance the signal-to-noise ratio at the neural level, the mechanisms by which these drugs work at a systems level is unknown. This study tests the hypothesis that a cholinesterase inhibitor, donepezil, will enhance the selectivity of visual representations by altering the neural activity pattern across a distributed network. Specifically, we predict that donepezil will cause the neural representations of sensory stimuli to exhibit less overlap with those that characterize other visual object categories. Healthy human subjects (n=28) were scanned with fMRI while they performed a 1-back task, which involved viewing images from two visual categories (faces or scenes) in alternating 16 sec blocks. The effects of donepezil (5mg) were assessed using a randomized, double-blind placebo-controlled crossover design. The 15 most responsive voxels for each visual category were identified for each subject within an anatomically defined region of inferotemporal cortex. An overlap analysis revealed that there was less overlap of maximally face and scene responsive voxels with donepezil administration. Furthermore, a percent signal analysis showed that donepezil does not selectively increase the signal (image category being shown) nor reduce the noise (image category not being shown), but rather amplifies the overall difference between the two. These results suggest donepezil increases representation selectivity by decreasing the overlap between representations of different object categories and enhancing the overall signal-to-noise ratio.

F24

ALCOHOL INTOXICATION SELECTIVELY AFFECTS NOVELTY-P3A AMPLITUDE AND TIME-FREQUENCY THETA ACTIVITY: A PLACEBO CONTROL DESIGN *Noah Venables[1], Edward Bernat[1], Paul Collins[1], Alan Lang[2], Christopher Patrick[1]; [1]University of Minnesota, [2]Florida State University* – Previous research has demonstrated moderately low doses of alcohol attenuate both novelty P3a and target P3b ERP responses in a novelty-oddball experiment, but suggests that novelty P3a responses related to orienting may be selectively reduced (Marinkovic et al., 2001). The current study assessed whether acute alcohol intoxication differentially impacts the amplitude of novelty P3a vs. target P3b. Additionally, time-frequency energy was decomposed into theta and delta components and evaluated. Finally, intoxication effects on the affective differentiation in the processing of unexpected emotional stimuli were assessed. A visual novelty-oddball paradigm in which IAPS pictures served as the novel affective stimuli was employed. Participants were randomly assigned to receive alcoholic or placebo beverages. Mean blood alcohol concentration in the alcohol group was .089%. Behavioral performance (accuracy and reaction times) was not significantly different between groups. Alcohol significantly reduced novelty P3a amplitude to a greater extent than target P3b amplitude. Despite the reduction in novelty P3a, the alcohol group showed the same ERP differentiation of emotional content relative to neutral in the IAPS pictures as placebos. Finally, time-frequency delta and theta components around the time of the P3a and P3b were identified using principal component analysis of time-frequency data (cf. Bernat et al., 2005). Results suggest that alcohol impacts midline-frontal theta more than parietal delta, particularly during orienting to novel stimuli.

F25

SUSTAINED ATTENTION DECREASES SPATIAL SPREAD OF VISUAL RESPONSES IN HUMAN EARLY VISUAL CORTEX *Michael Silver, Amitai Shenhav, Mark D'Esposito; University of California, Berkeley* – We used fMRI to measure the spatial extent of visual responses in human early visual cortex while subjects performed a sustained attention task. Animal studies have demonstrated that sustained attention increases cortical release of acetylcholine (ACh). We have previously shown that increasing synaptic ACh in human subjects with the cholinesterase inhibitor donepezil (Aricept) decreased the spatial spread of responses to visual stimuli. In the present study, subjects viewed a contrast-reversing checkerboard annulus centered about the fixation point. The annulus was presented in a block-alternation design, with periods of 10 seconds of stimulus alternating with 10 seconds of a blank screen. In separate 5-minute fMRI runs, subjects either passively viewed the stimulus annulus or covertly attended to its left or right half while performing a target (contrast decrement) detection task. Targets occurred at random times and locations within the annulus, thereby requiring subjects to maintain attention over the entire cued hemiannulus for the full stimulus duration (10 seconds). We measured the number of voxels in early visual cortex that showed a positive fMRI response to stimulus presentation for attended, ignored, and passively viewed stimuli. Relative to passive viewing, sustained attention caused a significant decrease in the spatial spread of visual responses. This result was obtained for visual cortex representing the attended hemiannulus as well as cortex representing the ignored hemiannulus. Thus, compared to passive viewing, sustained visual attention per se reduced spatial spread of responses to a visual stimulus, regardless of whether that stimulus was attended or ignored.

F26

ATTENTION NETWORKS AND WHITE MATTER: EVIDENCE FOR DISTINCT STRUCTURE-FUNCTION RELATIONSHIPS FOR ALERTING, ORIENTING, AND CONFLICT *Sumit Niogi[1], Rachel Kolster[1], Bruce McCandliss[1,2], [1]Weill Medical College of Cornell University, [2]CNRC-TBI: The Cognitive Neurobiological Research Consortium in Traumatic Brain Injury* – Attentional processes have been proposed to involve three component processes – alerting, orienting, and executive function – which have been linked to separable brain networks (Posner and Petersen, 1990) via functional neuroimaging and lesion studies. In the current study, we investigate relationships between individual differences in efficiency of components of attention and specific white matter tract regions. White matter microstructure was measured in 25 normal adults using 3 Tesla magnetic resonance diffusion tensor imaging, and related to performance in each component of attention using the Attention Network Task (Fan et. al., 2002). Fractional anisotropy (FA) values were evaluated using a small number of a priori regions of interest, analyzed on a subject-by-subject basis. Performance in the alerting component was correlated with integrity of the thalamic radiations ($p<0.05$), yet this ROI was uncorrelated with orienting or executive components of attention. Similarly, performance in orienting, but not alerting or executive function, was correlated with the splenium of the corpus callosum ($p<0.05$). Finally, performance with only the executive component of attention was correlated with FA scores in the anterior corona radiata ($p<0.05$). Statistical dissociation across these relationships is demonstrated using a series of multiple regression analyses showing that unique variance is attributed to each structure-function relationship. By establishing a relationship between individual differences in each component of attention with variations in integrity of specific white matter pathways, it is possible to delineate the neuronal pathways involved in the attention networks.

F27

NEURAL MECHANISMS OF IMMUNE-MEDIATED PALINOPSIA *Martin Goldstein[1], Michael Silverman[1], Annabel Wang[1], Oliver Tuescher[2], Jennifer Woehr[1], Marcel Kinsbourne[3]; [1]Mount Sinai School of Medicine, [2]Universitätsklinik Freiburg, [3]New School* – Background: Emerging evidence implicates inflammatory mediators (e.g., cytokines) in the neuropathophysiology of select neuropsychiatric disturbances. Interferon-alpha (IFN), a potent activator of the inflammatory cytokine network, has been recently employed as a model for probing inflammatory mechanisms by which somatic medical conditions can produce neuropsychiatric dysfunction. Objective: To characterize neural substrates of palinopsia (perseveratory afterimages (AI)) in a premorbidly neuropsychiatrically-well 42 year-old woman treated with immunomodulator therapy for chronic hepatitis C infection. Methods: 120 stimuli comprising 6 categories (iconic color, iconic black/white, nonsense forms, happy face, sad face, neutral faces) were serially presented at varying onsets in a counter-balanced pseudorandomized order (SOA=4s) during EPI-BOLD fMRI acquisition performed on a Siemens 3T MRI scanner (TR=2000ms; TE=30ms; flip angle=90°; FoV=210mm x 210mm; 3.0mm thickness; 1mm gap; matrix=64x64). Subject was instructed to attend to each image and, once removed, respond using a button press to AI presence (AI+) or absence (AI-). Image analysis was conducted using SPM2. Results: A significant difference in AI occurrence was revealed as a function of stimulus onset ($X2(3) = 12.26$, $p<0.01$). Contrasting mean BOLD responses associated with AI+ versus AI- trials revealed AI+ associated activation of a neural network including dorsal anterior cingulate, thalamus, caudate, and right parietal regions. Conclusion: Palinopsia can be associated with activation of a distinct neural network involving components implicated in visual attention and conflict-detection. Consistent with other findings revealing IFN-related cognitive impairment associated with functional neural changes, these findings offer additional evidence implicating inflammatory markers as candidate mediators of neuropsychiatric dysfunction in somatic medical illness.

F28

EFFECTS OF LEARNED INHIBITION ON CORTICAL PROCESSING *Maha Adamo[1], Taylor W Schmitz[2], Kamal Shaikh[1], Eve De Rosa[1]; [1]University of Toronto, [2]University of Toronto* – Selective attention operates by increasing the signal-to-noise ratio for behaviourally relevant information, which can be achieved by increasing the signal from relevant information and/or by reducing the noise from irrelevant information. When a given distractor has been ignored previously in two separate contexts, negative transfer is evident in the slowed response times elicited when that distractor becomes the target. For example, if places are first ignored while faces are attended, and then places are again ignored while chairs are attended, the places will elicit slower responses when they finally become the target and tools are ignored. We examined the modulatory effects of this suppression and subsequent negative transfer on functionally distinct extrastriate cortical areas that respond selectively to these different classes of stimuli. Fifteen healthy, young adults were scanned using a spiral-in/out protocol on a GE 3T MRI scanner (TR = 2s, TE = 30ms; 28 slices, slice thickness = 6mm, gap = 0, in-plane resolution = 3.6mm x 3.6mm). Using a block design, participants were exposed to place stimuli as distractors in two contexts before places became the target stimuli, as described above. Analyses using SPM2 revealed modulation in extrastriate areas commensurate with the relevance of the stimulus classes. Namely, altered BOLD activations were observed in the parahippocampal place area (PPA) during the final block in which places switched from irrelevant to relevant. This change in cortical activity is likely due to inhibitory modulatory influences from the lateral frontal cortex.

F29

DISTINCT AND OVERLAPPING FRONTAL-SUBCORTICAL NETWORKS FACILITATE CHANGES IN SELECTIVE ATTENTION DURING LEARNED INHIBITION *Taylor W. Schmitz, Maha Adamo, Eve De Rosa; University of Toronto* – The process of visual selective attention directly influences the scope of perceptual information encoded in extrastriate cortices. This enables the enhancement of behaviourally relevant information in the visual field, while minimizing distraction from irrelevant information. However, in order to facilitate such adaptive responses to stimuli, both the brain must rapidly learn new contingencies when confronted with changes in stimulus relevance. This fMRI investigation focused on differentiating the neural mechanisms underlying adaptive response to task-induced shifts in selective attention. We used a simultaneous discrimination paired-associate paradigm in which participants learned to respond to relevant target stimuli while ignoring irrelevant distractor stimuli. Then in a second learning phase, the participants continued to ignore the same distractors while learning to respond to new target stimuli. In a third negative transfer phase, the irrelevant distractor stimuli from the first two learning phases became the new target stimuli paired with new distractor stimuli. FMRI (3T Signa) was acquired on fifteen cognitively intact young adults while they performed this paired-associates task. Group analyses of the fMRI task revealed distinct and overlapping neural systems involved at each phase of learning and transfer. Signal in the left lateral orbitfrontal and rostral anterior cingulated cortices was significantly greater in the second learning phase compared to the first when the same distractor stimuli appeared in a new context, indicating that the distractors were truly behaviourally irrelevant. Comparisons of the transfer phase with the second learning phase yielded activation in the anterior hippocampus, indicating adaptive learning response to novel processing contingencies.

F30

AGE-RELATED CHANGES IN SELECTIVE ATTENTION ENHANCES MEMORY FOR THE IRRELEVANT *Fred Cheng[1], Taylor W. Schmitz[2], Lynn Hasher[1], Eve De Rosa[1]; [1]University of Toronto, [2]University of Toronto* – Selective attention enables us to process behaviourally relevant information from the environment while simultaneously filtering out the irrelevant. Given that the efficiency of selective attention is presumed to decline in the course of normal aging, the present study examined how the processing of irrelevant information differs between younger (n=48; mean age=19.3±2.6) and older adults (n=29; mean age=74.1±5.3). Participants performed a gender judgment task comprised of superimposed face (target) and house (ignored) stimuli. It was hypothesized that older adults would unintentionally encode more task irrelevant (house) information. Some of the stimuli were presented multiple times non-consecutively, whereas others were presented only once. On a subsequent implicit recognition test, participants matched the previously seen faces with either the correct (previously seen) house or a novel house. Performance accuracy on the implicit recognition test provided a measure of unintentional encoding of irrelevant (house) information during the gender judgment task. Older adults exhibited significantly better accuracy on the implicit recognition test (0.62±0.04) compared to the younger group (0.49±0.03) for the repeated irrelevant stimuli from the gender judgment task. However, there was no difference detected in explicit recognition for the houses between groups. The results suggest that older adult's enhanced implicit knowledge of irrelevant information reflect impaired selective attentional control. Future neuroimaging studies examining selective attention processes between these two groups may reveal distinct neural signatures that predict the behavioural correlates of impaired selective attention in older adults. This work is currently underway in our lab.

F31

THE ROLE OF FRONTAL CORTEX IN THE SPATIAL REPRESENTATION OF NUMBERS *Elena Rusconi, Domenica Bueti, Vincent Walsh, Brian Butterworth; University College London, UK* – Recent neuropsychological and neurophysiological studies have suggested that prefrontal cortex may be involved in non-verbal number processing, when relevant for the current behavioural goals. More precisely, it has been suggested that the right inferior frontal gyrus (rIFg) in humans may contribute to the spatial mental representation of numbers, also known as mental number line. rIFg is part of a right-lateralized frontoparietal network that conveys signals to a dorsal network supporting attentional orienting in contralateral space. In particular, the frontal eye fields (FEF) are known to contribute to visual scene analysis and visual conjunction search tasks when eye movement commands are not required. In the present study, we hypothesised they might be also involved in exploring a conceptual space, such as the mental number line. We examined the proposed functions of the human rIFg and rFEF by interfering with their normal functioning with rTMS while participants performed numerical tasks. The results establish that rIFG supports a representation of the entire mental number line while rFEF is crucial for contralateral orienting (that is toward small numbers), but only when number magnitude is relevant to the task.

F32

ATTENTIONAL DEPLOYMENTS IN SPACE: NEURAL CORRELATES OF BEHAVIORAL PERFORMANCE *Simon Kelly[1], Manuel Gomez-Ramirez[2], Jennifer Montesi[1], John Foxe[2]; [1]Nathan S. Kline Institute for Psychiatric Research, [2]The City College of the City University of New York,* – We investigated the dynamics of anticipatory attentional deployment and how these deployments support behavior during performance of a spatial cueing task. Arrow cues instructed subjects to attend to either the left or right hemifield in anticipation of an imperative stimulus appearing 800ms later. Stimuli consisted of either an 'X' or '+' surrounded by small circles. The subject was required to respond if a target appeared on the cued side, and to ignore stimuli appearing on the opposite location. By parsing the data into correct (i.e. hits) and incorrect responses (i.e. misses and false alarms) and then inspecting the activity in the interval between the cue and the imperative stimulus (CTI), we assessed the links between anticipatory attentional deployment processes and behavioral performance. Our analysis focused on the Late Directing Attention Positivity (LDAP) and the alpha-differential-effect of the late phase of the CTI. These electrophysiological (EEG) components have been extensively shown to reflect real markers of spatial attentional deployments. First, broadband ERP analysis revealed a greater LDAP contralateral to the cued side for hits relative to misses. Secondly, the oscillatory power in the alpha frequency range (8-14 Hz) showed a greater alpha-differential-effect for hit versus miss responses in both hemispheres. Importantly, no significant differences between hits and misses where found in the earlier ERP components of the cue stimulus, which further suggests that these two well-established EEG correlates of spatial attentional deployment may have direct influence on the behavioral outcome of task performance.

Emotion

F33

PERCEPTION OF POSITIVE AND NEGATIVE EMOTIONAL FACIAL EXPRESSIONS IN HUMANS: A COMBINED ELECTRO- AND MAGNETO-ENCEPHALOGRAPHY STUDY *Shasha Morel[1], Aurélie Ponz[2], Manuel Mercier[3], Patrik Vuilleumier[2], Nathalie George[1,4]; [1]CNRS UPR 640 – LENA / Université Pierre et Marie Curie, Paris, France, [2]Université de Genève, Switzerland, [3] Neuroscience, Brain-Mind Institute, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, [4]Centre MEG-EEG, Paris, France* — Several recent studies have provided evidence for influences of emotional facial expression on face encoding and memory. However, the temporal dynamics of this interaction is not yet clear. We investigated this issue in a repetition paradigm using 70 fearful, 70 happy and 70 neutral faces, each repeated once with a lag of 1 to 6 minutes. Fourteen subjects participated in this combined electro-encephalography (EEG -64 electrodes, nose reference-) and magneto-encephalography (MEG -151 sensors, whole-head CTF system-) study. An early repetition effect was found between 40 and 50 ms in occipito-temporo-parietal regions in both MEG and EEG. Although this effect was present for all emotions, its scalp distribution varied according to the facial expression in MEG and it reached significance only for neutral faces in EEG. The face-selective N170 (EEG) and M170 (MEG) both showed a repetition enhancement for neutral faces only. This was associated with greater M170/N170 for emotional than for neutral faces on first but not on second presentation. Around 300ms, a repetition suppression effect specific to fearful faces was observed in MEG, together with greater M300 component for fearful faces on first presentation only. Other effects included an earlier P100 and enhanced Late Positive Component (LPC) to fearful compared to happy and neutral faces, in EEG data. These results show that emotional facial expressions modulate face encoding and memory at different stages of face processing, starting as soon as 40-50ms. Fear-selective effects however were first found around 100 ms and then on the late components (LPC and M300).

F34

USING THE MEMORY CHARACTERISTICS QUESTIONNAIRE TO EXAMINE HOW WE REMEMBER EMOTIONAL STIMULI *Katherine Mickley, Elizabeth Kensinger; Boston College* — A major approach to the understanding of emotion and cognition is the study of memory for emotional events, but exactly what details are remembered about these emotional events has yet to be clearly defined. In order to determine the details people remember about emotional items, participants viewed pictures that varied by valence (negative, positive, neutral) and arousal (high arousing, low arousing). After an approximately 45-min delay, participants were given a recognition memory test. If participants indicated that an item was "old," they were then asked to complete a series of memory characteristics questions, asking them the amount of thoughts, feelings, associations, visual details, and temporal information they remembered about the item's presentation. Although recognition accuracy was similar regardless of valence or arousal, emotion did affect the memory characteristics responses. Thoughts as well as feelings were most likely to be remembered for negative arousing pictures. However, emotion did not affect the amount of visual detail, temporal information, or other associations that participants remembered between valence and arousal categories. These results suggest that people's internal thoughts and feelings often make up the core of an emotional memory, whereas other components such as visual details, order effects, or associations play a much smaller role.

F35

EMOTIONAL PROCESSES IN GO/NOGO CONFLICTS *Annekathrin Schacht[1,2], Roland Nigbur[1,2], Werner Sommer[1,2]; [1]Humboldt-University at Berlin, [2]Institute of Psychology, Biological Psychology/ Psychophysiology* — Recent research indicates close functional and neurophysiological ties between error and conflict processing. Emotional processes have been shown to be present in decision making and to be relevant for the optimization of behavior. Therefore, emotional processes might also play an important role in correct performance in cognitive conflict paradigms. Here we investigated emotional reactions in a Go/ NoGo paradigm which is known to evoke elementary but relatively strong response conflicts. In Experiment 1, the appearance of cognitive conflicts in NoGo trials was corroborated by enhanced N2/P3 amplitudes in Event-related potentials. NoGo trials elicited larger skin conductance responses (SCRs) and higher activity of the corrugator muscle than Go trials. Further, the intensity of cognitive conflicts was manipulated by varying the proportion of NoGo trials (50, 35, and 20%). As NoGo probability decreased, all psychophysiological indicators increased in amplitude or duration. In Experiment 2, only 20% NoGo trials were used. Here, additional to SCRs startle blinks of orbicularis oculi muscles were recorded in response to acoustic startle probes. Whereas SCRs replicated enhanced amplitudes in NoGo trials found in Experiment 1, no modulations of startle blink amplitudes were found. Taken together, the present results suggest that NoGo conflicts induce emotional arousal as reflected in SCRs. The prolonged corrugator activity may indicate the obtrusiveness of NoGo situations in predominantly Go-oriented response sets or it may reflect some kind of negative emotional valence. However, NoGo situations do not appear to activate the motivational defensive system as startle blink amplitudes were not modulated relative to Go trials.

F36

WATCH OUT ! FEARFUL FACES MODULATE EARLY ELECTROMAGNETIC BRAIN RESPONSES ASSOCIATED WITH GAZE CUEING EFFECT *Nathalie George[1,2], Sara Benetti[3], Shasha Morel[1], Teresa Farroni[3,4]; [1]Cognitive Neuroscience and Brain Imaging Unit, CNRS UPR 640 (LENA) / Université Pierre et Marie Curie, Paris, France, [2]Centre MEG-EEG, Hopital de la Salpetriere, Paris, France, [3]University of Padova, Italy, [4]Centre for Brain and Cognitive Development, Birkbeck College, London, England* — Seeing a face with averted gaze triggers in the observer an automatic orienting of spatial attention in the direction of the seen gaze. It has been recently shown that this effect can be enhanced when the face is fearful as opposed to happy or neutral. Here we investigated the cerebral correlates of this effect in a Posner-like cueing paradigm using fearful and happy faces. Fifteen subjects saw neutral faces with direct gaze which became fearful or happy while their gaze moved to the right or left or remained straight. This was followed after a variable delay by a target in the valid or invalid hemifield which the subject had to detect. Electromagnetic brain responses were recorded on a 151-sensors whole head CTF system. We found early differentiation of Event-Related magnetic Fields (ERFs) in response to fearful versus happy cues which peaked around 100ms. Most importantly, there was a very early enhancement of the ERFs in response to valid relative to invalid targets which was selective to fearful faces. This effect was observed between 55 and 65 ms and shows that fear can modulate the attentional bias induced by seeing gaze shifts from the very early stage of visual processing. It provides evidence for neural mechanisms subtending rapid spatial orienting of attention in response to fearful stimuli.

F37

NEURAL RESPONSE TO DYNAMIC PROPERTIES OF FACIAL EXPRESSION *Anna Matheson[1], Michelle de Haan[1]; [1]Institute of Child Health, University College London, London, UK* – Dynamic properties of facial expressions can influence the perception of emotions, with motion often enhancing the neural response and improving accuracy of perception. The aims of this study were to examine the effects of motion on: (1) the identification of 6 basic facial emotions, and (2) the timing and scalp topography of the neural events accompanying emotion perception. In Experiment 1 (n=36), participants identified emotion in static and morphed dynamic images of six basic facial expressions (anger, disgust, fear, happiness, sadness and surprise). Overall, they tended to rate dynamic images more accurately than static ones (p=0.056), but a Motion and Emotion interaction indicated that this was driven by anger, fear, and sadness (p's <0.05). In Experiment 2 (underway), participants' 128-channel event-related potentials are being recorded while they passively view a subset of these images selected to control accuracy of recognition across static and dynamic formats. We anticipate that the N170 component will be larger for dynamic than static expressions and show a different scalp topography due to the differential involvement of the fusiform gyrus and superior temporal sulcus in generating the N170 in the two conditions. The results suggest that the dynamic properties of facial expressions allow for a higher degree of accuracy of recognition, possibly because the temporal aspects of motion provide additional cues for differentiating emotions. Experiment 2 provides additional information about differences in the timing and topography of brain events involved in processing static and dynamic emotions.

F38

CAPTURING NEURAL PROCESSES OF FEAR EXCITATION AND INHIBITION WITH EVENT-RELATED SYNTHETIC APERTURE MAGNETOMETRY *Brian Cornwell[1], Linda Johnson[1], Christian Grillon[1]; [1]National Institute of Mental Health* – Neuroimaging studies of fear have predominantly focused on elucidating neural mechanisms mediating fear excitation with less emphasis on studying those mediating fear inhibition. Adaptive MEG beamformer analyses offer a unique way to study both these phenomena as they unfold over time across distributed neural systems. Using an instructed threat procedure, 180 trials began with a threat stimulus indicating potential risk of shock. One of two stimuli then appeared and coterminated with the initial threat stimulus (~1500ms SOA), either a cue indicating that participants were still at risk (100 trials, 20% shock reinforcement at cue termination) or a cue indicating that they were completely safe (80 trials). Neuromagnetic data were collected from 16 healthy participants (7 women) at 600Hz with a 275-channel whole-head MEG system. Event-related synthetic aperture magnetometry analyses were conducted to estimate the distribution of stimulus-evoked responses (1-30Hz) across the brain (in 5mm steps) in 100ms post-stimulus windows. Participants reported greater anxiety to the second threat stimulus and less anxiety to the safety stimulus relative the first threat stimulus. Source analyses confirmed that the initial threat stimulus elicited a rapid amygdala response, indicating fear processes were engaged before safety cue presentation. Notably, we found greater left ventromedial prefrontal and bilateral supramarginal gyral activity to the safety cue over the second threat cue, two structures that have been implicated in fear inhibition and successful regulation of negative affect. Our presentation will focus on characterizing the time courses of activity of the major structures involved in fear excitation and inhibition.

F39

EARLY NEUROMAGNETIC MODULATIONS TO EMOTIONAL FACES *Margot J. Taylor[1], Sarah J. Bayless[2], Nathalie George[3], Magali Batty[4]; [1]Hospital for Sick Children, University of Toronto, [2]Research Institute, Hospital for Sick Children, [3]CNRS UPR 640 - LENA / Université Pierre et Marie Curie, and Centre MEG-EEG, Paris, France, [4]INSERM U619, Centre de Pedopsychiatrie, CHU Bretonneau, Tours, France* – The neural system underlying the processing of facial emotion encompasses the face-sensitive visual ventral stream as well as limbic structures and orbitofrontal cortex. We used magnetoencephalography (MEG) with an event-related spatial filtering technique (erSAM), that calculates source power at single time points to image time-locked activity with high spatial accuracy, to determine the neural underpinnings of early emotional face processing. Eighteen adults participated. MEG was recorded while subjects viewed faces expressing six basic emotions (anger, disgust, fear, happiness, sadness, surprise) and neutral expressions; subjects responded to rare, non-face stimuli. Analyses of the latency and amplitude of M170 at the sensor level showed a main effect of emotion on latency (happy and neutral faces had shorter latencies than negative emotions); there was a trend for M170 amplitude to be largest to fearful faces. The latency of the occipitally recorded M90 showed a global effect of emotion. erSAM analyses of M170 showed activations in the fusiform gyri, which were not affected by emotion. This suggests that the effects on the peak measures of M170 were due to overlapping sources at the sensors, likely including STS regions. At 90ms the erSAM analyses showed the expected posterior visual regions of activity and also left orbitofrontal activation, but only for the fearful faces. This is consistent with models of activation of the frontal lobes via subcortical pathways with emotionally salient stimuli, as shown with fMRI. With MEG and erSAM we were able to demonstrate the impressive rapidity of this orbito-frontal involvement.

F40

FMRI EVIDENCE FOR SIMULATION AS A MECHANISM FOR EMOTION UNDERSTANDING AND EMPATHY *Christine I. Hooker[1], Sara C. Verosky[1], Laura T. Germine[2], Robert T. Knight[1], Mark D'Esposito[1]; [1]University of California at Berkeley, [2]University College London* – Recent research suggests that specific brain regions facilitate the use of simulation as a mechanism for understanding mental states, such as the inferior frontal gyrus (IFG) for imitation, the somatosensory related cortices (SC) for identifying emotional expression, and the ventromedial prefrontal cortex (VMPFC) for using self-knowledge to understand the mental states of similar others. We tested the hypothesis that these three regions should be active during emotion judgments in which people are most likely to use simulation; specifically, emotion recognition of someone with similar vs. dissimilar perspective as themselves, and emotion inference that requires imagining (vs. identifying from available cues) what a person would feel if they had more knowledge about a situation. Furthermore, we predicted that neural activity in these regions during these judgments would correlate with the amount of empathy experienced in daily life. We found that the IFG, VMPFC, and SC were more active during emotion judgments that were most likely to use simulation as compared to emotion judgments that were not. Furthermore, activity in these regions was significantly correlated to self-reported empathy. The findings suggest that using simulation as a strategy to understand emotional states is related to enhanced empathy.

F41

SEXUAL OFFENDERS BIAS ATTENTION TO EROTIC WORDS: AN ERP STUDY *Yu-Ying Chou[1], Chi-Kuang Sun[2], Chiao-Yun Chen[2], Ovid J.L. Tzeng[3], Daisy L. Hung[3]; [1]Institute of Cognitive Neuroscience, National Central University, Jhongli, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan, [3]Institute of Neuroscience, National Yang-Ming University; Institute of Linguistics, Academia Sinica, Taipei, Taiwan* – Introduction: The individuals with various emotional and drug-abuse disorders demonstrated attentional bias for stimuli specifically related to their characteristics. Here we incorporated the emotional Stroop task into the event-related potentials (ERPs) to investigate if the sexual offenders exhibit attentional bias for erotic words. Method: The study was divided into two sections. First, we requested twenty healthy male subjects to rate the valence of the emotional words to select the formal stimuli. Second, we required six sexual offenders and six normal subjects to conduct the emotional Stroop task when ERPs were recorded. There were a total of three types of the emotional words – negative, erotic, and neutral – to be presented in color of red, green, blue, or yellow. The colored rectangles were set as the baseline. The participants had to ignore the meaning of the words as well as press the button corresponding to the color of the word presented. Results: The sexual offenders relative to the normal controls tended to respond to the erotic words with stronger N1 but weaker N2 amplitudes. Both of them did not differ in their behavioral performance. Discussion: Our study demonstrated that behaviorally attentional bias might be reflected in the early ERP components. And our results suggest that these sex offenders might have differential neural underpinnings of attentional bias for erotic materials.

F42

NEURAL CORRELATES OF EMOTION REGULATION IN SEXUAL OFFENDERS AND HEALTHY CONTROLS: A GO/NO-GO TASK FOLLOWING AFFECTIVE PICTURE PROCESSING *Chi-Kuang Sun[1], Yu-Ying Chou[2], Chiao-Yun Chen[1], Ovid J. L. Tzeng[3], Daisy L. Hung[3]; [1]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan, [2]Institute of Cognitive Neuroscience, National Central University, Jhongli, Taiwan, [3]Institute of Neuroscience, National Yang-Ming University; Institute of Linguistics, Academia Sinica, Taipei, Taiwan* — Introduction: Recent theoretical accounts of emotion regulation assign an important role in inhibitory control, yet there is little relevant research on their neural underpinnings. Here we investigated how emotion regulation intertwines response inhibition across sexual offenders and healthy controls. Method: A total of five sexual offenders and five normal male subjects participated in this study. We recorded the event-related potentials (ERPs) when participants viewed emotional pictures followed by a simple go/no-go procedure. Three categories of emotional pictures derived from the IAPS (unpleasant vs. pleasant vs. neutral) were used as the emotion prime. Particularly, the pleasant contents were characterized by erotic couples and females. Results: The sexual offenders relative to the healthy controls showed larger late positive potentials (LPP) to pleasant pictures. The healthy controls, instead of the sexual offenders, showed smaller N2 amplitudes (No-Go minus Go) to the go/no-go tasks under the unpleasant and pleasant conditions relative to the neutral condition. Discussion: The results suggest that the differential N2 across the sexual offenders and healthy controls might derived from their previous differential impact of emotional pictures reflected in the LPP. There might be both genetic and environmental contributions to sexual offenders' altered neural underpinnings of emotion regulation on response inhibition.

F43

THE MEDIUM AND THE MESSAGE: NON-CONSCIOUS PROCESSING OF EMOTIONS FROM FACIAL EXPRESSIONS AND BODY LANGUAGE IN BLINDSIGHT *Marco Tamietto[1], Luca Latini Corazzini[1], Giuliano Geminiani[1], Lawrence Weiskrantz[2], Beatrice de Gelder[3,4]; [1]University of Torino, Italy, [2]University of Oxford, Oxford, UK, [3]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, Boston, MA, USA, [4]Tilburg University, The Netherlands* — Non-conscious recognition of emotions in the absence of striate cortex - affective blindsight - has thus far emerged only for facial expressions. Here we investigated whether: a) affective blindsight is present also when emotions are expressed through non-facial signals; b) non-conscious extraction of affective information is insensitive to perceptual differences between various ways of communicating the same emotion (e.g., a fearful facial or bodily expression). We used indirect measures of blindsight on the well-known patient DB with left hemianopia to test for affective blindsight for emotional body language (Experiment-1) and for the joint combination of facial and bodily emotional expressions (Experiment-2). Happy or fearful expressions were presented either unilaterally in the right intact hemifield or bilaterally in congruent and incongruent conditions (i.e., with both stimuli showing the same emotion, or with one stimulus showing happiness and the other showing fear, respectively). Reaction times (RTs) were faster in the bilateral congruent condition with two fearful bodily expressions than in the unilateral or bilateral incongruent condition (Experiment-1). Most interestingly, two congruent fearful expressions reduced RTs even when the same emotion was conveyed by body language in one hemifield and by facial expressions in the opposite hemifield (Experiment-2). These results indicate that: a) affective blindsight occurs also for bodily and not only for facial expressions; b) the congruency in the emotional meaning instead of the perceptual similarity between the consciously seen and non-consciously perceived stimulus is the critical factor for interhemispheric cooperation in affective blindsight to occur.

F44

THE INITIAL BRAIN RESPONSE TO PLEASANT AND UNPLEASANT MUSIC. AN FMRI STUDY. *Tom Fritz, Koelsch Stefan; Max Planck Institute for Cognitive and Brain Sciences, Leipzig* — The present study used short pleasant music excerpts and their manipulated unpleasant counterparts to determine neural correlates of music listening with functional magnetic imaging (fMRI). It contributes to the investigation of the timecourse of emotion, focusing on the initial response to acoustic stimuli with positive and negative valence. Furthermore, it investigates the distortion of the vertical organization of music (spectrum), and the distortion of a horizontal organization of music (forward/backward). A correlation of BOLD signal with decreasing valence revealed an activation of the right amygdala, the premotor cortex bilaterally, the right motor cortex, the paracentral lobe bilaterally, and the right superior parietal lobe. The activation of the amygdala in the response to increasing unpleasantness of the music replicates a previous finding (Koelsch et al., 2005), but now revealing that the amygdala is already activated in the initial response to unpleasantly manipulated music. A correlation of BOLD signal with increasing valence revealed activations in a dorsal aspect of the amygdala and the frontomedial orbitofrontal cortex (among others). That different anatomical aspects of the amygdala are involved in both, the perception of high and low valenced stimuli is in line with findings that demonstrated that this structure is not only important for negative emotions, but also relevant for positive emotions. The orbitofrontal cortex has previously been shown to be involved in emotion processing during music listening; the present data provide the first evidence for such an involvement with functional MRI. Furthermore, the functional connectivity of the observed maxima in the central and dorsal aspects of the amygdala are investigated.

F45

THE EFFECT OF MOTIVATION AND STRESS ON THE ERN AND THE P3 *Koki Ikeda, Taiki Takahashi, Hirokata Fukushima, Toshikazu Hasegawa; University of Tokyo* — Two ERP components, the error-related negativity (ERN) and the P3 are known to be enhanced when motivational factors of task performance are emphasized. To examine whether these motivational modulations of ERPs are accompanied with and related to the physiological stress responses, we measured the feedback-ERN, the P3, and two stress biomarkers, salivary cortisol and alpha amylase, simultaneously. The experiment was conducted in a between-subject design, using the time estimation task. Subjects in the experimental condition performed the task under video recording and negative evaluation by the experimenters. Preliminary data analysis showed, although the motivational manipulation did modulate the amplitude of the ERN and the P3 in the predicted direction, they were not accompanied with the overall group difference in salivary alpha amylase level. However, there was a significant correlation between the alpha amylase level and the P3 amplitude when the motivational factors were emphasized. The results were discussed in the context of central noradrenergic system of arousal and anxiety.

F46

DIFFERENTIAL HABITUATION OF AMYGDALA ACTIVITY TO FEARFUL FACES IN ADOLESCENCE *Todd Hare, B. J. Casey; Sackler Institute, Weill Medical College of Cornell University* — Functional magnetic resonance imaging studies have shown that the response of the amygdala to fearful facial expressions decreases with repeated presentations (Breiter, et al., 1996; Thomas et al., 2001). Here we compared habituation of the amygdala response to fearful faces between adolescents and adults. Eighteen adolescents (12-17 yrs; 10 male) and 22 adults (19- 32 yrs; 11 male) were scanned on a 3T GE Signa magnet using a spiral in and out sequence. Subjects viewed fearful faces presented as targets in the context of a go/nogo paradigm. Non-targets were calm faces. Adults and adolescents did not differ in terms of accuracy or reaction times to fearful target faces. There was a main effect of trial on amygdala response to fearful faces in the right and left amygdala (F 8.31; p< .05) as well as an interaction between trial and age (F 4.41; p< .05). Adults showed a decrease in the amygdala response to fearful faces by the middle trials of the run, but adolescents did not show a decrease until the last trials of the run. Across all ages trait anxiety scores from the Spielberger State-Trait Anxiety Index were negatively correlated with habituation in the left amygdala (r = -.466, p < .05) such that individuals with higher trait anxiety had less decreases in amygdala activity over time. These results suggest that examining changes in amygdala responses over time might provide clues as to why adolescence is a period of increased risk for the onset of anxiety-related disorders.

F47

ENCODING ACTIVITY PREDICTING SUBSEQUENT EMOTIONAL MEMORY AFTER SHORT AND LONG DELAYS *Maureen Ritchey, Florin Dolcos, Kevin S. LaBar, Roberto Cabeza; Duke University, Durham, NC* – Emotional arousal has been generally associated with memory benefits for words, events, and pictures. This effect may be mediated by multiple memory processes: for example, controlled attention and elaboration may be enhanced during encoding, while amygdala-mediated stress hormones may boost consolidation. Furthermore, emotional memory seems particularly resilient to time, and its integrity may be sustained or even improved relative to neutral over weeks or months. The present study aims to characterize how time modulates the importance of encoding- and consolidation-related activity in supporting emotional memory. In a subsequent memory paradigm, participants were scanned while encoding briefly-presented negative and neutral pictures. Recognition memory for half of the pictures was assessed at each of two delays: 20 minutes post-scan and 1 week later. Participants responded using a 6-point confidence scale, enabling us to analyze parametric effects of memory strength on encoding activity. Consistent with previous results, we found Dm effects in the prefrontal cortex and medial temporal lobes (MTL), with the amygdala associated with negative memory. Also consistent with previous research, short-delay memory across emotion types was associated with encoding activity in visual processing-related areas. Long-delay memory, on the other hand, relied more on activity within the prefrontal cortex. Preliminary investigations into emotion by delay interactions suggest that subregions of the amygdala differentially support subsequent emotional memory at each delay. These results demonstrate main effects of both emotion and delay interval on subsequent memory, suggesting distinct encoding and consolidation-related mechanisms that support negative and neutral information over time.

F48

ELECTROPHYSIOLOGICAL CORRELATES OF RECOGNITION MEMORY FOR EMOTIONAL FACES IN MILD COGNITIVE IMPAIRMENT *Maria Gruno[1], Katja Werheid[1], Ove Almkvist[2], Ulrika Lonnqvist-Akenine[3], Norbert Kathmann[1], Bengt Winblad[4]; [1]Humboldt University Berlin, Institute of Psychology, [2]Karolinska Institute Stockholm, [3]Karolinska University Hospital Stockholm, [4]Karolinska Institute Stockholm, Alzheimer Disease Research Center* – Previous behavioural research revealed that recognition memory is influenced by negative facial emotion in healthy young and elderly. The present study used event-related potentials (ERPs) to investigate whether the impact of negative facial emotion on recognition is preserved in Mild Cognitive Impairment (MCI). Sixteen mnestic MCI patients (mean age 67.3 ± 6.0) and matched controls were asked to discriminate previously studied from non-studied angry and neutral faces. Behavioural results indicated reduced memory performance for MCI patients. However, in both groups true recognition (hits) was enhanced for angry versus neutral faces. False recognition (false positives) was augmented for angry faces in controls but unaffected in MCI. ERPs generated by correctly classified studied compared to non-studied faces revealed similar frontal (400–550 ms) and parietal (550-700 ms) old/new effects for both groups. In the early time window angry faces elicited a stronger old/new effect than neutral faces. Moreover, in MCI patients compared to controls late positive component (LPC) amplitudes to correctly classified faces were lowered at parietal and augmented at frontal electrode sites. Concluding, despite reduced overall recognition, negative facial expression improved recognition performance in MCI. ERPs indicated that regardless of frontally distributed LPC, processes facilitating recognition memory are intact in MCI.

F49

EMOTIONAL PICTURE RELATED LATE POSITIVE POTENTIALS ARE OBSERVED IN TAIWANESE POPULATION *Kuan-Hua Chen, Nai-Shing Yen, Ying-Ru Lai, Yu-Chieh Chang; National Chengchi University, Taipei, Taiwan* – Viewing emotional pictures, comparing to viewing neutral pictures, prompts a larger P3 and a positive potential which sustained from 400 to 6000 ms after-stimulus. These emotional ERP (event-related potential) effects were repeatedly reported with Caucasian population, but its generalizability across cultures is still an open question. In present study, we replicated the study of Cuthbert, Schupp, Bradley, Birbaumer, & Lang (2000) and aimed to probe the generalizability of the emotional ERP effect to Taiwanese (Chinese) population. Twenty healthy males (n = 12) and females (n = 8) participated in this study and all received 54 pictures (positive = 18, negative = 18, neutral = 18; pictures were the same as that in Cuthbert et al.) from IAPS with each picture being presented 6 s. EEG were recorded on F3, Fz, F4, C3, Cz, C4, P3, Pz, P4 with a time window from 120 ms pre-stimulus to 1000 ms after-stimulus. A larger P3 and a late positivity were observed in all electrodes when participants viewed emotional pictures. This is consistent with the findings from previous studies with Caucasian population, but is inconsistent with the study by Hot and his colleagues (Hot, Saito, Mandai, Kobayashi, & Sequeira, in press) in which they used Japanese but did not find emotional effect on frontal area. In addition, we found a larger N2 for neutral pictures which was not observed in Cuthbert et al., but was reported in Palomba, Angrilli, & Mini (1997) with different pictures being used.

F50

STUCK IN A MOOD AND YOU CAN'T REMEMBER WHY: EVIDENCE FOR THE SUSTAINED EXPERIENCE OF EMOTION BEYOND DECLARATIVE MEMORY IN AMNESIA *Justin S. Feinstein, Melissa C. Duff, Daniel Tranel; University of Iowa* – Throughout life we encounter a range of events capable of eliciting intense and prolonged states of emotion (e.g., the sadness and grief triggered by the news of a loved one's death). In the above example, it is unclear how much the sustained experience of sadness is dependent upon, versus independent of, intact declarative memory for the news of the death. In other words, can the emotion persist once the memory for what induced the emotion has been forgotten? This question was addressed in 6 patients with severe anterograde amnesia due to circumscribed bilateral damage to the hippocampus. Each patient underwent a series of mood inductions using highly emotional film clips designed to elicit prolonged states of sadness, happiness, disgust, or amusement. Following the end of each induction, current emotion and mood were assessed at multiple time points, including before and after a memory recall test for the recently presented films. Amnesic patients reported experiencing significant levels of the induced emotion when probed immediately following the end of the induction. Approximately 5 minutes later, some of the patients were unable to recall any of the film clips. Despite this significant memory impairment, these patients continued reporting elevated levels of the induced emotion that lingered for over 20 minutes at a magnitude commensurate with healthy comparison subjects who have no brain damage and no memory impairment. These findings provide direct evidence that an emotion can endure beyond one's ability to consciously recall the events that initially triggered the emotion.

F51

EFFECTS OF AGING ON FUNCTIONAL CONNECTIVITY OF THE AMYGDALA DURING EMOTIONAL EVALUATION: A NETWORK ANALYSIS OF FMRI DATA *Peggy L. St. Jacques, Florin Dolcos, Roberto Cabeza; Duke University* – Although emotional evaluation is largely preserved in older adults, they sometimes experience negative stimuli as less negative than young adults. This effect may contribute to the "positivity bias" often observed in older adults. Most functional neuroimaging studies on the effects of aging in emotional evaluation have focused on amygdala activity. In the present study, in contrast, we focused on the interactions between the amygdala and the rest of the brain. Using event-related fMRI, we scanned healthy young and older adults while rating the valence of emotional pictures. Consistent with other behavioral evidence, older adults' valence ratings revealed that they experienced negatively valenced pictures as being less negative than young adults. To investigate the effects of aging on amygdalar interactions we identified a right amygdala region that was activated in both groups, and used this region as a "seed" in functional connectivity analyses. Using individual-trial fMRI activity within-participants, we measured correlations between the right amygdala and the rest of the brain across trials. Then, we identified regions whose correlations with the amygdala were significantly reduced or enhanced by aging. In young adults, activity in the right amygdala co-activated to a greater extent with superior frontal cortices, possibly reflecting increased processing of negative stimuli into working memory. In contrast, in older adults, activity in the right amygdala co-activated with inferior frontal cortices, possibly reflecting the inhibition of negative affect. Thus, age-related reductions in processing negatively valenced stimuli might reflect the engagement of top-down processes that inhibit the response to negative emotion.

F52

COGNITIVE AND EMOTIONAL INFLUENCES IN DORSAL ANTERIOR CINGULATE CORTEX *Jeffrey Maxwell, Heleen Slagter, Alexander Shackman, Richard Davidson; University of Wisconsin - Madison* – Anterior cingulate cortex (ACC) has been implicated in a variety of cognitive and emotional processes, with some evidence suggesting that it can be functionally delineated into dorsal cognitive and rostral-ventral emotional subdivisions (for a review, see Bush, Luu, & Posner, 2000). However, the majority of previous affective-conflict studies have differed from typical cognitive Stroop/Flanker investigations in that they have not explicitly induced motor/response-conflict. In the present investigation, participants responded to non-emotional geometric shapes in the presence of both cognitive (cf. typical Eriksen flanker paradigm) and emotional (cf. Emotional Stroop/Flanker) distractors that were mapped onto conflicting motor responses. Consistent with previous observations, dorsal ACC was activated by cognitive distractors. Moreover, this same putatively cognitive region was activated by emotional distractors (angry and happy facial expressions) and by emotional distractors more strongly than by cognitive distractors. The overall degree to which the dorsal ACC responded to cognitive and emotional distractors, however, was only related to behavioral interference during cognitive trials, suggesting a potentially different role of the dorsal ACC in dealing with cognitive and emotional distraction.

F53

MOTION AND FORM IN FEARFUL BODIES ENHANCE THE ACTIVITY OF DISTINCT NEURAL SYSTEMS *Anthony Atkinson[1], Maike Heining[2], Mary Phillips[3,2]; [1]Durham University, Durham, UK, [2]Institute of Psychiatry, London, UK, [3]University of Pittsburgh School of Medicine* – Emotional stimuli receive enhanced processing, exemplified by increased activity of ventral occipitotemporal form processing regions by fearful facial and body postures. It is unknown whether fearful body movements similarly enhance motion processing. Using fMRI, we found that form and motion cues in whole-body gestures elicit distinct patterns of emotional modulation. Seven males were scanned while viewing static and moving images of single actors portraying fear or emotionally neutral actions with their bodies (faces invisible). Participants judged the sex of the actors. Whole-brain analyses contrasted blood-oxygenated level-dependent neural responses to fearful versus neutral actions in full-light static displays, and in patch-light and identical but fully illuminated dynamic displays. Viewing full-light fearful gestures enhanced activity in ventral occipitotemporal cortex, relative to neutral gestures. This emotional modulation was greater for moving than for static full-light stimuli, likely reflecting enhanced processing of multiple configurations of body form. In contrast, fearful patch-light but not full-light displays increased activity in biological motion sensitive right posterior superior temporal cortex. Thus, bodily signals of emotion modulate neural regions that code for salient properties of the stimulus, instead of providing a more general boost to visual processing. Region-of-interest analyses showed a near-significant trend for greater amygdala activity to fearful versus neutral gestures, which is consistent with amygdala feedback mediating enhanced processing of emotional stimuli. Form and motion also differentially enhanced activity in several action representation regions, consistent with but suggesting the need to supplement the idea that seeing fearful bodies fosters flight: simulation processes may also be engaged.

F54

FACIAL IMITATION OF EMOTIONAL EXPRESSIONS: A STUDY COMBINING CENTRAL (EEG) AND PERIPHERAL MEASURES (EMG). *Amal Achaibou[1], Gilles Pourtois[1,2], Sophie Schwartz[1], Patrik Vuilleumier[1,2]; [1]Neurology and Imaging of Cognition, University of Geneva, Switzerland, [2]Swiss Centre for Affective Sciences, University of Geneva, Switzerland* – Several psychophysiological studies revealed that when human subjects are exposed to emotional facial expressions, they often produce an unconscious covert imitation that can be measured by electromyography (EMG) in emotion-relevant facial muscles. The neural pathways involved in these spontaneous reactions remain unknown. Here we measured concurrently cortical activity using electroencephalography (EEG) and facial muscle activity using electromyography (EMG), while 15 healthy participants watched short movies displaying either happy or angry facial expressions. EMG activity was recorded for the Zygomaticus major (ZM) which elevates the lips during a smile, and the Corrugator Supercilii (CS) which knits the eyebrows during a frown. We found increased EMG activity for CS in response to angry faces, and enhanced EMG activity of ZM in response to happy faces, corroborated by a significant muscle x emotion interaction in agreement with previous EMG work. More importantly, in EEG, we found that the amplitude of an early visual evoked potential (right lateral occipital P1) was larger in response to happy faces when the ZM activity was high as compared to low; whereas the amplitude of the N170 component was smaller in response to happy faces when ZM activity was high as compared to low, and smaller in response to angry faces when CS activity was high as compared to low. These results suggest that more intense facial mimicry may enhance processing within early visual pathways while reducing later cortical processing associated with N170, consistent with dual-route models for analysis of face expression and face identity.

F55

HUMOR PROCESSING IN NARCOLEPTIC PATIENTS ASSESSED BY FUNCTIONAL MRI *Aurelie Ponz[1], Rositsa Poryazova[2], Esther Werth[2], Ramin Khatami[2], Peter Boesiger[3], Patrik Vuilleumier[1,4], Claudio Bassetti[2], Sophie Schwartz[1]; [1]Neurology and Imaging of Cognition, University of Geneva, Switzerland., [2]University Hospital, Zurich, Switzerland, [3]Institute for Biomedical Engineering, University of Zurich and Swiss Federal Institute of Technology, Switzerland, [4]Swiss Centre for Affective Sciences, University of Geneva, Switzerland* – Narcolepsy with cataplexy (NC) is a sleep-wake disorder characterized by excessive daytime sleepiness and cataplexy, i.e. a sudden loss of muscle tone triggered by intense positive emotions. NC is linked to a hypothalamic hypocretin/orexin (Hcrt) deficiency, but the neurophysiological mechanisms underlying such dramatic reaction to positive emotion remain unknown. Here we used fMRI to test whether NC patients show an altered brain response to emotions. Twelve NC patients and 12 healthy matched controls were scanned while they performed a humor judgment task. Stimuli were "mini-action scenes" composed of a succession of two almost identical pictures. The first picture depicted a neutral scene while the second one could reveal either a funny or a non-funny new element. MRI data were acquired on a 3-T scanner and analyzed using the general linear model for event-related designs (SPM2). Behaviorally, NC patients had slower reaction times than controls, as expected. There was no group difference in humor rating. The fMRI results revealed that patients and controls share a common neural network for humor processing including associative visual areas, fronto-insula and amygdala, bilaterally. However, when compared to the controls, patients showed reduced hypothalamic response to humor and increased activity in the right amygdala. These data provide a first evidence for an exaggerated limbic response to positive emotions in NC patients. Our findings also suggest that hypothalamic Hcrt activity might exert a crucial modulatory influence on emotional processing within the amygdala, gating emotional signals to afford appropriate autonomic reactions.

F56

PLACEBO EFFECTS ON HUMAN MU-OPIOID ACTIVITY DURING PAIN *Tor Wager[1], David Scott[2], Jon-Kar Zubieta[2]; [1]Columbia University, [2]University of Michigan* – Placebo-induced expectancies have been shown to decrease pain in a manner reversible by opioid antagonists, but little is known about the central brain mechanisms of opioid release during placebo treatment. This study examined placebo effects in pain using PET with [11C] carfentanil, which measures regional mu-opioid receptor availability in vivo (binding potential). Noxious thermal stimulation was applied at the same temperature for placebo and control conditions. Placebo treatment affected opioid activity in a number of predicted opioid-rich regions that play central roles in pain and affect, including periaqueductal gray (PAG) and nearby dorsal raphe and nucleus cuneiformis, amygdala, orbitofrontal cortex (OFC), insula, rostral anterior cingulate (rACC), and lateral prefrontal cortex (PFC). These region appeared to be subdivided into two sets, one showing opioid increases specific to noxious heat and the other showing anticipatory opioid reductions during warm stimulation. These findings suggest that one of the mechanisms of placebo is the potentiation of endogenous opioid responses to aversive stimuli. Opioid activity in many of these regions was correlated with placebo effects in reported pain. Connectivity analyses on individual differences in opioid binding revealed that placebo treatment increased connectivity between the PAG and rACC, and increased functional integration among limbic regions and PFC. Overall the results suggest that endogenous opioid release in core affective brain regions is an integral part of the mechanism whereby expectancies regulate affective and nociceptive circuits.

F57

ATTENTION (BUT NOT INSTRUCTION) AFFECTS THE POSITIVITY BIAS IN MEMORY FOR EMOTIONAL PICTURES IN OLDER ADULTS *Jennifer Tomaszczyk, Myra Fernandes; University of Waterloo* – According to socioemotional selectivity theory, old age is associated with a greater emphasis on self-regulation of emotional states, and this focus fosters a bias in processing positively valenced material, relative to younger adults. There is disagreement in the literature, however, about whether the "positivity bias" influences performance on memory tasks. Some studies suggest older adults attend to and remember proportionately more positive relative to negative information than younger adults, whereas other studies show no difference in memory enhancement for negative and positive information in older adults. Differences in instructions, and subsequent attention paid to stimuli during encoding, across these studies could account for the inconsistent findings. In Experiment 1, younger and older participants were instructed to either passively view or actively categorize positive, negative, and neutral pictures by valence. There was a main effect of Valence and Age on number of pictures recalled, as well as an Age X Valence interaction, but no effect of Instruction condition. Older adults recalled significantly more positive, but not more negative pictures, relative to neutral ones, whereas in younger adults both positive and negative picture recall was higher than neutral. In Experiment 2 we directly manipulated attention through use of a divided attention (DA) paradigm. The effect of Valence, but not Age, was maintained, and there was no Age X Valence interaction under DA conditions. Results suggest that differences in amount of attention devoted to processing pictures during encoding may account for the varying results in the literature.

F58

THE EMOTIONAL VOICES: HUMAN AMYGDALA AND ORBITO-FRONTAL RESPONSES TO EMOTIONAL PROSODY: HUMAN INTRACRANIAL RECORDINGS *Didier Grandjean[1], Gilles Pourtois[1], David Sander[1], Lucas Tamarit[1], Sophie Schwartz[2], Patrik Vuilleumier[2], Margitta Seeck[3], Klaus Scherer[1]; [1]Swiss Center for Affective Sciences, University of Geneva, [2]University Hospital of Geneva, [3]Presurgical epilepsy unit, University Hospital of Geneva* – The central nervous system has developed specialized neural systems to process relevant information, including emotional prosody in the auditory domain. The exact neural architecture involved in the decoding of emotional prosody is still unsettled. Particularly, the respective contributions of the amygdala and the orbito-frontal cortex (OFC) in processing affective prosody are debated. Intracranial local field potentials (LFP) were recorded in a patient prior to surgery for pharmaco-resistant epilepsy while he was instructed to listen to fearful, angry, sad or happy tone of voice, and matched control auditory stimuli. These LFPs were analyzed in the time-frequency domain using Continuous Wavelet Transform. Our results demonstrate that the amygdala and the OFC are both involved in the online decoding of emotional prosody (positive and negative relative to neutral). The coupling between amygdala and OFC regions in response to emotional prosody was investigated by computing synchrony of the phase information in the time-frequency domain. These connectivity analyses reveal an increased synchrony between these two distant regions depending on the affective content of the voice. Thus, our new findings suggest that the decoding of emotional prosody is a complex auditory process, requiring cross-talks between distant but interconnected brain areas.

F59

COGNITIVE TRAINING FOR SCHIZOPHRENIA PATIENTS ENHANCES ABILITY TO CONTROL THE INFLUENCE OF NEGATIVE AFFECT ON SOCIAL JUDGMENTS *Sara Verosky[1], Asako Miyakawa[1], Demian Rose[2,3], Sophia Vinogradov[2,3], Christine Hooker[1]; [1]University of California at Berkeley, Helen Wills Neuroscience Institute, [2]University of California at San Francisco, [3]San Francisco VA Medical Center* – Prior research indicates that schizophrenia (SZ) patients misinterpret social cues, usually by ascribing negative valence or negative intentions to ambiguous stimuli. Factors contributing to this misinterpretation are unclear. Here, we investigated whether negative affect influences the social judgments of other people and whether the ability to control negative affect when making social judgments could be enhanced through training. Schizophrenia patients performed a task in which they were first primed with positive, negative, or neutral affect and then judged the trustworthiness of a neutral face. The results show that SZ patients rated the neutral face as significantly less trustworthy after the negative affect prime as compared to the positive or neutral affect prime. This problematic influence of negative affect on social judgment decreased after cognitive remediation training. The results suggest that social judgments, especially concerning the suspiciousness of other people, are influenced by negative affect. Furthermore, cognitive training can help patients regulate the influence of their negative affect on social judgments so that feelings such as paranoia do not lead to social misinterpretations. Data from healthy control subjects on this task suggest that the ability to regulate the influence of negative affect on social judgments is mediated by the lateral prefrontal cortex (PFC). Collectively the findings suggest that behavioral training in cognitive control, which is mediated by the lateral PFC, can help patients regulate the influence of negative affect on social judgments so that they can assess social situations more accurately.

F60

INCREASED ANXIETY AND POOR EXECUTIVE CONTROL INCREASE EMOTION-INDUCED MEMORY TRADE-OFFS *Jill Waring[1], Jessica Payne[2], Elizabeth Kensinger[1]; [1]Boston College, [2]Harvard University* – Healthy young adults have often demonstrated a trade-off in memory performance for highly emotional items relative to neutral contextual details in an image. We investigated whether results of normative testing of affective states, executive function, or visuospatial processing abilities may correlate with the magnitude of the trade-off observed. 64 young adults studied scenes comprised of a negative or a neutral object placed on a neutral background. They then took a recognition memory test: they were presented with objects and backgrounds separately, and asked to indicate whether each was the same studied item, a similar studied item, or a novel item. The trade-off was measured as the advantage in memory for the negative versus the neutral items coupled with the disadvantage in memory for the backgrounds presented with negative versus neutral items. The results revealed a significant positive correlation between measures of anxiety and the magnitude of the trade-off in memory for specific negative images over background details. There was also a significant negative correlation between spatial processing and executive function ability and a trade-off in memory for general (gist-based) information in a scene. These results suggest that increased anxiety, poor spatial memory, and poor executive function may prevent the creation of a complete mental representation of all components within a complex emotional scene.

F61

AFFECTIVE RATINGS OF SURPRISE FACES ARE MODULATED BY VISUAL FIELD AND BY ADJACENT FACIAL EXPRESSIONS WITHIN THE SAME VISUAL FIELD *Timothy D. Sweeny, Marcia Grabowecky, Ken A. Paller, Satoru Suzuki; Northwestern University* – Emotional expressions of briefly flashed faces can influence affective evaluation and various measures of neural activity. Given that face-responsive inferotemporal neurons have large receptive fields, often including the entire contralateral visual hemifield, we hypothesized that responses to surprise faces might be modulated by concurrent facial processing within the same hemifield if there is insufficient time to attend to individual faces. We developed a procedure to test this idea in which each trial included two faces presented for 50 or 100 ms backward-masked by Gaussian noise to limit visual attention. Participants made four-choice affective ratings of surprise faces concurrently presented with a happy or angry face. A central post-cue presented briefly at the offset of the masks indicated which face to rate. Within hemifield, surprise faces paired with angry faces were rated as more negative than surprise faces paired with happy faces. When faces were presented in opposite hemifields, no influence of emotional expression was found on surprise-face ratings, ruling out a high-level response bias from processing of emotional faces. In addition, left-visual-field surprise faces were rated as more negative than right-visual-field surprise faces. In sum, happy and angry faces modulated affective judgments of surprise faces presented within the same hemifield, but not across hemifields. In the absence of selective attention, we may tend to see an average expression of multiple faces in the same visual field due to the large receptive fields of inferotemporal neurons.

F62

IS EMOTIONAL PROCESSING FACILITATED UNDER DECREASED PERCEPTUAL CONDITIONS ? *Stephanie Dubal, Gwladys Rey, Aurelie Foucher, Roland Jouvent; CNRS-UPMC CHU Pitie-Salpetriere* – Affective stimuli enhance and facilitate sensory processing. Event-Related Potentials (ERPs) amplitude enhancement and latency shortening for emotional stimuli are generated in visual cortical areas. This facilitation mechanism would contribute to capture and guide attention to environmental important signals. Less is known about how sensory variables modulate emotional processing. We used affective stimuli with different contrast level to investigate whether or not emotional perception is modulated by perceptual characteristics. We tested this hypothesis using ERPs in conjunction with an affective rating paradigm. Positive and Neutral pictures at 100, 60 and 20 % contrast were displayed for 200 ms, and subjects had to judge the pleasantness of each picture. There was no selective modulation of the occipital P1 by emotion content: lowest contrast pictures elicited larger P1 than high-contrast pictures, for both neutral and positive pictures. The P1 wave was not earlier for low contrast emotional stimuli, suggesting that there was no effect of contrast manipulation on perceptual facilitation for emotional stimuli. Emotional content of the stimuli modulated the centrally P2 wave, with larger P2 amplitude for positive than for neutral images, at 100% contrast. In response to low-contrast pictures, there was no emotional effect on P2 amplitude. These results suggest that perceptual characteristics may interact with emotional content perceptive processing in affective tasks.

F63

WHEN I SEE YOUR SMILING FACE: AMYGDALA ACTIVITY WHILE REMEMBERING HAPPY FACES *Takashi Tsukiura[1,2], Roberto Cabeza[1]; [1]Duke University, Durham, NC, [2]Neuroscience Research Institute, AIST, Tsukuba, Ibaraki, Japan* – Using event-related fMRI, we investigated the neural correlates of the effect of emotion on memory for socially-relevant information. We predicted that memory for a recently encountered person would be better for happy than for neutral faces. Additionally, we predicted that this effect would involve the amygdala, a region known to mediate the enhancing effect of emotion on memory retrieval. During encoding, face-name pairs were presented one by one. Half of the faces were happy and half neutral, and participants rated facial expressions. During retrieval in the scanner, studied names intermixed with new names were presented, and for each one participants indicated whether it matched (1) a happy face, (2) a neutral face, (3) a studied face of unknown expression, or (4) no studied face (i.e., a new name). Confirming our first prediction, retrieval of face expression was faster and more accurate for happy than for neutral faces. Confirming our second prediction, amygdalar activity was greater for successful than for unsuccessful retrieval of happy faces but did not differ between successful and unsuccessful retrieval of neutral faces. Given that the names used as retrieval cues were emotionally neutral, the amygdala activation can be safely attributed to the emotional nature of the memories themselves. In addition to the amygdala, successful retrieval of happy faces was associated with enhanced activity in medial temporal, fusiform, and parietal regions. In sum, our results suggest that we are more likely to remember someone who was warm and approachable than someone who was cold or distant.

F64

TRAIT ANXIETY AND LATERALIZED EMOTIONAL INTERFERENCE: CORRELATION WITH CORPUS CALLOSUM MORPHOLOGY AND ELECTROENCEPHALOGRAPHIC COHERENCE *Andrei C. Miu, Julia Avram, Anca Amagdei, Rodica Baltes, Renata M. Heilman; Babes-Bolyai University, Romania* – The objectives of the present study were to replicate the effect of trait anxiety (TA) on right hemisphere emotional interference, and explore the correlation of the interhemispheric transfer time (IHTT) of emotional word processing with the morphology of the corpus callosum, the electroencephalographic (EEG) coherence and two indices of the autonomic regulation of emotion. For this purpose, 50 right-handed participants that scored below or above average on TA self-reported questionnaires were tested in a lateralized lexical task comprising both Stroop and emotional interference blocks of trials. Following the so-called Poffenberger paradigm, the lateralization of task varied the hemifield in which the visual stimuli were presented and the hand that the participant was instructed to use for response. During the task, skin conductance responses (SCRs) and electrocardiography were recorded. First, we tested whether the emotional interference was stronger when the stimuli were presented in the left visual hemifield, by analyzing both manual reaction times, and the synchronous SCRs and heart rate. Then, the IHTT calculated by subtracting the manual reaction times of the responses in the uncrossed conditions from those in the crossed conditions was correlated further with the midsagittal area of the corpus callosum estimated from magnetic resonance imaging scans, and the frontal, parietal and occipital EEG coherence. Finally, we assessed whether TA had an effect on emotional interference and its psychophysiological correlates.

F65

SELECTIVE INVOLVEMENT OF POSTERIOR STS IN RECOGNIZING EMOTION FROM MOTION *Jennifer Silvers[1], Thalia Wheatley[2], Alex Martin[1]; [1]NIH / NIMH, Lab Brain & Cognition, Bethesda, MD, [2]Psychology & Brain Sciences, Dartmouth College, Hanover, NH,* – A large body of monkey neurophysiological and human neuroimaging data indicates that a posterior region of the superior temporal sulcus (pSTS) plays a central role in processing biological motion. In addition, recent studies suggest that pSTS may also be involved in understanding social interactions, thus suggesting that this region may play a role in social cognition that extends beyond biological motion perception. The current study was designed to confirm the role of pSTS in perceiving abstract representations of animacy, and to determine whether pSTS is also modulated by emotional information embedded in those representations. To address this issue, we tested twenty-two healthy adults using an event-related fMRI design. During each run, subjects watched 18 cartoons of a single ball in motion. According to how it moved, the ball appeared to be inanimate (e.g., falling like a drop of water), animate but non-emotional (e.g., gliding like an ice-skater), or animate and emotional (e.g., shaking like someone scared). Subjects were required to rate the emotional intensity conveyed by each animation. We first identified regions involved in perceiving animacy by comparing the animate non-emotional and inanimate conditions. This analysis identified a number of areas previously implicated in social perception including bilateral pSTS, the middle frontal gyri, and dorsomedial prefrontal cortex. Within these regions, activity in the bilateral pSTS, but not in the other regions, increased when motion was interpreted as conveying emotion (animate emotional > animate non-emotional). This finding suggests that pSTS may be critically involved in decoding emotional content from motion cues.

F66

CONTRALATERAL N170 MODULATION BY NONCONSCIOUS FEAR-EVOKED SPATIAL ATTENTION AS MEASURED BY ERP *Joshua Carlson, Karen Reinke; Southern Illinois University* – The superior colliculus, pulvinar, and amygdala appear to comprise a neural network associated with processing nonconscious fearful faces. It has been suggested that this network may be involved in an automatic orienting response. Behavioral studies have revealed that spatial attention is influenced by nonconscious fearful faces, but a direct investigation of the neural dynamics associated with this behavior has yet to be performed. ERP studies of spatial attention using non-emotional cues have found that attention is modulated as early as P1. A modified version of the Posner (1980) dot-probe task was performed while ERPs were recorded. Two faces (from Gur et al, 2002) were simultaneously nonconsciously presented (33 ms) to the left and right of fixation, then were immediately masked by neutral faces (100 ms), and followed by a target dot appearing in one of the two locations. The subjects' task was to indicate the location of the target dot. Cued spatial attention trials consist of one fearful and one neutral nonconsciously presented face. Subjects produced faster reaction times for congruent (target dot appearing on the same side as a fearful face) compared to incongruent (target appearing on the opposite side as a fearful face) trial types. These behavioral results suggest that spatial attention is captured by fearful faces and attention is focused at the location of the fear stimulus. Consistent with these behavioral results we found a significant visual field by hemisphere interaction for the amplitude of the contralateral posterior N170 evoked by the nonconscious fearful face cues.

F67

THE INTEGRATED NEURAL PROCESSING OF ANTICIPATORY THREAT *Michael Silverman[1], Oliver Tuescher[2], Jin Fan[1], Suzee Lee[1], Antonia New[1], Martin Goldstein[1]; [1]Mount Sinai School of Medicine, [2]Neurologische Universitätsklinik Freiburg* – Background: James-Lange type conceptualizations of emotion (e.g., somatic marker hypothesis) hold that the visceral afferent component, modulated by the autonomic system, is essential for the phenomenological experience of fear. Although neural responses associated with threat stimuli have been robustly demonstrated (e. g., amygdala), the neural substrates responsible for transducing threat stimulus processing into component autonomic, cognitive, and emotional sequelae have yet to be fully elucidated. Objective: To test whether the anticipation of a shock in a novel threat paradigm would be associated with activations in brain regions hypothesized to mediate heteromodal sensory-limbic-autonomic integration, e.g., insula (Craig, 2003) and claustrum (Crick et al., 2005). Methods: Seven right-handed female subjects were presented with an anticipatory threat paradigm during EPI-BOLD fMRI acquisition on a Siemens 3T Allegra MRI scanner. Trials consisted of color stimulus cues representing "safe" or "threat" pseudorandomly paired with a color "target" stimulus. One cue-target pair was associated with a possible electrodermal stimulation; the other was not. Colors were fully counterbalanced across subjects. Galvanic skin response (GSR) was recorded contemporaneous with fMRI scanning. Image analysis was conducted using SPM2. Results: GSR measures demonstrated autonomic arousal associated with threat conditions. fMRI results revealed threat stimulus-associated neural activations in insula, claustrum, DLPFC, and pontine regions. Conclusion: This anticipatory threat paradigm demonstrated activation of a neural network whose components have been implicated in (a) integrating threat-related exteroceptive and interoceptive stimuli (insula, claustrum), and (b) transducing this integrated afferent stream into a cascade of efferent modulation of autonomic (insula, pons) and cognitive regulation (DLPFC).

F68

INVESTIGATING THE MOTIVATIONAL BRAIN: THE ROLE OF IMPLICIT POWER AND AFFILIATION MOTIVES ON NEURAL RESPONSES TO ANGRY FACIAL EXPRESSIONS *Julie L. Hall[1], Steven J. Stanton[1], Michelle M. Wirth[2], Christian E. Waugh[3], Patricia A. Reuter-Lorenz[1], Oliver C. Schultheiss[1]; [1]University of Michigan, [2]University of Wisconsin, [3]Stanford University* – Evidence from affective neuroscience reveals a network of core emotional and motivational brain structures dedicated to the analysis of a stimulus for emotional content and the preparation of motivated action toward or away from the stimulus (LeDoux, 2002; Rolls, 1999). Research indicates that implicit power motivation (the need to have impact on others) and implicit affiliation motivation (the need to have close, harmonious relationships with others) predict the reinforcement value of angry and surprise faces and attention toward or away from these facial expressions of emotion (Schultheiss & Hale, 2006; Schultheiss et al., 2005). The present study was designed to assess whether neural responses to angry facial expressions vary as a function of individual differences in implicit power and affiliation motives. Using an fMRI block design, 24 participants viewed angry facial expressions and control stimuli (neutral faces, gray squares) under passive viewing and oddball task conditions. Both individual differences in power and affiliation motives predicted greater neural activation in brain areas associated with affective processes, including the amygdala, OFC, and insula. However, these motives showed differential responses in areas of the brain associated with reward. Affiliation-motivated individuals showed decreased activation in the nucleus accumbens and ventral striatum in response to angry faces whereas power-motivated individuals showed greater activation in these areas. These data suggest that angry facial expressions, as signals of threat and/or dominance, are emotionally salient for both power-motivated and affiliation-motivated individuals, but differ in terms of their reward salience for these groups.

F69

NEURAL CORRELATES OF EMOTION UNDER VARYING PERCEPTUAL CONDITIONS *Gwladys Rey[1], Philippe Fossati[1], Laurent Lamalle[2], Alexandre Krainik[3], Kenneth Knoblauch[4], Roland Jouvent[1], Stephanie Dubal[1]; [1]CNRS / UPMC UMR 7593, Paris, France, [2]INSERM IFR1, Grenoble, France, [3]INSERM / UJF U594, Grenoble, France, [4]INSERM / UCBL U371, IFR 19, Cerveau et Vision, Bron, France* – Emotional pictures elicit greater activation in visual cortex than neutral pictures. This well documented phenomenon refers to a mechanism of perceptual amplification for emotional information. It has been speculated that such increases in neuronal activity may reflect feedback influences from the amygdala that would receive direct inputs from visual areas. Little is known about emotional amplification in conditions of low vision. We used functional magnetic resonance imaging (fMRI) to explore the effect of visual contrast level on emotional processing, in relation to anhedonia, ie the loss of the capacity to experience pleasure. Ten control subjects and 10 non-clinical anhedonic subjects - were presented with positive and neutral pictures at 20% and 100% of contrast in a 3T Bruker scanner. The event-related design included two randomized sequences of 120 stimuli and 30 null events presented for 1.5 sec and followed by a fixation point of 2 sec. Subjects judged the pleasant character of the pictures on a 4-point rating scale. Data analysis is on process. First, we wonder if sensory characteristics modulate visual areas activity for emotional content. As with high contrast pictures we expect that low contrast ones would also elicit emotional amplification in visual areas. Second, we test the hypothesis that the emotional amplification would be lower in anhedonic subjects. We also expect lower activations, in anhedonics, in regions known to be implied in emotional perception and regulation, with special emphasis on the amygdala, the anterior cingulated cortex, the medial prefrontal cortex.

F70

EFFECTS OF MINDFULNESS ON EMOTION REGULATION IN ATTENTION, PERCEPTION, AND DECISION-MAKING *Deidre Reis[1], Lisa Marchiondo[1], Elizabeth Weissberg[1], Jeremy Gray[1]; [1]Yale University* – Mindfulness-based meditation is a form of mental training intended to cultivate non-judgmental awareness of one's inner mental life. In previous work, experienced meditators demonstrated sustained high-amplitude gamma oscillations during meditation (Lutz, Greischar, Rawlings, Ricard, & Davidson, 2004) at frequencies associated with mental processes such as attention, working memory, and perception, suggesting that meditation might lead to long-term behavioral and neural changes. We examined the effects of meditation experience and trait mindfulness on attention, perception, and decision-making through a behavioral study of individuals with extensive experience (1000+ hours) in mindfulness meditation. Participants completed an attentional blink task adapted from Most et al (2005). In the face of negative emotional distractors, experienced meditators demonstrated target detection accuracy rates higher than those previously reported for the same task by healthy adults with a considerably lower mean (80% vs. 71%; $t=2.52$, $p < .05$), indicating less disruption of attention by negative images. Subjective ratings of distractor image valence and arousal were comparable to those reported by other participants previously. In addition, experienced meditators showed less of a difference in performance between trials with emotional distractors at short versus long lags than previously published (3% vs. 20%; $t = -3.68$, $p < .001$). These results indicate that negative images may have less of a distracting effect on experienced meditators, despite similar subjective reactions to the images.

F71

MITIGATING AMYGDALA RESPONSE HABITUATION TO FACIAL EXPRESSIONS OF EMOTION. *F.C. Davis[1], A.A. McLean[2], H. Kim[3], J.A. Oler[2], E.C. Mazzulla[2], T. Johnstone[2], P.J. Whalen[1]; [1]Dartmouth College, [2]University of Wisconsin, Madison, [3]California Institue of Technology* – The human amygdala is highly responsive to facial expressions of emotion, presumably because they convey important information about the state of one's social and physical environment. Though the amygdala is robustly activated by clearly negative expressions such as fear, the facial expression of surprise represents an interesting test for the amygdala because it can be associated with either positive or negative events. Indeed, individual differences in amygdala responsivity to surprise reflect this inconsistent reinforcement history, as people who interpret surprised faces negatively show greater amygdala responsivity than people who view the same faces positively. In the present study we used fMRI to examine amygdala responsivity to fearful, surprised, and neutral faces presented at varied durations. Subjects passively viewed these faces presented for either 33, 200, or 1000 ms. Consistent with previous work, amygdala responsivity to fearful facial expressions showed response habituation over time. This responsivity did not vary as a function of stimulus duration. In contrast, amygdala responsivity to surprised facial expressions was more sensitive to stimulus duration, such that longer presentations elicited more robust amygdala activation. This 'robustness' was reflected in a greater resistance to habituation over time during 1000 ms stimulus presentations only. To the extent that amygdala response habituation to static pictures of facial expressions can be likened to an extinction process (because facial expressions have a prior reinforcement history), these data are consistent with the well-documented partial reinforcement extinction effect, where events that are inconsistently reinforced take longer to extinguish than those that are consistently reinforced.

F72

THE AFTERMATH OF 9/11: EFFECT OF INTENSITY AND RECENCY OF TRAUMA ON OUTCOME *Barbara Ganzel[1,2], B. J. Casey[1], Gary Glover[3], Henning Voss[1], Elise Temple[2]; [1]Weill Medical College of Cornell University, [2]Cornell University, [3]Stanford University* – Background: Is there a long-term impact of traumas such as that of 9/11/01 on the brain and behavior of healthy individuals? Methods: Using functional magnetic resonance imaging, we imaged twenty-two healthy adults while they viewed emotional faces to assess the impact of trauma exposure on the amygdala. Half of the subjects were near the World Trade Center (WTC) on 9/11/01 and half lived more than 200 miles away. All resided within the New York metropolitan area at scan. Results: More than three years after 9/11/01, bilateral amygdala activity in the fear-calm contrast was significantly higher in the group with close proximity to the WTC on 9/11/01 as found in voxel-wise analysis of variance results for left amygdala (mni -25, -9, -20; $Z = 3.13$, $p = .001$) and for right amygdala (mni 22, -9, -20; $Z = 2.97$, $p = .001$) and in region of interest (ROI) analyses for left amygdala ($t = -3.3$, $p = .003$) and right amygdala ($t = -2.7$, $p = .01$). This activity mediated the relationship between group status and current symptoms of posttraumatic stress disorder. In turn, the effect of group status on both amygdala activation (fearful versus calm faces) and current symptoms was statistically explained by time since worst trauma and intensity of worst trauma, as indicated by reported symptoms at time of the trauma. Conclusions: These data are consistent with a model of relatively slow amygdala recovery from high-intensity trauma exposure in adults without a clinical disorder.

F73

IMAGING PLEASANT PAIN RELIEF *Siri Leknes[1,2], Merle Fairhurst[1,2], Keith Duncan[1,2], Jon Brooks[1,2], Irene Tracey[1,2]; [1]Anatomy and Genetics, University of Oxford, UK, [2]Functional Imaging of Brain (FMRIB) Centre, University of Oxford, UK* – Pain relief is often defined as a reduction in pain intensity, and little attention has been paid to the relief sensation itself. We used the topical capsaicin model to create heat hyperalgesia in 13 subjects. Normally neutrally valenced temperatures were then used to create 5 seconds of strong pain (mean 36°C) or pleasant cooling relief (mean 20°C). The baseline temperature of 32°C was perceived as mildly painful. In the 'immediate' condition, the cooling followed immediately after the painful heat. In the 'delayed' condition cooling was delayed by 30 seconds. The conditions were signalled by coloured cues. The immediate cooling was rated as significantly more pleasant and relieving than the delayed cooling, and the cue signalling this condition was associated with significantly more positive affect. These affect ratings were positively correlated with BAS reward responsiveness. The immediate cooling caused bilateral activation in the lateral orbital and prefrontal cortices, the anterior insula, the anterior cingulate, thalamus, caudate, putamen, and parietal cortices. No areas were significantly activated by the delayed cooling, suggesting that the immediate cooling activations were specific to type of relief rather than stimulus temperature. During the delayed cooling several areas were deactivated, including the thalamus and several brainstem nuclei previously implicated in central sensitisation to pain: the periaqueductal gray (PAG), rostral ventromedial medulla (RVM) and nucleus cuneiformis. Areas in the parahippocampal region were deactivated during both immediate and delayed cooling. This region has been implicated in anxiety-induced hyperalgesia to pain. Immediate cooling relief ratings were positively correlated with state anxiety.

F74

NEURAL CORRELATES OF EXPLICIT MORAL APPRAISALS: AN FMRI STUDY *Carla L. Harenski[1], Olga Antonenko[1], Matthew Shane[1], Kent A. Kiehl[1]; [1]Olin Neuropsychiatry Research Center* – The goal of the current study was to investigate neural responses associated with explicit judgments about the severity of visually depicted moral violations. In previous research we found that when individuals passively viewed unpleasant pictures depicting moral violations, greater activity occurred in superior temporal sulcus (STS) and posterior cingulate cortex (PCC) relative to viewing unpleasant pictures that did not depict moral violations, while medial prefrontal cortex (MPFC) was activated by both moral and nonmoral stimuli (Harenski & Hamann, 2006). In the current study, participants (n = 14) were scanned with fMRI while viewing 25 moral, 25 nonmoral, and 25 neutral pictures matched for social content and (for moral and nonmoral pictures) emotional arousal. Moral pictures were unpleasant scenes depicting moral violations, while nonmoral pictures were thematically similar unpleasant scenes that did not depict moral violations. While viewing all pictures, participants made explicit ratings based on the degree and severity of moral violations that they judged to be present in each picture. Results showed increased activity in MPFC, STS, and PCC when viewing moral relative to nonmoral pictures. Activity in each region was positively correlated with online ratings of moral severity. In addition, amygdala activity was correlated with moral severity ratings, suggesting that emotional responses influenced moral severity judgments. The finding of increased MPFC activity in the moral condition is inconsistent with our prior passive viewing study, in which MPFC activity occurred in both moral and nonmoral conditions. This suggests a role of MPFC in the explicit identification of moral violations.

F75

ACQUISITION AND EXTINCTION OF CONTEXTUAL FEAR: AN FMRI STUDY *Stephan Hamann, Katherine Vytal; Emory University* – Individuals can acquire fear responses not only to discrete stimuli paired with unconditioned stimuli (UCSs), but also to the context in which the UCS is presented, such as the testing room. Animal and human lesion studies implicate the hippocampus as a critical structure in the acquisition of contextual fear, via its role in forming integrated memory representations of the conditioning context. We examined the acquisition and extinction of contextual fear with fMRI to investigate the role of the hippocampus, amygdala, and other structures implicated in modulation of contextual fear such as the ventromedial prefrontal cortex (VMPFC). Thirteen subjects were first pre-familiarized with two distinctive real-world contexts and then viewed photographs from each context while auditory CSs (high or low tones) were presented in a 3 T scanner. Subjective online fear ratings and physiological responses (SCR, heart rate) were recorded concurrently. During acquisition, the CS+ tone was partially reinforced with a wrist shock during one context only. Halfway through the run, the UCS was discontinued and extinction was assessed. Behavioral measures indicated significant acquisition and extinction of contextual fear responses. As predicted, increased activity in the hippocampus/parahippocampal gyrus, insula, and amygdala was observed during the reinforced context during contextual fear acquisition and extinction. The VMPFC was more active during the “safe” context in the acquisition phase as well as to a lesser extent during extinction. These results are consistent with the proposed role of the hippocampal region in contextual fear and highlight the involvement of VMPFC in inhibitory fear processes.

F76

EXPLORING THE NEURAL SUBSTRATES FOR EMOTION REGULATION AND PSYCHOPATHOLOGY IN NON-HUMAN PRIMATES. *Andrew S. Fox, Steven E. Shelton, Terrence R. Oakes, Alexander K. Converse, Richard J. Davidson, Ned H. Kalin; University of Wisconsin-Madison* – The amygdala is a neural structure involved with affective processing and psychopathology. Recently researchers have begun to investigate the role of the prefrontal cortex in moderating amygdala responsiveness with the idea that altered prefontal regulation of amygdala activity underlies affective and anxiety-related psychopathology. In this study we selected three groups of anxious monkeys (High n=11; Med n=12; Low n=12) from 117 animals based on their propensity to become behaviorally inhibited or freeze when presented with the profile of a human intruder (Kalin & Shelton, 1989). After identification of the 3 groups of animals, each animal was given an injection of [18F]-fluoro-2-deoxy-D-glucose (FDG) and separated from its partner into a test cage where it remained for 30 min. During the FDG uptake period, animals were awake and freely behaving allowing for assessment of integrated brain metabolic activity during the separation period. Analyses revealed the amygdala to be more active in the high anxious group when compared to the medium and low groups. To detect patterns of brain activity associated with prefrontal-amygdala regulation, a whole brain voxel-wise search was performed to identify brain regions that were negatively correlated with amygdala activity. Results demonstrated regions of prefrontal cortex including Area 46/9 and Area 10 that were negatively correlated with amygdala activity in the middle or normative group but were not correlated with amygdala activity in the anxious group. These findings provide evidence for altered activity of prefrontal-amygdala circuits in highly anxious individuals.

F77

FRIEND OR FOE? MODULATION OF BRAIN ACTIVATION TO CANONICAL FACIAL EXPRESSIONS VIA SELF-RELEVANT CONTEXTUAL INFORMATION. *Jasmin Cloutier, F. Caroline Davis, Todd F. Heatherton, William M. Kelley, Paul J. Whalen; Dartmouth College* – The current study examined how self-relevant contextual information modulates the neural processes involved in the perception of emotional facial expressions. Specifically, subjects were imaged using fMRI while viewing happy and angry faces that were immediately preceded by a self-relevant context (e.g., "he just saw you win the lottery" or "she just saw you get punched in the face"). Subjects were instructed that the subsequent facial expressions were in reaction to information provided in the statements. Outcomes were either favorable or unfavorable and were either congruent or incongruent with each facial expression's canonical valence (favorable outcomes: happy face preceded by happy statement, angry face preceded by angry statement; unfavorable outcomes: angry face preceded by happy statement, happy face preceded by angry statement). Of interest was the neural activity to favorable and unfavorable outcomes regardless of facial expression, positive and negative facial expressions regardless of outcome, and, critically, the reversal of prepotent meanings of these facial expressions based upon outcomes (e.g., happy face preceded by " he just learned that you are very sick" - here the happy face reflects an unfavorable outcome and angry face preceded by "she just found out you lost your job"- here the angry face reflects a positive outcome, namely sympathy). Results revealed greater ventral prefrontal activation to "favorable" outcomes and greater insula activation to "unfavorable" outcomes, regardless of facial expression and greater amygdala activation in response to outcomes that required reversal of a facial expression's canonical valence.

F78

MIRROR NEURON SYSTEM AND MU RHYTHM INVOLVEMENT IN SOCIAL COGNITION: ARE THERE DISSOCIABLE SUBCOMPONENTS OF THEORY OF MIND? *Erin E Hecht, Pineda A Jaime; Emory University* – Gallese et al. (2004) distinguish between replication of others' mental states as if they were one's own (simulation theory), which is proposed to involve mirror neurons, and explicit reasoning about others' mental states (theory theory), which is not proposed to involve mirror neurons. Tager-Flusberg and Sullivan (2000) postulate a seemingly related distinction between the social-perceptive component of theory of mind, which involves online judgment of mental state from facial and body expressions, and the social-cognitive component, which is representation-based and linked to language and theory-building. In this study, the role of mirror neurons, as indexed by the mu rhythm of the EEG, was examined in subjects performing tasks that tapped either the social-cognitive or social-perceptive component of theory of mind. Mu suppression was positively correlated with accuracy on a social-perceptual task in which subjects matched facial emotional expressions. In contrast, mu suppression was not correlated with accuracy in a social-cognitive task in which subjects made judgments about others' beliefs and intentions. Furthermore, accuracy in a task that required judgments about person-object interactions was correlated with mu suppression in the emotion task, and vice versa. This suggests that a common neural mechanism, likely the mirror neuron system, underlies judgments about emotions and person-object interactions, while another mechanism underlies judgments about beliefs and intentions. These results are consistent with a componential view of theory of mind.

F79

THE INFLUENCE OF EMOTION REGULATION STRATEGIES ON RISKY DECISION-MAKING *Laura Martin, Dominic Fareri, Mauricio Delgado; Rutgers University* – In day to day behavior, an individual is constantly presented with salient conditioned cues representing risk-taking opportunities. Some of the cues may induce craving, subsequently leading to risky decision-making. One potential way of controlling risk-taking behavior is to use antecedent-focused strategies to reduce induced craving. The goal of this study was to examine the influence of emotion regulation on salient conditioned stimuli (CS), as measured by skin conductance responses (SCR) and risk-taking behavior. We used a conditioning paradigm in which a CS, a colorful picture of a slot machine, represented a reward-seeking opportunity. Participants were faced with a choice between two potential outcomes: a 50% chance of winning $20 (gamble) and a 100% chance of winning $5 (sure thing). Prior to CS presentation, an instructional cue directed participants on how to approach each trial. When the instruction was "attend," participants were to think about winning money during CS presentation. When the instruction was "reappraise," they were to use the colors in the slot machine to help them imagine a calm visual scene (e.g., sunset). Results from behavioral pilot studies suggest that emotion regulation strategies were successful in decreasing SCRs to the CS. Additionally, participants chose the sure thing more often than the gamble option when using emotion regulation compared to "attend" trials. These data suggest that cognitive strategies can decrease physiological arousal induced by a salient CS, in turn influencing subsequent behavior. Further investigations will probe the neural correlates underlying the influence of emotion regulation on risky decision-making.

F80

(EFFECT) SIZE DOES MATTER: A QUANTITATIVE META-ANALYSIS OF NEUROIMAGING STUDIES OF EMOTION *Karine Sergerie, Caroline Chochol, Jorge Armony; McGill University & Douglas Hospital Research Centre* – Several meta-analyses of neuroimaging studies of emotional processing have been conducted in order to determine the brain areas consistently involved, as well as whether these activations are different depending on laterality, stimulus modality, etc. Of particular interest has been to examine to what extent amygdala responses depend on these parameters. Although these previous analyses have provided critical insights on the neuroanatomy of emotion, they relied on the so-called vote-counting technique, in which the relative numbers of reported activations for different conditions across studies are compared. That is, this approach typically does not take into account the magnitude (effect size) and reliability (variance) associated with each of the reported activations. Here, we present results from a comprehensive meta-analysis of neuroimaging studies of emotional processing which we conducted based on over 400 published studies. Critically, we estimated the effect size associated with each peak activation, using the statistical values reported. These values were entered in a weighted general linear model to examine the potential influence of various moderating variables. We conducted whole-brain analysis as well as region-of-interest focusing on the amygdala. For the latter, preliminary results from 85 studies including 182 activation peaks revealed a significant effect of gender (stronger activation for men than women, $p < 0.001$), stimulus type (faces vs. pictures, $p < 0.005$), and type of control stimulus ($p < 0.01$) on the aggregated effect sizes. In contrast, there was no significant difference in overall magnitude of activation between left and right amygdala ($p > 0.5$).

Memory: Memory Disorders

F81

PATTERN SEPARATION PROCESSES IN THE HUMAN MEDIAL TEMPORAL LOBE *Brock Kirwan[1], Shauna Stark[2], Naomi Goodrich-Hunsaker[3], Barry Gordon[2], Ramona Hopkins[3], Craig Stark[2]; [1]University of California, San Diego, [2]Johns Hopkins University, [3]Brigham Young University* – Computational models and electrophysiology data from animal models suggest that pattern separation, a process whereby similar or overlapping mnemonic representations are made more dissimilar in order to reduce retrieval errors, is supported by the structures of the medial temporal lobe (MTL). These computational models typically posit the hippocampus as having a critical role in the pattern separation process. We hypothesized that damage to the MTL, and critically to the hippocampus, would result in increased susceptibility to inter-stimulus interference. To test this prediction, we tested amnesic patients with hippocampal damage and matched controls using a recognition memory paradigm that manipulated pattern separation demands. Patients and controls studied a series of either faces or objects and performed a recognition memory test after a brief delay. Pattern separation demands were manipulated by varying the degree of inter-item similarity between testing blocks. Results indicate that patients with hippocampal damage were impaired relative to controls when pattern separation demands were high but were relatively unimpaired when pattern separation demands were low. Furthermore, the deficit observed in the patients was modulated by stimulus type and task demands. These results are taken to broadly support the predictions of the computational models that the medial temporal lobe in general and the hippocampus specifically support pattern separation.

F82

NEURAL CORRELATES OF VERBAL RECALL DEFICITS IN SCHIZOPHRENIA PATIENTS AND THEIR UNAFFECTED BIOLOGICAL RELATIVES *Dongju Seo[1], Edward M. Bernat[1], John J. Stanwyck[2], Scott R. Sponheim[2,1]; [1]University of Minnesota, [2]Minneapolis VA Medical Center* – Verbal memory impairments are one of the most severe cognitive abnormalities in schizophrenia. Unaffected biological relatives of schizophrenia patients frequently show verbal memory dysfunction, suggesting an important genetic risk factor for schizophrenia. The purpose of this study is to investigate verbal memory dysfunction and underlying electroloencephalogram (EEG) correlates of these abnormalities in schizophrenia patients and their biological relatives. We utilized an experimental verbal memory task to examine free-recall performance in 29 schizophrenia patients, 20 first-degree biological relatives of schizophrenia patients, and 28 nonpsychiatric control participants. Participants in three groups performed a size judgment task of thirty words and later were asked to recall as many of those words as possible. Schizophrenia patients displayed significantly impaired recall performance compared to relatives (t (47) =-4.4, p <0.001) and controls (t (55)=-7.3, p<001). Additionally, biological relatives showed marginal impairment compared to the controls (t (46)= -2.0, p=. 05). EEG was simultaneously recorded during the encoding phase of the task. For words they later recalled, schizophrenia patients showed enhanced early EEG processing during encoding compared to the controls. Biological relatives showed similarly enhanced early processing during encoding of words they later recalled. We found verbal memory deficits in explicit recollection of words in schizophrenia patients and their relatives. Further, EEG results suggest that biological relatives of schizophrenia patients may have aberrant neural systems that reflect expression of genetic risk for the disorder in brain function. More detailed comparisons of EEG/ERP activity between schizophrenia patients, relatives and controls will be presented and discussed.

F83

A CASE WITH CONFABULATION CAUSED BY OCCLUSION IN THE INTERNAL CAROTID ARTERY: EVALUATION OF FANTASTIC-SPONTANEOUS CONFABULATION *Sachiko Anamizu[1], Motoichiro Kato[1], Masaru Mimura[2], Tomoko Akiyama[3], Fumie Saito[1], Haruo Kashima[1]; [1]Keio University School of Medicine, [2]Showa University School of Medicine, [3]Komagino Hospital* — We report a case who exhibited severe amnesia and fantastic spontaneous confabulation as a result of an occlusion of the internal carotid artery, which involved the basal forebrain, caudate nucleus, orbito-frontal and dorso-lateral frontal structures. His spontaneous confabulation was most pronounced from 4 to 5 months post onset, which then disintegrated into provoked confabulation. At the period of spontaneous confabulation, we observed severe impairment of both memory and executive function, which has been ongoing ever since. During the course of his recovery we used a confabulation questionnaire (a series of 89 questions) to assess the degree and rate of his improvement at 3 time points (4, 10 and 26 months post onset). We compared the case with two groups. The first group was comprised of 8 normal, healthy control subjects. The second was comprised of 9 amnesic control subjects who were suffering from basal forebrain damage, who no longer suffered from spontaneous confabulation but still showed amnesia and provoked confabulation. The results of this case were significantly different from the two control groups, especially with regard to the "unknown question" domains, such as questions to which one should answer "I don't know", and questions related to the subject's personal future. A common factor of the two domains is that there is no correct answer. The confabulation questionnaire proved to be an effective method to evaluate the patient's rate of recovery and the features of confabulation.

F84

PERCEPTUAL ENCODING DEFICIT UNDERMINES WORKING MEMORY FUNCTIONS IN SCHIZOPHRENIA. *Marina Shpaner[1,2], Esther Rabinowicz[1], Gail Silipo[1], John Foxe[1,2], Daniel Javitt[1]; [1]Nathan Kline Institute for Psychiatric Research, [2]Cognitive Neuroscience Program, City College of New York, Graduate Center, CUNY* — Working memory problems are believed to cause pervasive cognitive deficits in schizophrenia. There is mounting evidence, however, that cognitive deficits in schizophrenia stem from early perceptual deficits. Prior studies of the Dot Enumeration Perceptual Organization Task (DEPOT), comparing form vs. number processing of the same stimuli, implicated deficits in visual working memory in schizophrenia. These studies left open the question of whether patients' performance decrement was due to poor encoding or poor consolidation of information. The present study changed the DEPOT into a matching procedure to better differentiate encoding from consolidation and recall. Twenty-six schizophrenic patients and twenty-six matched controls made same/different form and number judgments for stimulus pairs (4-, 5-, or 6-dot squares, rectangles or rhombi), separated by varying ISIs (300, 600, 1000, 2000, 4000 ms). Consistent with previous studies, patients responded faster than controls as the saliency of the shape increased in the number task but not in the form task. There was no group by delay interaction in accuracy or reaction times. Patients' accuracy and reaction times followed the same pattern of responses as that of controls' across different delay intervals, albeit with lower overall accuracy. This differential performance is consistent with a perceptual encoding deficit rather than a dysfunction in consolidation. We concluded that patients employ the same cognitive process as controls, although less efficiently.

F85

REGIONAL WHITE MATTER PATHOLOGY IN MILD COGNITIVE IMPAIRMENT (MCI): DISSOCIATION OF LESION TYPE AND NEUROPSYCHOLOGICAL FUNCTIONING *Lisa Delano Wood[1], Christina Wierenga[1], Norm Abeles[2], Josh Sacco[2], Kelly Klump[2], Priyan Weerappuli[2], Zach Hambrick[2], Alexander von Eye[2], Dan Murman[2], Andrea Bozoki[2]; [1]University of California San Diego, School of Medicine, [2]Michigan State University* — Neuropsychological associations of regional white matter lesion (WML) pathology (deep white matter lesions [DWML] and periventricular lesions [PVL]) across the aging spectrum are not well understood and, to date, research has been largely contradictory and inconclusive. The current study set out to clarify some of the inconsistencies in the literature by relating volumetric analyses of WML (DWML and PVL) to neuropsychological performance in a large clinical sample of older adults diagnosed with Mild Cognitive Impairment (MCI), a transitional stage between normal and demented aging that is based on a pathological model of change. Seventy older adults with MCI were administered a comprehensive neuropsychological battery and WML found on T2-weighted FLAIR (fluid-attenuated inversion recovery) images were quantified using a semi-automated volumetric approach (Pixel Thresholding). Results showed that, in contrast to performance on memory and naming tasks, total WML strongly predicted executive impairments, slowed processing speed, and visuospatial/construction difficulties. In addition, separate regression analyses demonstrated that results were primarily accounted for by DWML (and not PVL), most likely due to frontal-subcortical circuitry disruption. Moreover, DWML but not PVL significantly predicted overall poorer neuropsychological functioning, after controlling for age, education, and level of depression. Taken together, findings demonstrate a dissociation of lesion type on cognitive impairment in MCI and implicate DWML as being most detrimental in terms of neuropsychological functioning. Clinical, theoretical, and methodological implications of these results are discussed.

F86

EPISODIC MEMORY AND TEMPORAL LOBE ATROPHY IN FRONTOTEMPORAL LOBAR DEGENERATION. *Hedvig Söderlund[1], Morris Freedman[1,2], Bruce L. Miller[3], Sandra E. Black[1,2], Brian Levine[1,2]; [1]The Rotman Research Institute, Baycrest Centre for Geriatric Care, Toronto, [2]University of Toronto, [3]Memory and Aging Center, University of California at San Francisco* — It has been unclear to what extent memory is affected in frontotemporal lobar degeneration (FTLD). Since patients usually have atrophy in regions implicated in memory function, the frontal and/or temporal lobes, one would expect certain memory impairment, and that the degree of atrophy in these regions is inversely related to memory function. The purposes of this study were twofold: 1) to assess episodic memory function in FTLD, and more specifically patients' ability to episodically re-experience an event, and determine its source; 2) to examine whether memory performance is related to atrophy in a particular region. FTLD patients (n=19) and healthy controls (n=14) were assessed with cued recall, recognition, "remember/know" (Tulving, 1985; Gardiner, 1988) and source, at 30 min and 24 hrs after encoding. Structural MRI was also run on 15 of the patients. ANOVAs revealed worse performance in patients than controls in all memory measures, all delays. Gray matter volume in the left medial temporal lobe was positively correlated with recognition and source memory, both delays. Volume in the left posterior temporal lobe correlated significantly with recognition, both delays, and with source at 30 min. In summary, not only is recall reduced in FTLD, so is the episodic re-experiencing of what is recalled. Although memory isn't always impaired in FTLD, this study suggests that performance will or will not be impaired depending on the degree of left medial and posterior temporal atrophy.

F87

EFFECT OF LEVELS OF PROCESSING ON RECOLLECTION AND FAMILIARITY IN PARKINSON'S DISEASE *Melanie Cohn[1], Patrick S.R. Davidson[2], Morris Moscovitch[1]; [1]University of Toronto, [2]University of Alberta* – Parkinson's Disease (PD) is traditionally associated with impaired free recall and intact recognition memory, suggesting that recollection (contextually-rich memory) is more impaired than familiarity (context-free memory). However, one study using single item recognition reported intact familiarity and impaired recollection in PD patients (Davidson et al.,2006). Our goals were to verify whether recollection and/or familiarity estimates derived from a paired-associate paradigm are compromised in PD and whether level of processing at encoding could explain the above discrepancy. In two experiments, PD patients (free of depression and of dementia) and healthy control participants studied unrelated word-pairs and completed an inclusion and an exclusion recognition task in which new, half-new, rearranged and intact pairs were presented. Participants had to identify pairs containing two studied words (i.e., rearranged and intact pairs) in the inclusion task and identify only intact pairs in the exclusion task. In Experiment 1, a deep encoding study strategy was imposed (sentence generation) and PD patients showed impaired recollection but intact familiarity. In Experiment 2, participants completed two study-test runs; one involving shallow encoding (reading) and one involving deep encoding (sentence generation). Based on preliminary data, PD patients showed intact recollection and impaired familiarity following shallow encoding, but impaired recollection and intact familiarity following deep encoding. The benefit from deep encoding varied between groups; it increased familiarity only in PD patients and increased recollection only in control participants. Results will be discussed in relation to medial temporal and frontal lobes' roles in supporting recollection and familiarity, two regions affected by PD.

F88

PSYCHOGENIC MEMORY DEFICITS ASSOCIATED WITH FUNCTIONAL CEREBRAL CHANGES: AN FMRI STUDY. *Anne Botzung[1], Lilianne Manning[2]; [1]Duke University; CNRS 7521, CNRS 858, Université Louis Pasteur, [2]CNRS 7521, CNRS 858, Université Louis Pasteur* – There is a remarkable paucity of neuroimaging studies having investigated the possible functional brain correlates of selective autobiographical memory deficits observed in the context of no detectable neurological damage. However, all these studies have indicated functional cerebral abnormalities. We studied a patient who presented with psychogenic memory deficits by means of a functional magnetic resonance imaging (fMRI) experiment involving the retrieval of autobiographical memories. The patient cannot access most of her autobiographical memories pertaining to her childhood up to sixteen years old. We carried out comparisons between the forgotten and the preserved periods of life. Memories from the preserved period were also compared with a control condition of semantic memory. Compared with the control condition, the evocation of the normally retrieved memories appears to be supported by neural networks similar to those of normal subjects. Compared with the forgotten period, the evocation of the normally retrieved memories was associated with increased activation in left parahippocampal and dorsolateral frontal regions. The evocation of the preserved "islands" was associated with loci of activations bilaterally distributed in the temporo-parieto-occipital cortex. In accordance with the literature, these results highlight cerebral functional changes associated with an autobiographical memory deficit observed without neurological background. These functional abnormalities are observed in brain regions that, if damaged, are likely to provoke similar memory deficits. Our data supports the idea of common mechanisms implicated in both organic and psychogenic amnesias. It also underlies the importance of such imaging studies in the context of this pathology.

F89

VERBAL MEMORY RECOGNITION RELATES TO VENTRICULAR VOLUME IN MILD ALZHEIMER'S DISEASE *Monique Cola[1], Stephanie Daniels[2], Maryellen McClain[1], Pamela DeGeorge[1], David Corey[1], Anne Foundas[1]; [1]Tulane University Health Sciences Center, New Orleans, LA, [2]Veterans Administration Hospital, New Orleans, LA* – Individuals in the early stages of Alzheimer's disease (AD) have profound memory loss, generalized brain atrophy and ventricular enlargement. The goal of the present study was to determine whether a derived ratio of hemispheric, cortical atrophy and/or ventricular enlargement correlated with memory loss in early AD. Individuals with a diagnosis of probable AD (n = 6) and healthy controls (n = 6) matched for age (Mean = 72.8 years) and education (Mean = 12.8 years) had volumetric MRI scans. Comprehensive neuropsychological tests were administered to all participants. Regions of interest in the left and right hemispheres were measured on MRI scans using a computer driven cursor. Total brain volume (TBV) and total intracranial volume (TICV) did not differ significantly between groups. AD subjects had volume reduction in prefrontal superior (p=.027) and occipital inferior (p=.009) regions. Total lateral ventricular volumes (VV) were increased in the AD group. Hemispheric VV was correlated with performance on tests of verbal delayed recognition (right hemisphere, p = .046, left hemisphere, p = .009). It is interesting that measures of ventricular volume in early AD correlated with verbal recognition memory but did not correlate with immediate or delayed recall. There is some evidence that ventricular volume expands at a more rapid rate than whole-brain atrophy in mild cognitive impairment and may predict conversion to AD. These results suggest that an index of cortical atrophy proportional to hemisphere volume and accounting for ventricular volume may provide an accurate measure of early memory loss.

Memory: Working Memory

F90

PREFRONTAL CONTROL OF FAMILIARITY VS. RECOLLECTION IN WORKING MEMORY *Eva Feredoes, Giulio Tononi, Bradley Postle; University of Wisconsin-Madison* – Controlling the effects of proactive interference (PI), the deleterious effect of prior mental activity on current memory representations, is believed to be a key function of prefrontal cortex (PFC). This view is supported by neuroimaging evidence that left inferior frontal gyrus (IFG) of the PFC is differentially sensitive to high PI conditions of working memory tasks. In a previous experiment we showed, using the interference methodology of repetitive transcranial magnetic stimulation (rTMS), that left IFG is indeed critical for controlling the effects of PI. In the present experiment, we addressed the question of what is the control mechanism supported by left IFG? First, with an item recognition response-deadline procedure, we determined that PI results from the rapid build-up of a familiarity signal that peaks approximately 200 msec after probe onset. A slower recollection-based signal, maximal at 500 msec, indicated this to be the time by which all decision-related information had accrued. Next, we tested item recognition with rTMS trains delivered either from 0 to 250 msec (early) or from 500 to 750 msec (late) after probe onset. Results indicated that the magnitude of early rTMS-related disruption of high-PI probe accuracy was predicted by an individual's susceptibility to PI. The absence of a comparable effect for late rTMS suggests that PI control occurs when the strength of the familiarity-based signal exceeds that of the recollection-based signal. Left IFG-based control may operate by biasing the influence of familiarity- vs. recollection-based signals on recognition decisions.

F91

DETECTABLE CHANGES IN THE LEVEL OF CEREBRAL ACTIVATION ARE RELATED TO AUDITORY WORKING MEMORY LOAD OF THE FRONTAL LOBE: A FUNCTIONAL NEAR INFRARED SPECTROSCOPY STUDY. *Gerald Voelbel[1,2], Jeannie Lengenfelder[1], Glenn Wylie[1], Neil Nadkani[1], Angela Smith[1], John DeLuca[1,2]; [1]Kessler Medical Rehabilitation Research and Education Corporation, [2]University of Medicine and Dentistry of New Jersey - New Jersey Medical School* – The objective of this study was to investigate whether increased cerebral activation in the frontal lobes of healthy adults was related to increased working memory load, using functional Near Infrared Spectroscopy (fNIRS). Nine right-handed, healthy adults (6 females) between the ages of 20 and 51 without any history of neurological disease or psychiatric disorders participated. Participants were seated comfortably and 30 fNIRS source/ detector optodes were placed on their foreheads. The fNIRS scan started with a 5 minute baseline period, followed by the auditory presentation of the N-Back test. The participants tapped the table with their right hand to respond to the target letters. The N-Back consisted of three randomly presented trials of the 0-, 1-, 2-, and 3- back conditions. In the N-Back test, the 0-back condition is a baseline condition, and the 1-, 2-, and 3- Back conditions place increasing demands on the working memory system. The results show that across the 9 participants there was significantly elevated concentration of oxyhemoglobin (OxyHb) in the right ventro-lateral prefrontal cortex (VLPFC) when 0-Back (baseline) was subtracted from the 1-, 2-, and 3-Back conditions. A significant increase in OxyHb was also detected in right VLPFC when the 2-Back was subtracted from the 3-Back condition. This study demonstrates the efficacy of using fNIRS to detect the relationship between cognitive constructs (working memory load) and physiological changes. Furthermore, it extends our understanding of these changes by strongly suggesting that the increases in the BOLD signal (fMRI) are due to increases in OxyHb.

F92

SCALP AND INTRACRANIAL ERP CORRELATES OF PROACTIVE INTERFERENCE IN FACE RECOGNITION MEMORY *Marieke van Vugt[1], Robert Sekuler[2], Hugh Wilson[3], Michael Kahana[1]; [1]University of Pennsylvania, [2]Brandeis University, [3]York University* – Individual differences in working memory span seem to be closely related to the ability to resolve proactive interference, i.e., interference from previous trials. Recent fMRI studies have shown the left inferior frontal gyrus, right inferior parietal sulcus and precuneus to be the main players in the resolution of proactive interference, yet the electrophysiological correlates of proactive interference are unknown. We examined subjects' electroencephalographical (EEG) activity as they studied and maintained short lists of faces (Wilson et al, 2002) for an immediate recognition memory test (Sternberg, 1966). We used a recent negatives paradigm (Monsell, 1978), where we varied how recently negative probes (lures) were studied. We then compared EEG amplitude as a function of the recency of the probe item, which allowed us to track the sequential involvement of different brain areas in interference resolution. Preliminary results show that the early ERP peaks (N1 and P2) are modulated by proactive interference in posterior and right parietal, as well as frontal areas. We observe later left frontal peaks in response-locked ERPs. We compare these findings to preliminary intracranial EEG studies using the same task and stimuli, where we find electrodes in temporal and perirhinal regions exhibiting sustained differences as a function of interference, and electrodes in the left parahippocampal region that show late proactive interference effects.

F93

RHYTHMIC EFFECTS IN VERBAL AND SPATIAL WORKING MEMORY *Caroline Palmer[1], Zachary A. Schendel[2]; [1]McGill University, [2]Ohio State University* – Both EEG and MEG studies indicate oscillatory neural behavior during verbal and nonverbal working memory tasks, and repetitive motor or submotor activity can maintain spatial information in working memory, similar to how repetitive subvocalizations maintain verbal information (Wesp et al, 2001). We test whether rhythmic activity during stimulus presentation and recall differentially affects verbal and spatial working memory. Digits and spatial grid squares were presented in different sequence lengths, either isochronously (with equal interonset intervals, IOIs) or in simple rhythmic patterns of 3:1, 2:1, and 1:1 IOIs. Participants spoke (Digits) or tapped (Spatial and Rhythmic sequences) their sequence reproductions on a spatially equivalent touchpad. Rhythmic presentation caused a modest reduction in accuracy (4%) for both Digit and Spatial sequences. The presence of Digits or Spatial items reduced overall accuracy of Rhythm reproduction substantially (14%), compared with Rhythms presented alone. Thus, the presence of Digits or Spatial information hurt Rhythm reproduction more than vice versa. Participants' Digit spans were significantly correlated with their Rhythm spans ($r = .63$, $p < .01$); participants with larger Digit spans – whether or not rhythm was present – tended to have larger Rhythm spans. Participants' Spatial spans did not correlate with their Rhythm spans in any conditions. The asymmetric interference of non-rhythmic information on Rhythms indicates that the representation of verbal and spatial memory preserves its temporal dynamics; furthermore, the selective correlation of rhythm and digit spans suggests that the oscillatory mechanisms involved in verbal encoding may also be involved in storage of verbal working memory.

F94

RETROSPECTIVE VS. PROSPECTIVE CODING IN OBJECT WORKING MEMORY *Jarrod Lewis-Peacock, Brad Postle; University of Wisconsin-Madison* – Both retrospective and prospective coding for objects have been observed in the prefrontal cortex and inferior temporal cortex of non-human primates performing working memory tasks (Rainer et. al 1999, Takeda et. al 2005). In the present study we use pattern classification to probe the nature of retrospective and prospective coding in object working memory in humans. A pattern classification algorithm identifies patterns of cortical activity associated with the study of three categories of pictures (faces, locations, and objects). The experiment proceeds in three phases: classifier training, paired-associate learning (offline), and delayed paired-associate recognition. Stimuli from different categories are paired to form between-category paired associates, e.g. face-location, face-object, and object-location pairs. The ensuring paired-associate delayed-recognition task, as compared to conventional delayed recognition, allows the discrimination of retrospective coding (target-related) from prospective coding (probe-related). For example, one trial contains a face-object pairing with the face as the target stimulus and the object as the probe stimulus. If the delay-period activity pattern correlates highly with the face pattern learned by the classifier this would be consistent with retrospective maintenance. However, if the delay-period activity pattern more highly correlates with the object pattern learned by the classifier, this would be consistent with prospective reactivation. We choose long delay periods (11 s) in our working memory task to permit the evaluation of the evolution of the object representation over time. In addition, analyzing cortical activation patterns for the entire brain allows for the investigation of regional differences in the nature of object representation.

F95

REPETITION SUPPRESSION AND REACTIVATION IN VERBAL SHORT-TERM RECOGNITION MEMORY *Bradley Buchsbaum, Mark D'Esposito; UC Berkeley* – A great deal of recent work on the neural underpinnings of recognition memory has shown that, in regions known to be important for sensory processing, a novel stimulus elicits a stronger response than a repeated one; and, moreover, the smaller response to the second stimulus the greater the subjective report of item familiarity. However, this phenomenon, often called "repetition suppression", would seem to stand at odds with another oft-proposed neural mechanism for recognition memory: namely, that perceptual traces established during stimulus encoding are "reactivated" upon a subsequent encounter of the same stimulus. Moreover, in short-term memory, at least, it is thought that memory traces established during initial stimulus perception undergo a rapid temporal decay. In the present work we examined, first, whether at short repetition lags, and using verbal stimuli, reactivation or repetition suppression is observed in sensory cortical regions known to be involved in memory for words. Second, we investigated whether both phenomena: repetition suppression and trace reactivation, are modulated by the number of intervening items (1-5) between an item and its repeat. Lastly, we examined how the phenomena of repetition suppression and reactivation are affected by a change in modality (auditory-to-visual or visual-to-auditory) between repetitions. Subjects performed a continuous verbal recognition task (ISI = 2.5 s), with randomly ordered auditory- and visual-verbal stimuli and repetition lag varied between one and five items. Pronounced repetition suppression was observed for both auditory and visual items in (mid-anterior superior temporal gyrus) auditory and visual sensory cortices, respectively. Moreover, the degree of within-modality repetition suppression in the mid-anterior superior temporal gyrus was correlated with individual differences in recognition memory accuracy. In contrast, reactivation (greater activity for a repeated item) was observed in auditory association cortex of the posterior superior temporal gyrus for both within- and cross-modality repetitions. Our results indicate that neighboring cortical regions in the superior temporal lobe exhibit repetition suppression and reactivation, respectively, and that these differential effects reflect fundamentally different roles for these areas in recognition memory.

F96

LEARNING MODULATES NEURAL ACTIVITY IN VISUAL WORKING MEMORY *Youssef Ezzyat[1], Katherine Sledge Moore[2], Ingrid Olson[1]; [1]University of Pennsylvania, [2]University of Michigan* – Because humans perform well on many visual cognition tasks, such as object recognition, the limits that have been observed in visual working memory (VWM) seem striking. Researchers have repeatedly found VWM capacity limits of approximately four items. This observation has proven robust to changes in features and familiarity. In a series of change detection experiments Olson et al (2005) further showed that overall VWM capacity was not improved when subjects learned to recognize task stimuli. However, subjects did show improvement when they learned to associate specific stimuli with specific to-be-detected changes. These results support the hypothesis that learning can determine the information stored in VWM (the prioritization account) but cannot increase its overall capacity. We conducted the present fMRI study to determine the neural correlates of VWM prioritization. Subjects were trained outside the scanner on visual arrays and were subsequently scanned while performing a change detection task on both learned and novel arrays. Our results showed learning-modulated activity reflected by decreased activation for learned displays compared to novel ones. These results are consistent with the prioritization theory and suggest a top-down modulation of information stored in VWM.

F97

AGE-RELATED DIFFERENCES IN WORKING MEMORY AS DETERMINED BY THE ANALYSIS OF SPEED-ACCURACY TRADEOFF *Brian C. Rakitin, Arjun Kumar, Rohit Namibisan, Christian Habeck, Yaakov Stern; Columbia University* – Speed-accuracy tradeoff (SAT) analysis of a delayed matching-to-sample task was used to examine age-related differences in working memory. Sixteen healthy young adults (ages 18-35) and sixteen healthy older adults (ages 65-85) completed a memory task in which they were presented with a visual sequence: memory stimuli (two abstract shapes; 3000ms), blank delay (5000ms), a probe stimulus of variable duration (single abstract shape; 125, 250, 500, 1000, or 2000ms), and a mask (500ms). Subjects decided whether the probe stimulus matched either of the memory stimuli; they were instructed to respond during the mask, placing greater emphasis on speed than accuracy. We used Hintzman & Curran's (1994) three-parameter compound bounded exponential model of SAT to describe changes in discriminability associated with processing time. Group-level analysis revealed a significantly higher asymptote for the young adult group, but no difference across groups in rate of curvature change or x-intercept. In addition, analysis of neuropsychological variables demonstrated that IQ is a better predictor of the shape of the SAT function than age. Our results suggest that working memory capacity decreases with aging, while the threshold for discriminability and the rate of information accumulation remain constant.

F98

REFRESHING FACES AND SCENES: ASSESSING FUNCTIONAL CONNECTIVITY AMONG BRAIN REGIONS DURING A SINGLE THOUGHT *Matthew Johnson[1], Carol Raye[1], Mark D'Esposito[2], Karen Mitchell[1], Marcia Johnson[1]; [1]Yale University, [2]University of California - Berkeley* – "Refreshing" is a basic component process of cognition used to foreground an active representation. Previously, we have shown that dorsolateral prefrontal cortex (DLPFC) and anterior prefrontal cortex (PFC) are active while refreshing representations of recently perceived stimuli (Johnson MK et al., 2005; Raye et al., in press). We have also recently shown that refreshing stimuli such as faces and scenes leads to top-down modulation effects in posterior areas responding preferentially to one stimulus class (relative to the other) during perception (e.g., fusiform face area [FFA], parahippocampal place area [PPA], and parts of middle occipital gyrus, lateral precuneus, retrosplenial cortex, and inferior occipital gyrus; Johnson MR et al., submitted). According to present models (e.g., of working memory), such effects should be mediated by modulatory control signals originating in PFC. Using methods established by Rissman et al. (2004), the present analysis sought to detect functional connectivity changes evoked by refreshing either a face or a scene stimulus. Participants (N=15 healthy young adults) saw pictures of faces and scenes, followed shortly by either a cue to refresh (think back to) one of the pictures, or a repeated presentation of one picture. Significant changes in functional connectivity were observed between our prefrontal regions of interest (ROIs) and our posterior stimulus-selective ROIs depending on whether the target stimulus was refreshed or repeated, and whether it was a face or a scene. These results generally support models of cognition that postulate prefrontal modulation of posterior perceptual regions for the maintenance and manipulation of mental representations.

F99

AGE-RELATED SLOWING ON EVEN SIMPLE COGNITIVE TASKS MAY BE DUE TO THE RECRUITMENT OF ADDITIONAL PROCESSES *Julie A. Higgins, Marcia K. Johnson; Yale University* – Young (YA, Mean = 20 yrs) and older (OA, Mean = 74 yrs) adults read three words presented simultaneously in a single column. For Task 1, after the words disappeared, participants either read one of the words presented a second time or were cued to think of (refresh) one of the words. We investigated response times on these simple reflective (refreshing) and perceptual (reading) tasks as a function of what the participants expected to do next (Task 2). Half expected to see the word set again before having to refresh or read a new word on Task 2 (2X), while the other half did not (1X). On Task 1, OA were slower overall and were disproportionately slower to refresh relative to YA, replicating previous findings (Johnson et al., 2002). For YA, response times to refresh and to read a word again were longer in the 1X compared to the 2X condition. This suggests that additional processing (e.g., rehearsal) was engaged in anticipation of performing Task 2 without the benefit of seeing the set again, and had the effect of slowing basic reflective and perceptual processes. In contrast, OA response times to refresh and read a word again did not differ between the 1X and 2X conditions suggesting that OA may have been engaging in rehearsing in both conditions. It is possible that age-related slowing on even very simple cognitive tasks may be partially due to the recruitment of additional processes by older adults.

F100

MONITORING AND MANIPULATION OF WORKING MEMORY CONTENTS IN THE N-BACK TASK: AN ERP STUDY *Scott M. McGinnis[1], Hyemi Chong[1], Jenna L. Riis[1], David A. Wolk[2], Phillip J.*

Holcomb[3], Kirk R. Daffner[1]; [1]Harvard Medical School/Brigham and Women's Hospital, [2]University of Pittsburgh Medical Center, [3]Tufts University – We investigated mechanisms underlying the allocation of working memory (WM) resources in healthy young subjects utilizing event-related potentials (ERPs). The n-back is a challenging task that requires frequently resetting the contents of WM. Each event is both a potential target and a stimulus to be processed for future target/non-target discriminations. An event thus requires the contents of WM to be monitored to identify targets and manipulated to prepare for decisions about upcoming events. The amplitude of the P3 component can serve as an index of the amount of processing resources allocated to the updating of working memory. Young healthy adult subjects performed a visual n-back task with 3 levels of difficulty (0-back, 1-back, 2-back). Subjects responded to target letters with a button press. Results indicated a decline in performance (decreased hits, increased RT) with increasing WM load, largest between the 1-back and 2-back conditions. For non-targets, P3 amplitude increased with increasing n-back demand, the largest increase occurring between 1-back and 2-back. In contrast, for targets, P3 amplitude was smaller in the 2-back compared with the 0-back and 1-back, which elicited P3s with similar amplitudes. These data suggest that n-back performance depends on 2 aspects of updating WM that may compete for resources: (1) target/non-target discrimination, and (2) mental manipulation of stimuli in preparation for future decisions. Increased appropriation of resources for mental manipulation may lead to decreased resources available for discrimination, reflected in both the decline in behavioral performance and reduction in P3 amplitude to targets.

F101

PREFRONTAL AND HIPPOCAMPAL CONTRIBUTIONS TO THE ACTIVE MAINTENANCE OF ITEM AND RELATIONAL REPRESENTATIONS IN WORKING MEMORY *Brian T. Miller[1], David Badre[1], Alex Konkel[2], Neal J. Cohen[2], Mark D'Esposito[1]; [1]Helen Wills Neuroscience Institute, University of California, Berkeley, [2]Beckman Institute, University of Illinois, Urbana-Champaign* – Previous evidence suggests that the hippocampus may be critical in the formation of memory for relations between items. Moreover, hippocampal lesion patients are impaired in relational memory performance even following brief retention intervals. While the prefrontal cortex (PFC) is implicated in maintenance processes necessary to bridge such temporal gaps, these WM deficits in patients with intact PFC underscore a gap in our understanding of prefrontal and hippocampal contributions to the maintenance of relational representations and the consequence of these mechanisms on long-term memory formation. In the present fMRI investigation, participants performed blocks of delayed-match-to-sample trials (DMS phase) followed by a surprise subsequent memory test. During the DMS phase, triplets of novel visual stimuli were presented with instructions to remember – over a brief delay - either the identity or the spatial configuration of the items. Since the goal was to assess the relationship between WM maintenance activity and subsequent memory, it was important to obtain a measure of delay period activity on trials for which there was no short-term test, and no re-exposure to items. Only a limited number of randomly presented DMS trials had a test with most being partial trials ending immediately after the delay. Behaviorally, high performance on test stimuli and sustained activity in bilateral PFC and hippocampus for untested trials of both item and spatial conditions indicated that participants were maintaining information on each trial. These estimates permit subsequent memory analyses of the contribution of delay activity in these regions to relational and item memory formation.

F102

AGE-RELATED INABILITY TO SUPPRESS IRRELEVANT INFORMATION: A SPECTRAL STUDY OF GAMMA BURSTING DURING A WORKING MEMORY TASK. *Wesley Clapp[1], John Kelley[2], Kevin McEvoy[2], Mark D'Esposito[2], Adam Gazzaley[1]; [1]UCSF, [2]UC Berkeley, Helen Wills Neuroscience Institute* – This study investigated the balance between enhancement of relevant and suppression of irrelevant face stimuli in a working memory task performed by younger and older adults. Subjects participated in a delayed-response task, where they were asked to view sequentially presented faces and scenes with instructions to passively view the stimuli, remember only the faces, or remember only the scenes. In previous fMRI and EEG (ERP) studies implementing this task, older adults demonstrated short-term memory impairment. Importantly, this memory deficit correlated with subjects' inability to suppress irrelevant information (Gazzaley et al., Nature Neuroscience 2005). There exists a strong link between induced gamma-band responses and attentive, sensory stimulus processing. Recently we demonstrated that gamma bursting in young subjects was increased in response to relevant faces and decreased in response to irrelevant faces relative to passively viewed stimuli. Enhancement and suppression indices were generated by subtracting the response to passively viewed stimuli from the relevant stimuli and subtracting the response to irrelevant stimuli from the passively viewed stimuli, respectively. Using these indices it was shown that younger subjects successfully suppress irrelevant information. The present study reveals that healthy older adults show no significant enhancement or suppression effects. When compared between groups, older adults show a significantly smaller suppression index than younger subjects, suggesting that the older subjects were unable to suppress irrelevant information. This finding strongly supports past ERP and fMRI results and suggests gamma bursting associated with memory and attention processing may serve as another neural marker for cognitive aging.

Memory: Memory Systems

F103

SPATIAL SOURCE MEMORY ROCS SUPPORT A CONTINUOUS (SINGLE-PROCESS) MODEL OF MEMORY *Julie A. Grimes, Scott D. Slotnick; Boston College* – The dual-process model assumes memory is based on familiarity or the all-or-none process of recollection while the single-process unequal variance signal-detection model assumes memory is a continuous process. In source memory paradigms, these models make disparate predictions with regard to the shape of the receiver operating characteristic (ROC; a plot of hit rates vs. false alarm rates) and z-transformed ROC (zROC). The dual-process model predicts the source ROC is linear and zROC has positive curvature while the unequal variance model predicts the source ROC is curved and zROC is linear. In this study, we designed the experiments to maximize the process of source 'recollection' in an effort to find evidence supporting the dual-process model (should it exist). During study, twenty line drawings of objects were presented on the left or right side of the screen (objects were repeated in the second experiment). Participants were instructed to remember each object and its spatial location, while maintaining central fixation. During test, participants were presented with studied (old) and new objects. Participants made two judgments indicating: 1) confidence that each object was old or new and 2) confidence that each object had been presented on the left or right. Source memory ROCs for both experiments were curved and source memory zROCs were linear (or showed negative curvature). These results support the unequal variance model of memory retrieval and are inconsistent with the dual-process model. The implications for interpreting neuroimaging results, which typically involves assuming the dual-process model is valid, are considered.

F104

TOPOGRAPHIC ERP DIFFERENCES FOR PRIMACY AND RECENCY RECALL *Petter Kallioinen, Sverker Sikström; Lund university* – Recall for items in a list is typically better for items in the beginning and end of the list. These findings are known as primacy and recency effects and are thought to reflect different memory mechanisms. Brain responses during item presentation measured with ERP, event related potentials, typically differ between items later remembered and forgotten. This is called the subsequent memory effect, SME. In our experiment participants studied words in a list learning task were memory was tested with free recall. The behavioral results show a marked primacy and recency effect. The SME for primacy words had a somewhat left lateralized parietal center whereas corresponding effect for recency words had a right frontal center. These topographies of SME have been described earlier in the literature but not in relation to primacy and recency effects.

F105

LEVELS OF PROCESSING EFFECTS ON THE PERCEPTUAL SENSITIVITY OF FAMILIARITY MECHANISMS: AN ERP STUDY *Christian Groh-Bordin[1,2], Hubert D. Zimmer[2]; [1]Clinical Neuropsychology Unit, Saarland University, Saarbruecken, Germany, [2]Brain and Cognition Group, Saarland University, Saarbruecken, Germany* – Early models of recognition memory already differed in how far familiarity mechanisms were supposed to code perceptual and conceptual information respectively. Recently, this debate has been renewed due to divergent findings in event-related potential (ERP) studies, where the mid-frontal old/new effect (FN400) - typically associated with familiarity - has shown a differential sensitivity to an item's perceptual changes from study to test. In our study, we investigated the effects of a levels-of-processing (LOP) manipulation on the emergence of FN400 effects for perceptually modified items to further specify the conditions under which familiarity codes perceptual stimulus attributes. Previous behavioral studies indicated that shallow encoding enhances perceptual specificity effects, and we expected this enhancement to be visible also in a modulation of ERP old/new effects. Two subject groups studied a series of visually presented objects by assessing the size of each picture either on the screen (shallow encoding) or in reality (deep encoding). In a subsequent recognition memory test, old items previously seen in the study phase together with new items were presented. For half of the old items, color and orientation were changed from study to test. Preliminary analyses indicated a considerable mid-frontal old/new effect in both subject groups. However, contrary to our expectations, this component was not affected by perceptual changes in the shallow, but only in the deep encoding group. This pattern suggests that familiarity is able to code perceptual stimulus features, but this coding may require the active encoding of these attributes into a comprehensive memory trace.

F106

SEPARABLE FORMS OF REALITY MONITORING SUPPORTED BY ANTERIOR PREFRONTAL CORTEX *Jon S. Simons[1], Richard N.A. Henson[2], Sam J. Gilbert[3], Paul C. Fletcher[1]; [1]University of Cambridge, UK, [2]MRC Cognition and Brain Sciences Unit, Cambridge, UK, [3]Institute of Cognitive Neuroscience, University College London, UK* – Reality monitoring refers to the ability to discriminate between information that was generated internally, as opposed to that derived from the outside world, at the time of encoding. In the cognitive literature, two different tasks have often, interchangeably, been used to assess this ability: memory for perceived vs. imagined stimuli; and memory for participant- vs. experimenter-performed tasks. We aimed to examine activation associated with these two reality monitoring tasks in the same participants using fMRI, to investigate whether the network of regions we have previously shown to play a general role in source memory (involving anterior prefrontal cortex and other regions) might also be engaged during these forms of reality monitoring. When contrasted against a semantic baseline, both reality monitoring tasks did indeed engage the previously observed lateral anterior prefrontal network. However, when the two forms of reality monitoring were contrasted against one another, the only area of the brain to show significant activation was medial anterior prefrontal cortex, in which signal was higher during recollection of self/experimenter status than perceived/imagined status. One hypothesis is that this result reflects differences in the degree to which the reality monitoring tasks require processing of self-referential information. Further analyses sought to understand which stages of the retrieval process these different anterior prefrontal regions might support: evidence from retrieval cue manipulations and effective connectivity analyses suggests that the lateral anterior region may be involved in pre-retrieval processes whereas the medial anterior region might modulate activity in dorsolateral prefrontal cortex during post-retrieval monitoring.

F107

DISSOCIATION OF AUDITORY AND VISUAL SOURCE MEMORY FOLLOWING A RIGHT POSTERIOR MEDIAL TEMPORAL LOBE LESION. *Jan Peters[1], Benno Koch[2], Michael Schwarz[2], Irene Daum[3]; [1]International Graduate School of Neuroscience, Ruhr-University Bochum, [2]Municipal Hospital Dortmund, [3]Institute of Cognitive Neuroscience, Ruhr-University Bochum* – The present single case analysis of memory performance in a patient with an ischemic lesion affecting posterior but not anterior right medial temporal lobe (MTL) indicates that recollection can be disrupted in a domain-specific manner. The patient showed estimates of recollection and familiarity in the normal range. Also, in a novel recognition memory paradigm, memory for spoken words (auditory condition) and pictures of objects (visual condition) was unimpaired. While memory for visual source (texture/color of the background against which pictures appeared) was also within the normal range, auditory source memory (male/female speaker voice) was at chance level ($z = -2.08$). Critically, the patient also showed a highly significant increase in source accuracy difference between the auditory and the visual condition, indicating abnormally reduced auditory source memory. This dissociation is consistent with recent fMRI evidence of anterior/posterior MTL dissociations depending upon the nature of source information (visual texture/color vs. auditory speaker voice). The findings are in good agreement with the view of dissociable memory processing by the perirhinal cortex (anterior MTL) and parahippocampal cortex (posterior MTL), depending upon the neocortical input that these regions receive.

F108

THE LIMITS RECOLLECTION DRAWS ON MEMORY *Bertram Opitz; Experimental Neuropsychology Unit, Saarland University* – A well known phenomenon is the memory enhancment after deep processing of the to be learned material. This deep processing advantage can be explained by dual-processing accounts of recognition memory: deep encoding, i.e. encoding in a semantically meaningful way, leads to recognition based on enhanced recollection. It has also been suggested that repeated presentation also leads to improved memory performance based on recollective processes. The present study investigated whether this repetition induced recollection improvement acts on top of the recollection enhancement due to deep processing. Thus, ERPs were recorded during recognition judgments to new words and old words which had been studied shallowly or deeply and were presented once or three times. Results revealed that recognition is significantly enhanced for deeply studied words and for repeated words, thereby confirming previous results. In addition, ERP data indicate significant effects of Depth of processing and repetition on the parietal old/new-effect reflecting recollection processes, whereas no differences were present in the early frontal old/new-effect, the ERP correlate of familiarity. Interestingly, the effects of Depth of processing and repetition were non additive. Instead, an increased parietal old/new effect was only found for repeatedly presented words under shallow encoding. For deeply studied words, in contrast, such a repetition related memory enhancement was not observed. This suggests, that recollection is an all-or-none process and, therefore, limits the memory enhancement that can be achieved.

F109

SELECTIVE ATTENTION DEMAND MEDIATES RULE-BASED CATEGORIZATION DEFICITS IN FOCAL BASAL GANGLIA LESION PATIENTS *Shawn Ell[1], Andrea Weinstein[2], J. Vincent Filoteo[3], W. Todd Maddox[4], Rich Ivry[2]; [1]University of Maine, [2]UC Berkeley, [3]UC San Diego/VASDHS, [4]University of Texas* – Patients with basal ganglia pathology have been found to be impaired on category learning tasks, but the extent of this deficit is unknown. One consistent finding has been that basal ganglia dysfunction impairs learning in rule-based tasks – i.e., categorization tasks where learning is thought to depend upon the use of an explicit, hypothesis-guided strategy. Recent data suggest that, in individuals with Parkinson's disease (PD), this impairment may be limited to rule-based tasks that place demands upon selective attention (Filoteo et al., in press). The goal of the present study was to extend this work to patients with focal basal ganglia lesions. Six patients (4 left side, 2 right side) were tested on two rule-based categorization tasks. The unidimensional task places demands upon selective attention because participants must learn to attend to the relevant stimulus dimension while ignoring an irrelevant dimension. In contrast, the conjunction task places minimal demands upon selective attention because participants must attend to both dimensions. The patients were impaired on the conjunction task, but not the unidimensional task. Quantitative, model-based analyses suggest that this accuracy deficit may be due to the use of suboptimal decision strategies. These results are opposite those observed in PD patients and raise the intriguing possibility that focal basal ganglia lesions and disorders that alter dopamine systems (i.e., PD) might have opposite effects on rule-based category learning.

F110

COMPLEMENTARY ROLES FOR THE HIPPOCAMPUS AND NUCLEUS ACCUMBENS IN ENCODING OF NOVEL INFORMATION: EVIDENCE FROM INTRACRANIAL EEG *Nikolai Axmacher[1], Michael Cohen[2], Juergen Fell[1], Sven Haupt[1], Christian Elger[1], Thomas Schlaepfer[1], Volker Sturm[3], Charan Ranganath[2]; [1]University of Bonn, Germany, [2]University of California at Davis, [4]University of Cologne, Germany* — The ability to detect and encode novel stimuli is fundamental to survival in dynamic environments. Human neuroimaging studies have shown that the medial temporal lobe (MTL) region is involved in novelty detection and encoding of items into long-term memory, and recent electrophysiological data in animal models suggest that neurons in the ventral tegmentum and nucleus accumbens facilitate memory for novel items. We attempted to bridge the gap between these two literatures by using electrophysiological recordings from the human MTL and nucleus accumbens to identify the neural mechanism of memory enhancement for novel items. Intracranial EEG was recorded from epilepsy patients with electrodes implanted in the MTL and from patients with electrodes in the nucleus accumbens undergoing deep brain stimulation for therapy-refractory depression. We found that contextual novelty enhanced event-related potentials (ERPs) in the hippocampus and rhinal cortex. Hippocampal ERPs were accompanied by an increased power and phase concentration in the theta frequency range, while we found only an effect on theta phase concentration in the rhinal cortex. Furthermore, there was a selective subsequent memory effect on hippocampal and rhinal ERPs for contextually novel but not standard items. In the nucleus accumbens, we found a significant enhancement of ERPs during processing of contextually novel items, but no subsequent memory effect. Our findings support recent models that processing of novel items activates dopaminergic regions, which in turn modulate encoding processes in the MTL.

F111

BRAIN ACTIVITY THAT PREDICTS MEMORY FORMATION BEFORE AN EVENT: SPOKEN VERSUS SEEN WORDS *Leun J. Otten, Angela H. Quayle, Bhamini Puvaneswaran; Institute of Cognitive Neuroscience, University College London* — It has been assumed that laying down a new memory primarily relies on the cognitive and neural processes set in train when an event is encountered. Recently, we have shown that brain activity elicited by a cue before an event can predict whether the event will later be recollected. Memory formation thus seems influenced by the neural context in which an event occurs. We found this effect for seen, but not spoken, words. One explanation is that as the cue was always visual, the requirement to switch modalities prior to spoken words prevented the preparation of processes relevant for effective encoding. Here, we test this possibility. EEG was recorded from the scalps of 24 healthy young adults while they performed an incidental semantic-encoding task on an intermixed series of spoken and seen words. Each word was preceded by a cue signalling the modality of the upcoming word. Spoken words were preceded by auditory cues, and seen words by visual cues. A recognition memory test incorporating remember/know judgments was performed after a delay. As observed previously, a negative-going, frontally-distributed modulation just before visual word onset predicted later recollection. Crucially, when stimulus modality was kept constant between cue and word, the same effect occurred for spoken words. Prestimulus effects were present regardless of whether successive trials involved the same, or a different, modality. Thus, neural context plays an important role in memory formation regardless of input modality. With an unpredictable stimulus sequence, this context is set up on a trial-by-trial basis.

F112

INCREASED HUMAN HIPPOCAMPAL THETA ACTIVATION RELATED TO GOAL-DIRECTED NAVIGATION REVEALED BY SPATIALLY-FILTERED MAGNETOENCEPHALOGRAPHY (MEG) *Linda Johnson[1], Brian Cornwell[1], Tom Holroyd[1], Christian Grillon[1]; [1]National Institute of Mental Health* — Consistent with animal studies of hippocampal theta rhythms, recent studies using intracranial EEG in patients and MEG in healthy human participants have found a relationship between theta activity (4-8 Hz) and spatial navigation. It is unclear whether theta increases reflect spatial memory processes or, more generally, sensorimotor integration processes. With a virtual reality analog of the widely-used Morris water maze in rodents, nine healthy human participants (6 women) "swam" around a pool while neuromagnetic data were collected with a 275-channel whole-head MEG system at 1200Hz. Participants navigated as quickly as possible to a submerged, hidden platform that never changed location, which could be learned by using distal visual cues on the surrounding walls. To control for sensorimotor neural processes, participants were instructed to "swim" aimlessly on separate trials in the same pool with different visual cues and without a platform. To localize theta activity related to goal-directed navigation, spatial filtering analyses (synthetic aperture magnetometry [SAM]) were conducted on 1-sec windows (normalized to a resting baseline) during virtual swimming in both conditions. SAM analyses revealed robust left hippocampal theta activity 1-2 sec into trials with a platform relative to control trials, suggesting that perception of relevant spatial cues elicited memory retrieval processes necessary to begin navigating in the correct direction. These data are consistent with evidence of a role for hippocampal theta oscillations in spatial memory processes. We will present further analyses to characterize the time course of hippocampal theta during navigation and to identify any relationships with behavioral performance.

F113

NEURAL CORRELATES OF CONCEPTUAL IMPLICIT MEMORY AND THEIR CONTAMINATION OF PUTATIVE NEURAL CORRELATES OF EXPLICIT MEMORY *Joel Voss[1], Ken Paller[1]; [1]Northwestern University Interdisciplinary Neuroscience Program* — During episodic recognition tests, meaningful stimuli such as words can engender both conscious retrieval (explicit memory) and facilitated access to meaning that does not rely on the awareness of remembering (conceptual implicit memory). Neuroimaging investigations of one type of memory are frequently subject to the confounding influence of the other type of memory, thus posing a serious impediment to theoretical advances in this area. We used minimalist visual shapes (squiggles) to evaluate this problem. Subjective ratings of squiggle meaningfulness varied idiosyncratically, and behavioral indications of conceptual implicit memory were evident only for stimuli given higher ratings. These effects did not result from perceptual-based fluency or from explicit remembering. Distinct event-related brain potentials were associated with conceptual implicit memory and with explicit memory by virtue of contrasts based on meaningfulness ratings and memory judgments, respectively. Frontal potentials from 300-500 ms after the onset of repeated squiggles varied systematically with perceived meaningfulness. Explicit memory was held constant in this contrast, so these potentials were taken as neural correlates of conceptual implicit memory. Such potentials can contaminate putative neural correlates of explicit memory, in that they are frequently attributed to the expression of explicit memory known as familiarity. These findings provide the first neural dissociation of these two memory phenomena during recognition testing, and underscore the necessity of taking both types of memory into account in order to obtain valid neural correlates of specific memory functions.

F114

INFLUENCE OF CONCEPTUAL KNOWLEDGE ON VISUAL OBJECT DISCRIMINATION *Morgan Barense, Kim Graham; Medical Research Council, Cognition and Brain Sciences Unit* – Although recent studies have highlighted the key role played by the perirhinal cortex in complex object processing, it is not currently clear whether this region also contributes to semantic processing of objects. To address this issue, object processing for meaningful (e.g., familiar real world objects) and novel (e.g., barcodes, blobs, greebles) stimuli was investigated in individuals presenting with a significant loss of conceptual knowledge in the context of semantic dementia (SD), a progressive condition that affects anterior and medial temporal lobe (MTL) regions (including perirhinal cortex). The performance of this group was contrasted with that of participants with non-progressive focal lesions to the MTL (including perirhinal cortex) who typically show less impaired semantic memory. Subjects were administered a series of object discrimination tasks involving either meaningful or novel stimuli. When the objects possessed a high number of overlapping features, the two patient groups were impaired relative to controls on discriminations of both meaningful and novel stimuli. The two patient groups, however, demonstrated different profiles of impairment on meaningful compared to novel discriminations. Although they were impaired on both types of discriminations, the deficit in individuals with focal MTL damage was attenuated by the use of meaningful stimuli. By contrast, performance in the SD group did not benefit from the use of meaningful stimuli. These findings suggest that perceptual representations of complex familiar and novel objects (dependent upon perirhinal cortex) interact with higher-order abstract conceptual representations (dependent on antero-lateral temporal regions).

F115

MEMORY NETWORKS USED TO SUPPORT RETRIEVAL UNDER CONDITIONS OF FULL AND DIVIDED ATTENTION *Erin Skinner[1], Myra Fernandes[1], Cheryl Grady[2,3]; [1]University of Waterloo, [2]Rotman Research Institute, Baycrest Center for Geriatric Care, [3]University of Toronto* – We used a multivariate analysis technique, Partial Least Squares (PLS), to identify distributed patterns of brain activity relating to verbal recognition memory, when performed under full attention (FA) or two different divided attention (DA) conditions during retrieval. Behaviourally, recognition was disrupted when a word- but not digit-based distracting task was performed concurrently with retrieval. PLS was used to identify patterns of brain activation that together co-varied with the three memory conditions. Results identified a FA network consisting of left medial frontal, left parahippocampal, right anterior cingulate, left cuneus, and several sub-cortical regions, whereas the DA-digit condition was associated with right superior frontal activity. The DA-word condition was not reliably associated with either pattern. A second analysis identified patterns that co-varied with recognition accuracy. Increases in memory performance in the FA and DA-digit condition were related to increases in a network consisting of right medial frontal, left middle, inferior, and superior frontal regions, and the right precuneus, whereas decreases in memory performance were related to increases in middle occipital, bilateral cuneus, left fusiform, and left cerebellar regions. This pattern of brain-behaviour correlations was not found in the DA-word condition, in which memory was disrupted. Results indicate that 1) attentional manipulations that do not disrupt memory (DA-digit) alter the network used to sub-serve retrieval, though successful memory is associated with activation of the same set of brain regions as FA, and 2) those DA conditions that disrupt memory (DA-word) interfere with recruitment of both retrieval-related and performance-related networks.

F116

IMPAIRED FAMILIARITY AND INTACT RECOLLECTION FOLLOWING ANTERIOR TEMPORAL-LOBE REMOVAL THAT AFFECTS THE PERIRHINAL CORTEX BUT SPARES THE HIPPOCAMPUS *Ben Bowles[1], Carina Crupi[1], Seyed Mirsattari[1], Susan Pigott[1], Andrew Parrent[1], Jens Pruessner[2], Andrew Yonelinas[3], Stefan Köhler[1]; [1]University of Western Ontario, [2]McGill University, [3]University of California, Davis* – Whether recognition memory is guided by one continuous strength process or by two different processes, each with distinct functional characteristics and neural bases, is widely debated in the literature. According to the most popular dual-process view, the two recognition processes, recollection and familiarity, are supported by the hippocampus and perirhinal cortex, respectively. Influential support for this view comes from the observation that selective hippocampal damage can lead to deficits in recollection while leaving familiarity unimpaired. If the two processes are truly independent, however, it should also be possible to establish the opposite dissociation following temporal-lobe damage that affects perirhinal cortex but spares the hippocampus; such evidence is currently missing. Here we examined recollection and familiarity in MA, a patient who acquired precisely this type of lesion in the left hemispheres as a result of surgical treatment for intractable epilepsy. Using the remember-know procedure in two experiments and receiver operating characteristics (ROC) in another, we show that patient MA exhibits consistently impaired familiarity with recollection in the normal range. In a fourth experiment involving response deadlines, MA's performance was impaired when a response was required quickly but normal when more time was allowed. In line with the idea that familiarity is available earlier than recollection, this finding provides further converging evidence for a familiarity deficit. These results indicate that the familiarity component of recognition can be selectively impaired. They also support the view that recollection and familiarity rely on distinct medial temporal lobe structures.

F117

THE HUMAN PERIRHINAL CORTEX: INVOLVEMENT IN VISUAL PERCEPTION IS TASK SPECIFIC *Ingrid Olson[1], Alan Plotzker[1], Youssef Ezzyat[1]; [1]University of Pennsylvania, Philadelphia, PA* – A recent and controversial proposal based on findings from monkeys is that the perirhinal cortex is involved in high-level perceptual processing (Buckley et al., 2001; Bussey et al., 2002;Murray & Bussey, 1999). This hypothesis has been tested in human patients with large MTL lesions extending into hippocampal, perirhinal, and temporal polar cortices, and the results show that they exhibit a pattern of behaviors similar to that reported in monkeys with focal perirhinal lesions (Barense et al., 2005; Lee et al., 2006; Lee et al., 2005a; Lee et al., 2005b). These findings have been controversial because at least one group has failed to replicate these findings (e.g. Squire and colleagues), and memory impairments may have contributed to the pattern of performance. To overcome these problems, we tested two patients with spared hippocampi and parahippocampal cortices, but unilaterally damaged perirhinal cortex. Subjects were shown two faces and asked to choose which face was (Exp 1) older or (Exp 2) more beautiful. The results show that patients were as fast and as accurate as controls, even when the task was difficult and the stimuli had a high degree of feature overlap. Next, subjects were asked to choose which of two faces (Exp 3) or two dot patterns (Exp 4) was most similar to a sample stimulus. The results show that patients were slower and less accurate then controls at all levels of difficulty. These findings show that the perirhinal cortex is involved in disambiguating visual stimuli in some tasks but not others.

F118

ANALOGY: AN FMRI ANALYSIS OF HIPPOCAMPAL LEARNING WITH AND WITHOUT AWARENESS *Anthony Greene, Keith Hice; University of Wisconsin, Milwaukee* – Three theories attempt to describe the role of the hippocampus in acquiring complex associations. Configural Association Theory contends that the hippocampus binds groups of stimuli into a unitary representation. The Declarative Memory Model maintains that learning complex associations requires explicit awareness which in turn requires the hippocampus. Relational Learning Theory asserts that the hippocampus acquires complex associations as abstract relationships but does not represent the items per se. We report that the capacity for analogy or transfer is implicit and entails differential hippocampal activity. Our analogy task requires acquisition of a transverse patterning set, and then tests to see if the relations transfer to an unrelated set. Participants are presented with pairs of faces and learn that A>B (given faces A&B choose A) and B>C. Only the experimental group is trained on the transverse patterning pair C>A. All are concurrently trained on an unrelated set X>Y and Y>Z. At test all trials are unreinforced: A?B, B?C, A?C, X?Y, Y?Z, X?Z. Analogy was observed when the experimental group chose Z>X at greater frequency than controls who always chose X>Z. Fast ER-fMRI revealed differential hippocampal hemodynamic responses for both transverse patterning acquired at study and analogy expressed at test. The hemodynamic response for analogy occurred in both analogy-aware and -unaware participants. Configural Learning Theory would not predict transfer or at least not transfer which involves differential hippocampal activity. The Declarative Memory model predicts differential hippocampal involvement only when there is explicit awareness.

F119

A DEVELOPMENTAL FMRI STUDY OF HIPPOCAMPAL FUNCTION: RECOGNITION MEMORY IN TYPICALLY DEVELOPING CHILDREN AND CHILDREN OF DIABETIC PREGNANCIES *Lyric Jorgenson[1], Ruskin Hunt[1], Kathleen Thomas[1]; [1]Institute of Child Development - University of Minnesota* – Adult neuroimaging studies indicate the hippocampus to be an essential component of the neural circuitry underlying explicit memory. However, relatively few neuroimaging studies have investigated the role of this structure in the developing brain. The current study used fMRI to investigate hippocampal activity during a continuous recognition memory task in typically developing 9 and 10 year old children and in children who were infants of diabetic pregnancies (IDMs). IDM children are hypothesized to be at risk for atypical hippocampal development due to prenatal iron deficiency. During the continuous recognition memory task, stimuli varied in familiarity (either abstract or concrete) and repetition lag (lag 2 or lag 5) during an event-related fMRI design. Combined group results demonstrated that new objects activate right hippocampus and bilateral parahippocampus when compared to previously seen (old) objects. The hippocampus also showed significantly greater activity for a lag of 5 when compared to a lag of 2. The hippocampus did not show differential activation for abstract versus concrete stimuli. In separate analyses, the magnitude of the new versus old effect was found to differ between control children and the IDM sample. Furthermore, IDM children showed differential activation of the hippocampus for concrete versus abstract objects, which was not observed in the combined group analysis. The observed effect of new greater than old in children is consistent with the current adult neuroimaging literature. This study provides additional insight into the processing of novel and familiar information and the role of prenatal experience for the developing hippocampus.

F120

IMPACT OF BRAIN DERIVED NEUROTROPHIC FACTOR VAL66MET POLYMORPHISM ON HIPPOCAMPAL AND STRIATAL LEARNING: EVIDENCE FROM FMRI *Dima Amso, Fatima Soliman, Juliet Davidow, Todd Hare, Sarah Getz, Alexander Millner, Kevin Bath, B. J. Casey; Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University* – A common single nucleotide polymorphism in the human Brain Derived Neurotrophic Factor (BDNF) gene, resulting in a valine (Val) to methionine (Met) substitution at codon 66 in the prodomain (Val66Met), has been shown to lead to hippocampal-dependent memory impairment in mouse (Chen et al., 2006) and human (Egan et al., 2003). BDNF is implicated in the neuronal remodeling that supports learning and memory processes. This work uses fMRI to examine the role of BDNF in hippocampal and striatal learning. Adult participants were genotyped for the Val66Met polymorphism and scanned, using a spiral in/out sequence on a GE 3T scanner, as they participated in a learning task that integrates association- and frequency-based learning (Amso et al., 2005). Participants are presented with sequential cue and target stimuli and simply respond to target identity. The paradigm is such that 2 cues predict 3 targets with varying probabilities. Simultaneously, we vary the frequency of target presentation, independent of associations with cues. Responses to novel and frequent items are initially equivalent and become slower to novel, and faster to frequently-presented items, as the structure is learned. Consistent with previous work (Amso et al., 2005), we show increased caudate activity to infrequent relative to frequent targets and increased hippocampal activity to infrequent relative to frequent cue-target associations. Current data also suggest that Met carriers show impairments specific to hippocampal-dependent associative learning. Results will be discussed in the context of interactions between hipopcampal and striatal learning systems, as well as their supporting cellular and molecular mechanisms.

F121

NEUROPHYSIOLOGICAL EVIDENCE FOR TRANSFER APPROPRIATE PROCESSING: ROLE OF MEMORY FOR PERCEPTUAL GROUPING PROCESSES, GLOBAL SHAPES, AND LOCAL CONTOURS IN VISUAL OBJECT COGNITION *Haline E. Schendan[1,2], Marta Kutas[3]; [1]Tufts University, [2]Massachusetts General Hospital-NMR Martinos Center; Boston University, [3]University of California, San Diego* – Categorization of visual objects entails object model selection, matching a percept to representations of structural knowledge in long-term memory, but the representational format is largely unknown. People categorize previously experienced objects more quickly and accurately than new objects. Transfer appropriate processing accounts attribute this memory benefit to reactivation of identical neural processes from the initial to later encounters. In two experiments, event-related potentials (ERPs) to degraded objects were recorded during an indirect memory test to isolate transfer of perceptual processes from overlap of visual features between experiences. Results revealed transfer of both but at different times. In direct support of transfer appropriate processing accounts, an occipitotemporal P200 showed implicit memory modulation to items for which similar perceptual grouping processes were repeatedly engaged but not to items that merely reinstantiated features. After 500 ms, memory modulation of a late positive complex, indexing secondary categorization processes and recollection, was sensitive to local contour changes. In between, a frontocentral N350, indexing object model selection and implicit memory, showed memory modulation when the same global shape and parts were reactivated, regardless of local contour differences. The representations supporting model selection include knowledge beyond local contours and about higher-order perceptual structures. The overall ERP findings show the format of visual memory representations varies across time with the specific processing and memory system engaged.

F122

MEDIAL TEMPORAL LOBE AND BASAL GANGLIA CONTRIBUTIONS TO LEARNING AND FLEXIBLE TRANSFER *Daphna Shohamy, Anthony D. Wagner; Stanford University* – Converging evidence suggests that the medial temporal lobe (MTL) and the basal ganglia (BG) support two distinct memory systems. The MTL supports rapid learning of single episodes. The basal ganglia (BG) support feedback-based incremental learning of stimulus-response associations. Recent fMRI studies suggest both systems may contribute to learning, either in parallel, or in a competitive interaction. These findings raise important questions regarding the consequences for learning based on one system vs. the other, in terms of the subsequent representation of knowledge. To address this issue, we used functional imaging (fMRI) to examine MTL and BG activity while subjects engaged in a two-phase learning and flexible transfer task. Subjects first engaged in a feedback-based associative learning task, followed by a transfer phase, where subjects were probed to flexibly use previously learned knowledge in a new context. Results indicated changes in both MTL and BG during learning, with a negative relation between them. Furthermore, MTL activity during learning was correlated with subjects' ability to flexibly transfer. Flexible transfer was not correlated with BG activity. These results suggest a tradeoff between neural systems during learning, with greater MTL activity related to decreased BG activity. Which system is more engaged during learning has important implications for the representation of knowledge. Specifically, greater recruitment of MTL mechanisms during associative learning is related to enhanced flexibility at transfer. By contrast, BG-based learning mechanisms appear to contribute more generally to incremental, stimulus-response learning.

F123

EFFECTS OF PRELIMBIC CORTEX LESIONS ON INTERDIMENSIONAL TRANSFER IN A BILATERAL CLASSICAL CONDITIONING TASK *Kristin Mauldin, Robin Thomas, Stephen Berry; Miami University* – We investigated whether infusion of Procaine into the prelimbic cortex impairs interdimensional transfer on a unidimensional categorization task. Using a bilateral classical conditioning paradigm, rabbits categorized bivariate auditory stimuli by blinking either their right or left eye. The learning phase required the rabbits to categorize the tones according to a simple, unidimensional rule. The conditioned stimuli varied in starting pitch and magnitude of upward sweep in frequency. The relevant dimensions were counterbalanced during the learning phase. Once the rabbits had reached criterion the rule changed requiring them to categorize to the previously irrelevant dimension. Much like the WCST, this task should depend upon the areas responsible for flexible rule switching, namely the prelimbic cortex in the rodent. For the pre-training group, Procaine was infused into the prelimbic cortex (Brodmann's Area 32) before any training had begun. For the post-training lesion group, Procaine was infused after the initial training but before the interdimensional transfer. Learning rates were compared between the lesion groups and a sham control that had implants but no Procaine. Preliminary results are presented here.

F125

TASK CONTEXT AND MEMORY ACCESSIBILITY IN FREE RECALL *Sean Polyn[1], Neal Morton[1], Dov Kogen[1], Kenneth Norman[2], Michael Kahana[1]; [1]University of Pennsylvania, [2]Princeton University* – A series of free-recall experiments investigated the role of task information in guiding memory retrieval. Words were encoded using one of three judgments: pleasantness, size, and living / nonliving. In some lists the encoding task was consistent throughout, while in others the identity of the encoding task switched within the list. A robust "switch-cost" (an increased reaction time to respond to an item presented after a task-switch) was observed during the encoding period, usually taken as evidence that a task representation is being updated. Analyses of recall transitions and serial-position effects suggest that the context of the encoding task exerts a strong influence on the organization of memory. Specifically, subjects were more likely to make transitions during recall among items encoded with the same task. Furthermore, we have identified a "recall switch-cost"; an increased inter-response latency when subjects make recall transitions between items studied with different tasks. In certain cases, a shift in encoding task caused enhanced recall of succeeding items, suggesting a reduction in proactive interference from items studied before the shift. This pattern of results suggests that the encoding task contributes strongly to subjects' inner mental context and --- through this --- influences how memories are accessed during retrieval. Finally, we report the electrophysiological correlates (measured using EEG) of these task-related effects, including event-related analyses of task-related activity during encoding, and of within-task and between-task transitions during recall.

F126

DISSOCIATING THE NEURAL CORRELATES OF RECOGNITION MEMORY IN HEALTHY OLDER ADULTS USING PICTURES AND WORDS *Joshua D. McKeever[1,2,3], Brandon A. Ally[1,2,3], Jill D. Waring[1,2,3], Ellen H. Beth[1,2,3], Andrew E. Budson[1,2,3]; [1]Edith Nourse Rogers Memorial Veterans Hospital, Bedford MA; [2]Boston University, Boston MA; [3]Brigham & Women's Hospital, Boston MA* – Behavioral studies of recognition memory have shown increased recollection of pictures over words. Research suggests that this picture superiority effect is also evident in healthy older adults. However, reports debate whether older adults base recognition memory decisions on an increased sense of familiarity with the test item or on specific recollection of the studied item. Event-related potentials (ERPs) have proven useful in dissociating these memorial processes. A recent study from our laboratory involving young adults showed that although studied words enhanced early frontal positivity associated with familiarity, studied pictures enhanced the parietal effect associated with recollection. An electrophysiological investigation into the memorial processes of older adults might elucidate which processes allow them to remember, and whether those processes differ for pictures versus words. Using methodology from our previous study, we systematically varied pictures and words at study and test. Seventeen young adults and seventeen older adults performed four study-test phases (Word-Picture, Picture-Word, Word-Word, Picture-Picture), each consisting of 50 study items and 100 test items (50% old). Data are currently being analyzed. We hypothesize that older adults will show enhanced parietal activity for studied pictures compared to words, suggesting that older adults also exhibit greater recollection for pictures versus words. However, in a comparison with young adults, we hypothesize that although the early frontal effect associated with familiarity will be similar in older adults, the parietal effect associated with recollection will be less robust in older individuals. Results will be discussed in light of neuroimaging data and cognitive theories of aging.

F127

DOES PARIETAL CORTEX SUPPORT EPISODIC MEMORY? EVIDENCE FROM FOCAL LESION PATIENTS *Patrick Davidson, David Anaki, Elisa Ciaramelli, Melanie Cohn, Alice Kim, Kelly Murphy, Angela Troyer, Brian Levine, Morris Moscovitch; Rotman Research Institute, Baycrest* – Functional neuroimaging studies often show considerable activity across the parietal lobe during episodic memory tasks, leading some researchers to suggest that parietal cortex (both medial and lateral regions) plays a heretofore underappreciated role in episodic memory. We tested this hypothesis by examining episodic memory in twelve focal parietal lesion patients (who showed minimal aphasia and neglect). We focused on the lateral posterior parietal region, because medial parietal lesions often extend into the posterior cingulate and retrosplenial regions, which are well established as critical for episodic memory. In our examination of the patient cases, we found little evidence that damage to lateral posterior parietal cortex yields severe episodic memory impairment. There was some evidence, however, that lateral posterior parietal damage may impair some aspects of retrieval or post-retrieval processing. We discuss how the focal lesion data relate to functional neuroimaging data, in order to evaluate several hypotheses about what role, if any, parietal cortex may play in episodic memory.

F128

SIMULATING PROPERTIES OF ABSTRACT CONCEPTS *Christine Wilson[1], W. Kyle Simmons[2], Alex Martin[2], Lawrence Barsalou[1]; [1]Emory University, [2]National Institute of Mental Health* – How do we understand the abstract concepts that structure our complex world? Previous functional neuroimaging evidence suggests that abstract concepts are processed exclusively in left-lateralized language systems. These experiments, however, have often used tasks that do not require deep conceptual processing. We propose that the meaning of an abstract concept is represented by simulating property-specific information captured from real-world situations in which the concept was experienced. To assess this proposal, we developed a new paradigm that required participants to process the same two abstract concepts (convince and arithmetic) repeatedly in meaningful contexts. We predicted that property-specific brain regions relevant to the meanings of the abstract concepts would become active, not just language areas. One specific prediction was that the network of brain areas involved in theory of mind tasks, including medial prefrontal cortex and superior temporal sulcus, would be active when participants processed the abstract concept convince, because simulating mental states is a central property of this concept. On the other hand, processing numerical information should be significant in representing the abstract concept arithmetic, so we predicted that we would observe activation in intraparietal sulcus and posterior parietal areas when participants processed this concept. Our results confirmed that distributed brain regions associated with the relevant properties of abstract concepts become active when processing them. These findings suggest that simulating the specific content of an abstract concept, as opposed to accessing linguistic information, is critical in representing its meaning. Furthermore, the paradigms used to study abstract concepts should be carefully considered.

F129

PROBABILISTIC LEARNING OF SOCIAL CUES IN SCHIZOPHRENIA *Katalina McInerney[1,2], Barbara Schwartz[1], Lauren Ullrich[1], Stephen Deutsch[1]; [1]Georgetown University Medical Center, [2]The Catholic University of America* – Learning of stimulus-response associations in the presence of feedback is relatively intact in the weather prediction task in schizophrenia. In this task, combinations of cues predict one of two outcomes according to a probabilistic rule such that some cues are highly predictive of an outcome whereas others are less predictive. Probabilistic learning is thought to occur without explicit knowledge of cue associations and to depend on striatal structures. Findings of normal learning in the weather prediction task contrasts with many findings of explicit memory failure in schizophrenia. We capitalized on this normal learning capacity to explore whether people with schizophrenia could overcome face processing deficits to learn probabilistic rules for social stimuli. In this research, we used two tasks of probabilistic learning, one composed of figural patterns and the other of faces. In the face version, participants viewed photographs of faces and predicted outcomes based on face groupings. Feedback was provided on each trial. Our results replicated earlier findings of normal learning of stimulus-response associations with figural patterns and extended these findings to learning of associations with faces. These data suggest that learning of probabilistic rules for social information can occur despite face processing deficits in this population. Supported by National Alliance for Research on Schizophrenia and Depression

Memory: Other

F130

EFFECT OF STRESS ON CLASSICAL EYEBLINK CONDITIONING IN HUMANS *Denise Minnebusch[1], Oliver Wolf[2], Irene Daum[1]; [1]Institute of Cognitive Neuroscience, Dept. of Neuropsychology, Ruhr-University of Bochum, Germany, [2]Department of Psychology, University of Bielefeld, Germany,* – Animal studies have documented that stress influences the acquisition of eyeblink conditioned responses (CR). While male animals showed a stress related facilitation of acquisition, females performed reduced learning. Studies in humans indicate that stress impairs declarative memory retrieval. The effect of psychosocial stress of delayed eyeblink conditioning is as yet unknown. The aim of the present study was to investigate the effect of social stress, triggered by a standardized psychosocial laboratory stressor (Trier Social Stress Test, TSST), on delay conditioning of the eyelid response. Thirty-two young healthy male subjects participated in this study. Thirteen subjects were exposed to the TSST, and the remaining subjects completed a control condition. Salvia was collected before, immediately after, 10 min and 30 min after the TSST or control task. All participants filled out a mood questionnaire. After stress induction subjects learned 30 wordlist. Subjects than took part in a classical delayed eyelid conditioning task with 60 tone-airpuff acquisition trails (70% reinforced) followed by 10 tone-alone extinction trails. The stress group showed significantly higher cortisol levels than the controls. Stress induction led to a reduction in delayed recall of the words, although this trend did not reach significance. Subjects in the control group showed significantly higher CR rates compared to the stress group and a steeper learning curve. The stress group showed fewer CRs in the extinction relative to controls. The present study showed an impairment of classical conditioning after psychosocial stress in humans, which might be related to stress-induced temporary disruption of hippocampal functions.

F131

AGE-RELATED CHANGES IN ERP CORRELATES OF ITEM MEMORY *David Wolk[1], Hyemi Chong[2], Jenna Riis[2], Scott McGinnis[2,3], N. Mandu Sen[2], Phillip Holcomb[4], Kirk Daffner[2,3]; [1]University of Pittsburgh, [2]Brigham and Women's Hospital, [3]Harvard Medical School, [4]Tufts University* – We investigated age-related changes in memory retrieval using event-related potentials (ERPs). Prior work has suggested age-associated memory loss is related to prefrontal dysfunction. Studies of young subjects have described early (300-700 ms) ERP components, the FN400 and LPC, elicited during item recognition, which may reflect medial temporal processing. A later (800 to 1500 ms) sustained positive potential at prefrontal scalp sites, the late frontal effect (LFE), is prominent in tasks which require greater utilization of controlled, strategic processing. ERP studies of aging have reported preserved early components, but a reduced LFE, consistent with the notion that prefrontal dysfunction underlies age-associated memory impairment. In contrast, many functional imaging studies have demonstrated increased prefrontal activity thought to represent compensation. In this study, twenty-eight young and 28 elderly subjects performed a difficult item memory task. Differences in ERP response to old vs. new items were examined. Memory performance was better in young than old subjects (hits minus false alarms: .57 versus .46). Significant early ERP effects (FN400/LPC) were present only in the young subjects. Old subjects generated a larger LFE than young subjects. An interaction between memory performance (good/poor discrimination) and LFE was found in the older participants, with the LFE being larger in poor performers. Contrary to prior ERP studies, our results suggest that on difficult item memory tasks, old adults may require increased prefrontal processing, perhaps related to the use of additional memory search strategies to compensate for weak memory traces (mediated by medial temporal activity).

F132

FAMILIARITY IS SENSITIVE TO PERCEPTUAL MANIPULATIONS OF INTRINSIC BUT NOT CONTEXTUAL FEATURES – A RECOGNITION MEMORY STUDY USING EVENT-RELATED POTENTIALS. *Ullrich Ecker, Hubert D. Zimmer; Saarland University, Germany* – In an object recognition memory experiment, we investigated the influence of a study-test manipulation of color on ERP old-new effects associated with familiarity and recollection. Color was either manipulated as an intrinsic feature of the object or as an extrinsic feature of the background context. At test, subjects made a threefold decision (new, old-same, old-different). The perceptual study-test manipulation affected recognition memory ERPs differentially, depending on whether color was intrinsic or extrinsic. The intrinsic manipulation of color affected the midfrontal old-new effect associated with familiarity. The extrinsic manipulation did not affect the midfrontal old-new effect, but rather impacted selectively on the parietal recollection component. Although memory performance was less accurate in the different vs. same condition, it was well above chance in all cases. Moreover, performance was not reliably worse in the extrinsic vs. intrinsic condition, and there was no interaction of congruency (same vs. different) and the intrinsic-extrinsic factor, suggesting that the ERP effects cannot be explained by basic behavioral performance differences. Interestingly, a subgroup of subjects showed a reversed parietal old-new recollection effect (correct rejections more positive than hits). The effects on the familiarity component were, however, uninfluenced by this group factor.

F133

A NAP CONTAINING ONLY NON-REM SLEEP FACILITATES RELATIONAL MEMORY *Hiuyan Lau, Mathew Tucker, Erin Wamsley, Yasutaka Hirota, Sara Alger, Annie Chaklader, Raphael De Jesus, William Fishbein; City College of New York* – NREM sleep has been shown to facilitate consolidation of declarative memory. Furthermore, as demonstrated in animal studies, hippocampal processes operative during NREM sleep appear to play a critical role in extracting relational information common to distinct memory traces. The present study investigated the effect of a daytime nap containing only NREM sleep on performance of a relational memory task. Participants learned two lists of face-object photograph pairs (AB and BC) separately. The objects (B) were common to both lists but paired with two different faces. After either a daytime nap or a period of wakefulness, participants were tested on a force-choice task (AC task), in which they had to associate faces previously paired with the same object, followed by retests of the AB and BC tasks. An ANCOVA, with the average score of AB and BC tasks at baseline as the covariate, revealed that the nap group ($n = 14$) performed better on the AC task than the wake group ($n = 17$) ($F = 4.2$, $p < 0.05$). A repeated-measures ANOVA on average performance on AB and BC tasks found no significant interaction between condition (nap/wake) and time of test (baseline/test). The results suggest that sleep facilitates processes that reorganize and form relational links among discrete memory traces sharing common elements.

F134

EFFECTS OF RETENTION INTERVAL ON INCIDENTAL RETRIEVAL OF EMOTIONAL INFORMATION: AN EVENT RELATED POTENTIAL STUDY *Antonio Jaeger[1,2], Maria Corona[1], Michael Rugg[1]; [1]UC Irvine, Irvine, CA, [2]Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil* – Prior studies indicate that, in tests of recognition memory, ERPs elicited by correctly recognized test items differ according to whether the items were encoded in an emotionally arousing or an emotionally neutral study context. These prior studies employed only a relatively brief (ca. 10 min) retention interval, however. The present study contrasted the ERP correlates of incidental emotional retrieval as a function of study-test delay. Pictures of emotionally neutral objects were encoded in association with either emotionally negative or emotionally neutral scenes. In a repeated measures design (N=19), half of the objects were subjected to a recognition memory test 10 min after completion of the study phase, whereas the remainder were tested 24 hrs later. After the short delay, ERPs elicited by objects paired with emotional vs. neutral backgrounds differed from around 200 ms post-stimulus, the objects paired with the emotional scenes eliciting the more positive-going waveforms. After 24 hrs, differences between the ERPs elicited by the two classes of object were still apparent from around 200 ms post-stimulus. Strikingly, these effects differed from those obtained 10 min after study both in their polarity and scalp distribution. The early onset of these ERP effects suggests that they may reflect a form of memory independent of the conscious recollection of the associated study contexts. The qualitative differences in these effects, as a function of retention interval, raises the possibility that the encoded objects were subjected to consolidation processes that differed according to the emotional attributes of their study contexts.

F135

INFLUENCE OF APOE ?4 AND AGE ON ENTORHINAL CORTEX VOLUME AND MEMORY RECALL IN OLDER PILOTS *Maheen Adamson[1], Art Noda[1], Greer Murphy[2], Michael Weiner[3], Joy Taylor[1]; [1]Stanford University/VA Palo Alto Health Care System, [2]Stanford University, [3]UC San Francisco/VA San Francisco* – The present study investigates whether APOE ?4 carrier have smaller ERC volumes compared to non-carriers. The earliest pathological signs of Alzheimer's Disease (AD) are reported to occur in the entorhinal cortex (ERC; Braak, 1992), a region strongly associated with memory function like the hippocampus (Squire, 1991; Rodrigue & Raz, 2004). Cross-sectional structural MRI studies show significantly greater ERC shrinkage in mild AD patients compared to cognitively normal older adults (Juottonen, 1998). Cognitively normal older carriers of Apolipoprotein E (APOE) ?4 allele, a genetic risk factor for AD, show decreases in hippocampus size over time (Moffat, 2000) compared to non-carriers. In contrast, such decreases in ERC have not yet been detected (Du, 2006). Cross-sectional findings from our cohort of healthy older pilots showed that ?4 carriers perform worse than non-carriers during immediate memory recall. Surprisingly, there were no differences in hippocampus size in this cohort. Because ERC is also implicated in memory recall, the present study investigates whether older ?4 carrier pilots have smaller ERC volumes compared to non-carriers. Specifically, we calculated ERC volumes from structural MRI images of 45 pilots aged 50-75 years and examined the effect of age, APOE ?4 and their interaction. We also computed correlation coefficients among ERC volume, hippocampal volume and immediate vs. delayed memory recall. This study explores the anatomical differences related to AD pathology that may co-occur with differences in memory performance in healthy older adults who perform complex tasks and are genetically at risk for AD.

F136

MAKING A CASE FOR VERBAL ENCODING ASYMMETRIES: ABSTRACT VERSUS VERIDICAL SYSTEMS IN THE LEFT AND RIGHT CEREBRAL HEMISPHERES *Karen M. Evans, Kara D. Federmeier; University of Illinois, Urbana-Champaign* – We investigated the implications of hemispheric encoding biases in two continuous recognition experiments in which study words were lateralized to one visual half-field (thus biasing the encoding stage to one hemisphere) and test words (to which participants made a manual recognition judgment) were presented centrally. Letter case was consistent in some study-test repetitions (Same Case: house-house; HOUSE-HOUSE), but inconsistent in others (Switched Case: house-HOUSE; HOUSE-house). Two groups of participants viewed identical word lists, but were given different instructions regarding the Switched Case test words. Participants in Experiment 1 were told to accept both Same and Switched Case test words as repeated. Under these instructions, repeated words whose study presentation had been biased to the left hemisphere (LH) were recognized with equal accuracy and speed for Same and Switched Case repetitions; in contrast, words preferentially encoded by the right hemisphere (RH) showed a strong disadvantage for Switched Case repetitions relative to Same Case repetitions. Participants in Experiment 2 were told to accept only the Same Case repetitions, and to reject Switched Case test words. Same Case repetitions were recognized more accurately when their study presentation had been biased to the LH; Switched Case test words, however, were rejected more accurately when the study presentation had been biased to the RH. The results of both experiments are consistent with proposals that the LH is biased to encode verbal material abstractly, whereas the RH is biased to encode verbal material in a veridical manner that emphasizes form-based as well as semantic information.

F137

PROCEDURAL-BASED CATEGORY LEARNING IN PATIENTS WITH PARKINSON'S DISEASE *J. Vincent Filoteo[1], W. Todd Maddox[2], David Salmon[1], David Ing[2], David Song[1]; [1]UCSD, [2]University of Texas* – Previously we found that Parkinson's disease (PD) patients are impaired in procedural-based category learning when category membership is defined by a nonlinear relationship between stimulus dimensions but are normal when the rule is defined by a linear rule. We suggested that PD patients' impairment was due to a deficit in recruiting striatal 'units' in order to represent complex nonlinear rules. In the present study, we further examined the nature of PD patients' procedural-based deficit in three experiments designed to examine the impact of (1) category discontinuity, (2) delayed feedback, and (3) increased category number. Results indicated that PD patients were impaired only under discontinuous category conditions but were normal when there was a delay between the response and feedback, and when the number of categories was increased from two to four. The lack of impairment in the delayed feedback condition suggests that the nigro-striatal dopamine reward signal involved in procedural-based category learning is normal in medicated PD patients. The lack of impairment in the four category condition suggests normal integrity of striatal medium spiny cells involved in procedural-based category learning. In contrast, and consistent with our previous finding of a nonlinear deficit, the finding that PD patients were impaired in the discontinuous condition suggests that these patients are impaired when an increased number of striatal 'units' are necessary to represent the categories. Theoretically, this deficit might be related to dysfunctional communication among medium spiny neurons within the striatum. A plausible mechanism involving deficient striatal interneuron activity is discussed.

F138

VISUAL ANTIPRIMING AND PRIMING PREDICTED BY NEURALLY PLAUSIBLE MODELS OF OBJECT IDENTIFICATION. *Pradeep Ramanathan[1], Nicholas A. Ketz[1], Rebecca G. Deason[1], Carmen E. Westerberg[2], Chad J. Marsolek[1]; [1]University of Minnesota, [2]Northwestern University* – Long-term repetition priming is well known as facilitated processing of stimuli due to recent processing of the same stimuli. We have recently reported a concurrent effect, long-term antipriming, which is impaired processing of some stimuli due to recent processing of others. For example, visual identification of a desk not only enhances subsequent identification of that desk but can also impair subsequent visual identification of a piano, presumably due to their representations being superimposed. We examined whether biologically plausible computational models of visual object identification that make use of superimposed representations of objects naturally produce both priming and antipriming effects. We further examined whether the antipriming that occurs in these models mimics the object identification errors produced when antipriming is exhibited in human behavioral experiments. Recurrent multi-layer neural networks were first trained, using LEABRA++, to identify the same set of line drawings of familiar objects that have been used in previous behavioral experiments. These networks were then tested in simulated experiments that followed the behavioral priming and antipriming protocol. Significant priming and antipriming effects occurred in the networks following one relearning trial for each of a subset of originally trained (hence "familiar") visual objects. These results closely followed the behavioral results, with the priming effect stronger than the anti-priming effect. Results indicate that long-term priming and antipriming for visual objects likely reflect ongoing adjustments of superimposed representations, which are simulated readily in neurally plausible LEABRA++ models.

F139

THE CONTROL OF RECOLLECTION IN DIRECTED FORGETTING: AN ERP STUDY *Shu-ching Lee[1], Shih-kuen Cheng[1], Daisy L. Hung[2], Ovid J. L. Tzeng[2,3]; [1]Institute of Cognitive Neuroscience, National Central University, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taiwan, [3]Institute of Linguistics, Academia Sinica, Taiwan* – This study incorporated item-method directed forgetting paradigm with exclusion task to examine the strategic control of recollection. At study, subjects were presented with Chinese two-character words followed by an "R" cue or an "F" cue, which instructed the subject to remember or to forget the preceding word. At test, subjects engaged in two blocks of exclusion tasks. The to-be-remembered (TBR) and to-be-forgotten (TBF) items were designated as targets and non-targets respectively in the first task, and vice versa in the second block. ERPs recorded during the test phase were compared across the response categories of hits to targets, correct rejections to non-targets, and correct rejections to new items in the two exclusion tasks. The hit rate was higher when the TBR items were designated as targets as opposed to when the TBF items were designated as targets. In test phases, the left parietal ERP old/new effect -- the electrophysiological correlate of recollection -- was observed for hits to targets in both exclusion tasks, and was reliable for correct rejections to non-targets only when the TBF items were designated as targets. These findings lend support to the claim that subjects were able to adjust retrieval strategies according to the level of target memory, so as to maximize the efficiency of retrieval performance.

F140

ELECTROPHYSIOLOGICAL INDICES OF HUMAN SPATIAL MEMORY: USING A SPATIAL GRID TASK TO INVESTIGATE EGOCENTRIC AND ALLOCENTRIC REPRESENTATIONS *Jonathan Murphy, Richard Roche, Ciara Wynne, Sean Commins; National University of Ireland, Maynooth* – We report the findings of two experiments investigating spatial memory using a new computer-based test of spatial relations comparing egocentric and allocentric viewpoints. In Experiment 1, eighteen participants were asked to remember the locations of eight visual objects, presented one at a time, together with two landmarks on a 3D spatial grid. 128-channel electroencephalography was used to record ERPs while participants performed a recognition test of object location from a number of orientations around the environment. Landmark presentations cued orientation, and included 0 degrees (same viewpoint as study phase), 90 degrees right, 90 degrees left and 180 degrees rotation. Early perceptual differences were found in parietal P2 where left and right rotations evoked contralateral peaks. Rotated (allocentric) trials elicited more parietal positivity than 0 degrees (egocentric) during the landmark cue, but a larger parietal P300 was found during object presentation at 0 degrees. Experiment 2 tested for the implicit coding of spatial location. Ten participants performed the same task, but responses were based on old/new judgments of the objects - no instruction to encode spatial location was given. Distractors were presented in the test block as 'new' objects. Latency and amplitude differences were observed for study objects in correct locations versus incorrect. Source analyses for both experiments are also reported illustrating various subcortical generators reflecting egocentric and allocentric differences.

F141

COMPUTATIONAL MODELLING OF FAMILIARITY AND RECOLLECTION: A DUAL-PROCESS SINGLE-TRACE ACCOUNT OF EPISODIC MEMORY. *Andrea Greve[1], David I. Donaldson[2], Mark C.W. van Rossum[1]; [1]University of Edinburgh, [2]Stirling University* – Dual process theories of episodic memory state that retrieval is contingent upon two independent processes: familiarity (providing a sense of oldness) and recollection (the recovery of events and context). Neuroimaging studies have reported distinct neural signatures for familiarity and recollection, lending further support to dual-process theory. However, it remains unclear whether these signatures reflect activation of distinct memory traces or different retrieval mechanisms operating on a single memory trace. This question is important because the alternative explanations have very different implications. The first option necessitates storage of two distinct memory traces, which further requires accounting for how these traces are encoded and linked at retrieval. By contrast, the second alternative does not demand distinct traces. To date it is unknown whether empirical findings can be accounted for by distinct retrieval processes accessing a single memory trace. Here we present a computational model that uses a single neuronal network to store memory traces, with two distinct and independent retrieval processes accessing the memory store. The model is capable of discriminating old from new items after a single exposure, and exhibits ROC curves analogous to those found in empirical data. The putative familiarity and recollection processes exhibit distinct characteristics in the model, for example, diverging in capacity and sensitivity to sparse and convoluted patterns. By demonstrating that a dual-process single-trace model can account for a range of empirical findings, this work highlights the importance of distinguishing between neuronal processes and the neuronal representations upon which they operate.

F142

TRAINING MATTERS: MEASURES OF CROSSMODAL ATTENTION AND MEMORY IN LAW ENFORCEMENT *Kasee Page, Corey Thibeault, Tim Riley , Justin Smallfield, Jill Meyer, Jonathan Page[1]; Minnesota State University, Mankato, MN* – Police-officers must pay close visual and auditory attention to information in their surroundings since they may later have to report on specific items from one or both of these sensory modalities. This is also true during high-speed pursuits where the police driver must keep an eye on the road and the vehicle being pursued, while simultaneously listening to his/her partner and the police-band radio. Multi-tasking requirements in this environment raise an important question, especially when it comes to remembering events and the sequence of those events: Does training facilitate the shifting of focus and the subsequent recall of information? We tested personnel from the London Metropolitan Police Service to see if various levels of driving training influenced memory recall during an attention-shifting task. Participants were presented standard memory items consisting of pictures and words (from the Snodgrass and Vanderwart series) and police-related memory items containing actual pursuit videos and police-radio transmissions (provided by the Metropolitan Police). Additionally, and simultaneously, participants were instructed to attend to auditory tones and colored circles presented as distracters in the opposite modality of the memory items. Event-related potentials were measured to the presentation of the distracters to ensure participants were indeed paying attention to both tasks. We found that training did have a significant effect on memory for police-related items. This difference was attributed to training since concentration (measured using event-related potentials) and natural ability (measured by comparing memory for the standard items) were ruled out as possible explanations for the results.

F143

BEHAVIOURAL AND ELECTROPHYSIOLOGICAL CORRELATES OF CONTEXTUAL PROCESSING IN EPISODIC MEMORY *Jennifer L. Moore[1], Sarah Cassidy[1], Emma Joyce[1], Sabrina Boll[2], Richard A. P. Roche[1]; [1]National University of Ireland, Maynooth, Ireland [2]University of Mainz, Germany* – Here we report three sets of experiments which investigate the influence of both local and global context upon episodic memory and retrieval. Experiment 1 (n=120) investigated the impact of contextually-sparse versus contextually-rich environments on memory retrieval. Results suggest that re-instantiation of the learning context, even when contextually-sparse, can elicit facilitation of recall for episodic information learned in that context. Experiment 2 investigated local context by varying the backgrounds in a standard Visual Paired-Associates task. Eighty participants completed a Visual Paired Associates task with a local contextual background to each pair. All pairs were learned and tested in a block wherein contextual cues were either congruent or incongruent. Participants showed improved accuracy and faster reaction times in the congruent context condition compared to the incongruent context. Experiment 3 (n=12) investigated the electrophysiological correlates of local context by varying the backgrounds in a standard Visual Paired-Associates task. The resultant ERP waveforms reflected contextually-based processing, and were enhanced in context-congruent trials. Taken together, the findings of these experiments suggest that measures of hippocampal-based episodic memory may be particularly susceptible to facilitation following reinstantiation of context.

F144

THE INFLUENCE OF PRIOR MORAL INFORMATION ON FEEDBACK BASED LEARNING *Priyanka Khanna, Catherine E. Myers, Mauricio R. Delgado, Martin J. Guthrie, Mark A. Gluck; Rutgers University-Newark* – Previous studies suggest that perceptions of social and moral character can influence the mechanisms involved in trial and error affective learning (Delgado et al., 2005). It is unclear, however, how such declarative moral knowledge impacts simple non-affective discrimination learning. In a discrimination learning task, for example, subjects learn to choose the correct object in a pair through trial and error. The goal of this study was to examine performance in this simple learning task when previous social information presents a conflict with typical feedback systems. During the decision phase, subjects were presented with a pair of objects and asked to select the correct one. For each pair of objects, one of three partners offered advice on which object to choose. The three partners were depicted to be of praiseworthy, neutral, or suspect moral character, and this declarative information was relayed to the subjects prior to the experiment via written biographies. Irrespective of their moral posture, the partners' advice was always 50% correct. Early in training, subjects tended to follow the praiseworthy partner's advice, even though the advice was random, thus bypassing feedback due to current declarative information. Pre- and post-test analysis showed that participants' ratings of the praiseworthy partner dropped from "very trustworthy" to about the same as the bad and neutral partners. In accordance, most participants learned to choose the correct object irrespective of advice by the end of training. These results suggest that previous declarative information can influence simple discrimination learning tasks.

F145

THE ROLE OF SENSORY AND COGNITIVE PROCESSES IN REPETITION PRIMING IN MUSIC *Sean Hutchins, Caroline Palmer; McGill University* – Repetition priming has been shown in many domains, but its explanation in terms of sensory processes (short-term, arising from physical stimulus characteristics) or cognitive processes (slower, arising from learned associations) is unknown. Hutchins and Palmer (2006) documented facilitation for repeating tones in short melodies; singers exhibited faster production latencies for tones heard earlier than for non-repeated tones. However, this study did not disentangle sensory and cognitive contributions to repetition priming. We describe tests of pitch repetition priming that contrast sensory and cognitive explanations by altering the physical match between prime and target tones. As in Hutchins and Palmer (2006), musically untrained participants heard a short melody at a fixed rate (500 ms interonset intervals) and sang the pitch of the melody's last tone as quickly as possible. The tone to be sung (target) was either heard earlier in the melody (primed) or not, but with different physical (timbral) properties. Singers in both experiments who responded quickly to the stimulus showed larger repetition priming effects (correlation = -.43, $p < .01$). Singers formed a bimodal response distribution, with some singers responding closer to one beat after the target tone (near 500 ms), and some responding closer to two beats (1000 ms). Faster subjects showed significant repetition priming, whereas slower subjects did not; reanalysis of Hutchins and Palmer's (2006) data showed the same results when the prime and target tones were physically identical. These findings implicate cognitive associations, rather than a direct sensory match, as responsible for repetition priming effects in music.

F146

WHY ARE SOME PEOPLE'S NAMES EASIER TO LEARN THAN OTHERS? *Peter C. Pantelis[1], Marieke K. van Vugt[1], Michael J. Kahana[1]; [1]University of Pennsylvania* – We examined the role of face similarity in the learning of novel name-face associations. Sixteen faces were synthesized in a four-dimensional face space (Wilson et al, 2002), which had dimensions that were verified using multidimensional scaling. We found that subjects more easily learned the names of distinctive faces. When cued with a face at test, subjects' accuracy at recalling the proper name decreased monotonically with the number of studied faces present within a small neighborhood of the target face. Reaction time showed the opposite effect. Furthermore, recall errors tended to be names associated with faces that were similar to the target face. These effects were specific to the face set being learned rather than a general property of the face space.

F147

ADAPTIVE CODING OF REWARD VALUE IN THE HUMAN NUCLEUS ACCUMBENS AND PREFRONTAL CORTEX *Nico Bunzeck[1], Emrah Duzel[1,2]; [1]University College London, London, UK, [2]Otto von Guericke University, Magdeburg, Germany* – The ability of neurons to contextually scale their response properties is called 'adaptive coding' and has been suggested to be a nearly universal feature of neural activity. Currently, little is know about adaptive coding of reward value and its relation to prefrontal functions in human. Using fMRI we show that the outcome of predicted reward value is adaptively coded in the ncl. accumbens, the medial superior frontal gyrus, an orbital part of the middle frontal gyrus and the hippocampus. The results give insight how efficient representation of reward might contribute to reinforcement learning and even more complex behaviour such as decision making. Furthermore, they support the notion of dynamic and adaptive properties of prefrontal neurons. Finally, although inferential previous studies including animal research suggest that this effect (at least in the ncl. accumbens) might be linked to dopaminergic neuromodulation.

F148

PUNISHMENT BASED LEARNING CORRELATES WITH A PUTATIVE INDEX OF SEROTONIN IN HEALTHY YOUNG ADULTS *Priya Bolikal[1], Catherine E. Myers[1], Roshani Patel[1], Lauren Ropp[1], Nathaniel Daw[2], Mark A. Gluck[1]; [1]Rutgers University-Newark, [2]University of London* – The neurotransmitter serotonin may be involved in regulation of mood, and many current antidepressant medications appear to act by upregulating brain serotonin levels. Montague et al. (1996) have suggested that dopamine plays a role in learning to obtain reward, whereas Daw et al. (2002) have suggested that serotonin may play a complementary role in learning to avoid punishment. To investigate the role of serotonin in learning in healthy young adults, we created a probabilistic task, in which subjects learn to obtain reward on some trials, and learn to avoid punishment on other trials. For one group of subjects, the reward and punishment learning trials were intermixed; for a second group of subjects, the reward and punishment learning trials occurred in separate blocks. In the intermixed condition, a correlation was found between punishment-based learning and behavior correlated with the harm avoidance (HA) score on Cloninger's Tri-dimensional Personality Questionnaire (TPQ), which has been postulated to be an index of serotonin function. In the blocked condition, this correlation was no longer evident. Neither condition showed a correlation between reward-based learning and the novelty-seeking (NS) score of the TPQ, which has been postulated to be an index of dopamine function. This suggests that, even in healthy adults, there may be a correlation between serotonin levels and learning to avoid punishment. One implication is that individuals with disrupted serotonin levels may be impaired at learning to avoid punishment, which might be one contributing factor in depression.

Poster Session G

Higher level cognition: Disorders

G1

P300 ASYMMETRY AND POSITIVE SYMPTOMS' SEVERITY: A STUDY IN THE EARLY STAGE OF A FIRST EPISODE OF PSYCHOSIS *Louis Renoult[1], Marie Prévost[1], Mathieu Brodeur[2], Claire Lionnet[3], Ridha Joober[1], Ashok Malla[1], J.Bruno Debruille[1]; [1]McGill University, [2]Université de Montréal, [3]Douglas Hospital Research Center* – The amplitude of the P300 event-related potential (ERP) has been reported to be reduced over left compared to right temporal sites in schizophrenia patients. This left-temporal P300 reduction has been associated with positive symptoms' severity and gray matter reduction in the left superior temporal gyrus. Moreover, P300 asymmetry and related anatomical changes seem to increase with the evolution of the disease. We investigated a group of patients with a first episode of schizophrenia spectrum psychosis, a group of non-schizophrenia first-episode psychosis and a group of normal controls to see if P300 amplitude asymmetry over temporal sites already exists at the time of presentation for treatment. All subjects had their ERP recorded during an auditory oddball task (Debruille et al., 2005). Relative to normal control subjects, no P300 asymmetry was found in any of the FEP groups, possibly because of relatively recent onset of their symptoms and their young age. Nevertheless, a correlation between P300 asymmetry itself (the subtraction of the amplitude of the P300 at the left temporal site from the amplitude of the P300 at the right temporal site) and positive symptoms' severity was already present in the schizophrenia spectrum FEP group. On the other hand, P300 asymmetry was correlated with worse global functioning scores (GAF) in the schizophrenia spectrum FEP patients, a good predictor of poor outcome. Globally, these results strengthen both the specificity of the P300 asymmetry index to schizophrenia and its sensitivity to the disease progression.

G2

DISSOCIATIONS BETWEEN SENSORY, MOTOR, AND CONCEPTUAL KNOWLEDGE OF MANIPULABLE OBJECTS *Bradford Z. Mahon[1,2], Gioia A.L. Negri[3], Alina Menichelli[4], Anna Sverzut[4], Alfonso Caramazza[1,2], Raffaella Rumiati[3]; [1]University of Trento, Italy, [2]Harvard University, [3]SISSA International School for Advanced Studies, Trieste, [4]Azienda Ospedaliera Ospedali Riuniti di Trieste; SISSA International School for Advanced Studies, Trieste, Italy* – An unselected group of 37 patients with unilateral lesions was administered four tasks involving the same 29 manipulable objects: Object Naming (Task 1); Pantomime Recognition (Task 2); Object Use (Task 3) and Pantomime Imitation (Task 4). A group of neurologically normal participants (n = 35) matched to the patient group on age and education was also administered the same tasks with the same objects. Within the group of patients, we observed significant positive correlations between performance on Tasks 2 and 4, and between Tasks 1 and 3. These correlations are consistent with Embodied Cognition Theories stating that the same neural representations subserve both action recognition and action production (Tasks 2 and 4) and object recognition and action production (Tasks 1 and 3). However, dissociations in performance across tasks within patients (referenced to control performance) lead to different conclusions. We observed patients who were differentially impaired on Task 2 but not on Task 3, as well as the reverse dissociation. A second double dissociation was observed between patients who were impaired for Task 3 but who were within the normal range on Task 1, and patients who were impaired for Task 1 but within the normal range on Task 3. The dissociations between tasks observed within the single case analyses cannot be accounted for by Embodied Cognition Theories. This conclusion has important consequences for interpreting functional neuroimaging evidence demonstrating that motor relevant structures are automatically activated when subjects observe the actions of other individuals as well as manipulable objects.

G3

PACING TIME: MODULATION OF TIME ESTIMATION AND REPRODUCTION BY STN DEEP BRAIN STIMULATION IN PARKINSON´S DISEASE *Lars Wojtecki[1], Saskia Elben[1], Lars Timmermann[1], Silke Jörgens[1], Stefan Groiss[1], Martin Südmeyer[1], Markus Ploner[1], Volker Sturm[2], Michael Niedeggen[3], Alfons Schnitzler[1]; [1]Heinrich-Heine University Duesseldorf, [2]University of Cologne, [3]Freie Universität Berlin* – Motor timing is an important issue of basal ganglia function. As time estimation can be impaired in Parkinson´s Disease (PD) basal ganglia may also participate in cognitive representation of time. Recent studies provided evidence for a frequency dependent modulatory impact of deep brain stimulation (DBS) on cognitive circuits involving the subthalamic nucleus (STN). It is not known whether DBS frequency settings modulate time estimation in patients with PD. We examined a time production and reproduction paradigm for time intervals of 5 and 15 seconds, unpaced tapping and time discrimination for time intervals around 1200 milliseconds in a double-blind randomised design in 12 PD-patients three or more months after bilateral electrode-implantation into the STN. 12 healthy subjects served as controls. After overnight withdrawal of dopaminergic medication we randomly changed stimulation frequency between no stimulation, 10 Hz and ≥130 Hz . Statistical analysis showed underestimation in time production and reproduction especially in the 15 second interval in PD patients and a significant increase of this effect by low frequency stimulation compared to no stimulation and ≥130 Hz stimulation. Tapping tasks and time discrimination in the 1200 ms range were not significantly different between the groups. This study provides first evidence for a modulatory effect of different frequency settings in STN-DBS on time representation tasks in the 5 to 15 seconds domain but not for tasks in the one second range. The basal ganglia seem to participate in the cognitive representation of longer time intervals and STN-DBS modulates these non-motor aspects of timing.

G4

MEMORY FOR ACTION EVENTS IN SUBJECTS WITH ASPERGER SYNDROME *Tiziana Zalla[1], Elena Daprati[2], Pauline Chaste[3], Daniele Nico[4], Marion Leboyer[3]; [1]Ecole Normale Supérieure, Paris, France, [2]IRCCS Fondazione Santa Lucia, Roma, Italy, [3]Hospitalo-Universitaire de Psichiatrie, Créteil, France, [4]Università La Sapienza, IRCCS Fondazione Santa Lucia, Roma, Italy* – Theoretical models claim that the same cognitive mechanism required for attributing thoughts and feelings to others is also necessary for attributing mental states to self (Frith and Happé, 1999). However, while the inability to attribute mental states to others has been extensively documented in individuals with autism, fewer studies have addressed the issue whether self-knowledge processing is preserved. Studies in cognitive psychology have shown that recall of sentences describing previously performed actions is enhanced compared to recall of heard-only action-phrases (enactment effect, see Engelkamp, 1998, for a review). First-person knowledge which is constitutive of the autobiographical memory should therefore benefit of the enactment effect. In the present study, we investigated the ability of a group of subjects with Asperger syndrome in remembering whether they or another person had performed certain actions. Preliminary results show that although the enactment effect is present in patients with autism, their ability in consciously discriminating performed and observed actions might be selectively disrupted as compared to a matched control group. These findings suggest the automatic/implicit nature of the enactment effect is relatively spared in individuals with Asperger syndrome while a defective source-memory might reflect an impairment at the level of the conscious processing of self-knowledge.

G5

POWER SPECTRAL ANALYSIS REVEALS DECREASED DELTA SYNCHRONISATION IN SCHIZOPHRENIA AND BIPOLAR DISORDER DURING AN AUDITORY ODDBALL TASK *Patricia Bestelmeyer; University of Aberdeen* – The auditory P300 has been proposed to be a potential trait marker for schizophrenia. However, it has been shown that this P300 abnormality is not specific to schizophrenia but can also be found in patients with other types of psychiatric illnesses such as bipolar disorder. The purpose of this study was to explore which EEG frequency band(s) may be responsible for the P300 amplitude decrease in these psychiatric conditions and to determine whether the pattern of abnormal spectral dynamics in schizophrenia and bipolar disorder can dissociate the two illnesses. The P300 amplitude and event-related (de-) synchronisation (Pfurtscheller & Aranibar, 1977) in response to oddball (OB) trials in the ranges of delta (0.1-4 Hz), theta (4-8 Hz), alpha-1 (8-10 Hz) and alpha-2 (10-12 Hz) were analyzed in 22 patients with schizophrenia, 19 bipolar patients and 37 healthy controls. All participant groups showed strong correlations between the P300 amplitude and the magnitude of synchronisation in the delta range but no other frequency band. Further, patients with schizophrenia and bipolar disorder displayed significantly decreased delta synchronisation compared with healthy controls to OB trials. No other spectral abnormalities in the studied frequency ranges were observed in these patient groups. As with the P300 amplitude, investigating the spectral properties of the EEG was not able to distinguish between the two psychiatric groups which adds to the accumulating evidence from other areas (e.g. genetics) that there is substantial overlap between schizophrenia and bipolar disorder.

G6

THE INTRINSIC FUNCTIONAL ORGANIZATION OF THE HUMAN BRAIN IS ALTERED IN AUTISM *Daniel Kennedy[1], Eric Courchesne[2]; [1]UCSD, [2]UCSD; Children's Hospital Research Center, San Diego* – A cardinal characteristic of autism is the imbalance between socioemotional incapacity and disinterest on the one hand and often spared or even heightened cognitive capacity and interest in non-social objects on the other. In control subjects, neuroimaging studies have demonstrated that two distinct large-scale brain networks seem to support these two distinct functional domains. One of these networks, known as the Task-Positive Network (TPN), activates during externally-directed attention-demanding tasks, while the other network, termed the Task-Negative Network (TNN) or default mode (Raichle et al., PNAS, 2001), activates during social, emotional and self-reflective tasks. Since autism is largely characterized by deficits in TNN-type processes (i.e., social, emotion, self-reflective) but relatively less impaired, entirely spared, or even heightened in TPN-type processes (i.e., cognitively-demanding tasks not of a social, emotional, or self related nature), we hypothesized that this may be due to dysfunction of the TNN but spared functioning of the TPN. By examining the intrinsic organization of these two networks in 9 autism and 9 control subjects using resting state functional connectivity MRI (fcMRI), we confirmed our hypothesis of disturbed TNN but entirely spared TPN organization, and also demonstrate an altered relationship between the two networks. Furthermore, we find that one region of the TNN, the medial prefrontal cortex, is particularly abnormal in autism. Follow-up analyses of this region revealed significantly reduced functional connectivity with the nucleus accumbens. Together, we suggest that these findings relate to the interesting pattern of spared and impaired abilities in autism. (Supported by R01 MH36840).

G7

FUNCTIONAL REORGANIZATION FOLLOWING SEMANTIC MEDIATION TREATMENT WITH OVERLEARNING IN A CASE OF PHONOLOGIC ALEXIA *Jacquie Kurland[1], Carlos R. Cortes[1,2], Anne J. Sperling[1,3], Susan Lott[1], Elizabeth H. Lacey[1], Malle A. Tagamets[1,2], John VanMeter[1,5], Rhonda B. Friedman[1]; [1]Georgetown University Medical Center, [2]University of Maryland School of Medicine, [3]National Institute of Mental Health, [5]Center for Functional and Molecular Imaging* – Patients with Phonologic Alexia read semantically rich words (e.g, nouns) more accurately than semantically impoverished words (e.g., functors), suggesting preserved semantic route reading in the face of damaged access to phonology. Patient YCR, a 50-year-old man with Phonologic Alexia, two years post left parieto-temporal stroke, participated in a behavioral treatment designed to recruit the preserved semantic route to improve the reading of difficult words . Two sets of 20 words were trained to criterion; one trained set was then “overlearned” by receiving continued treatment for eight additional weeks. Another set of 20 words was not trained. To assess neural treatment-related functional reorganization, fMRI scans were obtained pre-treatment, post-treatment, and post-overlearning. Pre-treatment, there was equivalent accuracy across the three sets, and no statistically significant difference in activation profiles across sets. Post-treatment, accuracy on the two trained sets increased. Both sets of trained words recruited larger and more significant clusters of activation in the right hemisphere, located in right inferior frontal cortex (including Broca's area homologue) and right inferior parietal lobe, compared with untrained words. Post-overlearning, YCR showed greater left hemisphere (LH) activation, including perilesional activation in superior parietal lobe, when reading overlearned words compared to untrained words. Contrasts of both overlearned words and trained-but-not-overlearned words, vs. untrained words, demonstrated a shift in activation to left anterior superior temporal gyrus, suggesting that some generalization had occurred to non-overlearned trained words. This study demonstrates functional reorganization resulting from cognitive retraining and suggests an advantage for LH recruitment in alexia recovery.

G8

PARAMETRIC INDUCTION OF ANIMACY EXPERIENCE: APPLICATIONS TO AUTISM *Natacha Sofia Santos[1], Nicole David[1,2], Ralf Tepest[1], Wolfgang Huff[1], Fritz Lehnhardt[1], Kai Vogeley[1,3]; [1]University of Cologne, Germany, [2]University of Tuebingen, Germany, [3]Research Center Juelich, Germany* – To identify the relevant aspects of animacy perception and clarify impairments in mentalizing ability commonly observed in autistic patients we have performed a parametric study in which a series of computer-generated animations with different degrees of animacy were presented. A group of patients with Asperger syndrome (N=25) was compared with a group of healthy subjects (N=25). All participants watched 3D animations of two spheres moving on a black background. These animations were constructed by systematically and parametrically varying potentially relevant kinetic properties for animacy perception (e.g. direction of movement, approach of one sphere to the other, duration of approach, reaction of second sphere, etc.). In this way the participant’s perception of animacy varied from ”low” (the spheres were perceived more as physical objects) to “high” (the spheres were perceived as having human-like behaviors). After each animation the subject rated the degree to which animacy was experienced by making a judgment from “physical” to “personal” (1-4). The task did not depend on capacities of verbalizing social expressions. Results corroborated our prior hypothesis that Asperger subjects perceived the stimuli more “physically” than the healthy subjects. Furthermore, animacy parameters such as the duration of interaction between characters were perceived differently for the groups: autistic patients needed stronger physical signals before they perceived animacy. The results of this parametric study confirm that autism is associated with mentalizing difficulties and clarify which animacy-kinetic cues contribute to this impairment. This paradigm constitutes a suitable tool to study the neural correlates of animacy experiences.

G9

DTI TRACTOGRAPHY EVIDENCE FOR A SUBCORTICAL CIRCUIT IN A CASE OF VISUOMOTOR APRAXIA *Karl Doron[1], Mitchell Glickstein[2,3], Megan Steven[4], Michael Gazzaniga[1,3]; [1]University of California, Santa Barbara, [2]University College London, UK, [3]Sage Center for the Study of the Mind, UC Santa Barbara, [4]Dartmouth College* – Visuomotor apraxia (VMA) is a parietal lobe syndrome characterized by the impaired use of visual information during goal-oriented movement. In the past this deficit has been assumed to be caused by disconnection of a cortico-cortical circuit linking visual to motor cortical areas. Here we studied an alternative circuit originally proposed in a 66 year old patient (Classen et al, 1995) who developed visuomotor apraxia with no obvious damage to cortex or cortico-cortical fibers. MRI scans in this case had revealed a subcortical lesion involving the right somatosensory thalamus and the posterior limb of the internal capsule. In order to study the possible fiber connections that may have caused the deficit, the lesion was replicated in stereotaxic space and used as part of probabilistic tractography on DTI data collected from 20 neurologically healthy controls. Results show a direct fiber pathway passing through the site of the lesion, connecting the right parietal lobe to the lateral edge of the right cerebral peduncle. We suggest that the visuomotor deficit in this case was caused by interrupting the connections between the parietal lobe and the pontine nuclei, thus blocking dorsal stream visual information to the cerebellum.

G10

A COMPUTATIONAL MODEL OF IMPAIRMENTS IN COGNITIVE CONTROL IN CHILDREN WITH CHROMOSOME 22Q11.2 DELETION SYNDROME *Carter Wendelken[1], Joel Bish[2], Tony Simon[3]; [1]Center for Mind and Brain, UC-Davis, [2]Ursinus College, [3]M.I.N.D. Institute, UC-Davis* – Individuals with Chromosome 22q11.2 Deletion Syndrome (DS22q11.2) have impairments in visual attention, numerical cognition, and executive function that negatively impact their development and have been linked to risk for later psychiatric illness. Data from a modified Stroop test, a SNARC task, which manipulates spatial and numerical conflict, and the Attention Networks Test (ANT) showed that children with DS22q11.2 produced greater response costs than typical controls to incongruity on all tasks. However, children with DS22q11.2 also demonstrated an unusual adaptation to congruent stimuli but did not produce the "Gratton Effect", which is an adaptive response to the second of two contiguous incongruent trials in the ANT. We used connectionist computational modeling to examine this pattern of results. A previously developed connectionist model of cognitive control (Botvinick et al., 1999) was fit to the data of typical controls in each task. This model posits that "control" or "context" units bias processing in the circuits that transform sensory information into response decisions, and further posits that the detection of conflicting information affects subsequent processing. We show that while the basic model can account for the data of controls, it is insufficient to account also for the pattern of results children with DS22q11.2. However, a small change to the model, involving the separation of top-down control into two components, allows for both sets of data to be explained. This change suggests that a lack of task-specificity in top-down control may explain the cognitive impairments exhibited by children with DS22q11.2 in the studied tasks.

G11

SUBCORTICAL APRAXIA: TRANSITIVE AND INTRANSITIVE GESTURES DISSOCIATE WITH RECOVERY AND LANGUAGE *Maryellen McClain[1], Stephanie K. Daniels[2], Monique G. Cola[1], Pamela C. DeGeorge[2], Anne L. Foundas[1]; [1]Tulane University Health Sciences Center, [2]New Orleans VA Medical Center* – Apraxia is a disorder of learned skilled movement unrelated to elemental neurologic or emotional/behavioral disturbance. The praxis neural system is generally lateralized to the left hemisphere in right-handed individuals in a widely distributed network. The role of subcortical structures, and the degree to which praxis dissociates from language, remains unresolved. Using a comprehensive neuropsychological test battery and neuroimaging protocol, we examined a series of five left hemisphere damaged (LHD), right-handed male stroke patients in the hyperacute (3-5 days) post-stroke phase and at one month. All patients had subcortical lesions on diffusion-weighted MRI. Acutely, apraxic patients were more impaired on transitive (tool-based) than intransitive (emblematic) gestures, consistent with cognitive apraxia models. No significant improvement was seen at one month in either transitive or intransitive gestures, and lesion volumes did not change significantly. Detailed analysis of the relationship between apraxia and language test performance in the hyperacute phase revealed a significant correlation between apraxic production of intransitive gestures and the Western Aphasia Battery (WAB) total score ($p=.04$), and a strong trend toward a significant correlation ($p = .06$) with the Boston Naming Test (BNT). These correlations were not present at one month. These patients had lesions localized to posterior subcortical white matter. These results suggest that disconnection of the inferior parietal lobule (gesture representations) from frontal gesture production centers yields transient deficits of gesture production, and persistent deficit in intransitive limb movements. The relationship between intransitive gestures and language tasks suggests that conceptual knowledge may underlie the cognitive representations of intransitive gestures.

G12

ASSOCIATIONS BETWEEN HIPPOCAMPAL VOLUME AND COGNITIVE FUNCTION IN CHILDREN WITH CHROMOSOME 22Q11.2 DELETION SYNDROME *Tracy DeBoer[1,2], Zhongle Wu[1,2], Yukari Takarae[1,2], Vy Nguyen[1,2], Leeza Gabriel[1,2], Tony J. Simon[1,2]; [1]University of California, Davis, [2]M.I.N.D. Institute* – Children with Chromosome 22q11.2 Deletion Syndrome (including Velocardiofacial/DiGeorge syndromes) exhibit learning difficulties, marked impairments in the domain of visuospatial cognition, and are at an elevated risk for psychopathology. Although the specific mechanisms remain unknown, it is hypothesized that this genetic microdeletion alters neural structure and function, which results in the observed phenotype. Previous investigations in this population have found global reductions in both grey and white matter volumes (e.g., Simon et al., 2005). These reductions have been identified as significant predictors of overall cognitive performance and behavioral disturbance (Bearden et al., 2004). However, there are conflicting reports regarding structures within the medial temporal lobe and their relation to the cognitive/behavioral phenotype (cf. Debbané et al., 2006; Kates et al., 2006). The aim of the present investigation was to assess abnormalities of the amygdala and hippocampus in 7- to 14-year-old children with DS22q11.2 and explore associations with cognitive abilities. Neuroanatomical guidelines were used to define borders of the amygdala and hippocampus bilaterally and volumes were calculated based on manual tracings of the regions (see Schumann et al., 2004). After controlling for total grey volume reductions, a significant decrease in hippocampus volume, but not amygdala volume, was observed in the DS22q11.2 group. Critically, these volumetric reductions were significantly related to behavioral performance on standardized cognitive tests assessing verbal, performance, and full scale IQ. These findings suggest a possible underlying pathophysiology for the cognitive deficits observed in this syndrome.

G13

DOPAMINERGIC MODULATION OF RESPONSE INHIBITION NEUROCIRCUITRY *Meghan Campbell[1], Kevin Black[1], Dana Perantie[1], Johanna Hartlein[1], Susan Loftin[1], Deanna Barch[2], Tamara Hershey[1]; [1]Washington University School of Medicine, [2]Washington University* – Title: Dopaminergic modulation of response inhibition neurocircuitry.Authors: Campbell, M., Black, K., Perantie, D., Hartlein, J., Loftin, S., Barch, D., and Hershey, T. Background: Parkinson's disease (PD) is a neurodegenerative disease caused by a marked reduction in dopamine and is associated with deficits in cognitive control. Although dopaminergic medications, such as levodopa, alleviate the motor symptoms, cognitive impairment remains. The purpose of this study was to determine the role of dopamine on response inhibition in PD. Methods: During fMRI scanning, 12 PD and 17 healthy control (HC) participants completed the Go/No-Go task of response inhibition for both pre- and post-infusion scans of saline and levodopa. Behavioral and task-driven regions of fMRI activity were analyzed for possible drug, group, and drug by group interactions. Results: There were no significant group or drug effects on task performance, except a decrease in response time with levodopa ($p < .05$). For the fMRI activity, however, there were significant task by infusion by drug interactions in the left inferior operculum and left prefrontal gyrus ($ps < .05$) and significant task by infusion by drug by group interactions in the medial frontal gyrus and left putamen-thalamus region ($ps < .05$). For the PD group, fMRI task-related activity in the medial frontal gyrus and left putamen-thalamus correlated during levodopa infusion and were positively associated with non-target accuracy, whereas fMRI activity in these regions was inversely related to levodopa levels for HC participants. Conclusion: These results indicate a selective, modulatory role of dopamine in the neurocircuitry involved in response selection and inhibition. Furthermore, these results suggest that the modulatory effects of dopamine are influenced by the integrity of the dopaminergic system.

G14

AN FMRI CASE STUDY IN PERSISTENT POST CONCUSSIVE SYNDROME *Alina K. Fong-Ichimura, Mark D. Allen, James Larsen, Tyler Owens, Rachel Kramer; Brigham Young University* – In this study, we promote the use of functional imaging as an assessment tool in clinical neuropsychology by means of imaging strategies which optimize the similarity of cognitive tasks performed within the physical and temporal limitations of the scanning environment to those performed on standardized paper and pencil tests. We present data from 26 unimpaired control subjects on fMRI analogs of six of the most commonly used tests in contemporary neuropsychological batteries. These include Raven's Progressive Matrices, Trails A and B, Facial Recognition Task (Wechsler Memory Scales-III), Verbal Fluency, Verbal Memory (Rey Auditory Verbal Learning Task), and the Boston Naming Test. We then use this data to address a current controversy about the physiological basis of Persistent Post Concussive Syndrome (PPCS), and at the same time highlight the usefulness of our approach on a single subject basis. We present data from a representative PPCS patient three years post-injury. We compare his performance on a battery of traditional neuropsychological assessments with his fMRI data from our six protocols. There is a striking correspondence between the selective deficits he shows on standardized neuropsychological assessments and the deviations present in his fMRI data. These data not only demonstrate the usefulness of fMRI in addressing theoretical issues surrounding PPCS, they also contribute to the development of functional imaging as a viable tool in clinical settings.

G15

THE EFFECT OF DUAL-TASK ENGAGEMENT ON RESPONSE-SELECTION INTERFERENCE IN AGING AND ALZHEIMER'S DISEASE *Elena K. Festa, Brian R. Ott, William C. Heindel; Brown University* – Previous studies suggesting that one of the earliest cognitive changes in Alzheimer's disease (AD) may be a breakdown in inhibitory processing have utilized tasks (such as the Stroop task) that primarily involve competition at the sensory-selection stage, rather than tasks (such as the Simon task) that primarily involve competition at the response-selection stage. In the Simon task, stimulus-response pairings are either spatially congruent or spatially incongruent, and participants must inhibit pre-potent responses to location information. The purpose of this study was to investigate (1) the relative deficits in response-selection inhibitory processes with aging and AD and (2) the effect of dual-task engagement of the visuomotor response system in a continuous tracking task on the magnitude of the Simon effect. Under single-task conditions, the young and elderly control groups demonstrated comparable Simon effects while the AD group demonstrated a significantly larger Simon effect, suggesting a breakdown in response-selection inhibitory processes with AD but not age. Under dual-task conditions, all groups exhibited overall slowing of response times, consistent with reduced attentional resources for the task. Although the visuomotor task did not influence the Simon effect in either control group, the AD group demonstrated a normalization of the level of interference that was driven by a relatively smaller increase in response times to the incongruent than the congruent condition. These results suggest that AD patients display increased sensitivity to the interference of pre-potent responses that can be minimized by continuous engagement of the response selection system through a secondary tracking task.

G16

A COMPARISON OF SVM AND GLM IN THE ANALYSIS OF FMRI DATA FROM INDIVIDUALS WITH AUTISM *Arielle Schmidt, Catherine Hanson, Stephen Hanson; Rutgers University* – There is increased interest in using support vector machine (SVM) classifiers to analyze fMRI data. SVM classifiers may be more sensitive to differences in brain activity than a general linear model (GLM) analysis because SVM can generalize more accurately and is successful in classifying datasets with high dimensionality. In this study we compare analysis of fMRI data using an SVM classifier with that produced by GLM. The data were obtained from individuals with autism as they performed tasks in which a cue (eye gaze or arrow) was used to direct attention. Our expectation that the SVM classification would show greater sensitivity to differences in brain activity than did a GLM analysis was confirmed. Since a prominent trait of autism spectrum disorders is the inability to interpret facial cues and expressions, the increased sensitivity of SVM analysis allows us to better quantify the underlying differences in brain activity in autistic individuals.

G17

REFLEX SYMPATHETIC DYSTROPHY (RSD) AND OBSESSIVE-COMPULSIVE DISORDER (OCD): NOVEL EXPERIMENTAL APPROACHES *Lisa E. Williams, Vilayanur S. Ramachandran; UCSD* – Reflex Sympathetic Dystrophy (RSD) is a chronic syndrome wherein pain resulting from a relatively trivial injury becomes amplified (partly through sympathetic mechanisms) and persists long after the initial injury has healed. Based on an evolutionary hypothesis we irrigated the ears of these patients with cold water to produce vestibular caloric stimulation accompanied by nystagmus, which produced a striking reduction of pain. No such reduction occurred in two placebo control conditions (body-temperature stimulation; ice applied to the forehead). Multiple stimulations in a short amount of time induced a longer period of reduced pain. We postulate that caloric stimulation activates vestibular neurons which then "mask" the sympathetic pain in the adjacent insular cortex. We are currently testing whether repeated caloric stimulations will permanently abolish pain and whether other kinds of chronic pain (e.g., thalamic pain) improve after stimulation. We also explored the role of the mirror neuron system in OCD characterized by obsessive ritual hand washing after the patient touches a shoe or doorknob. We found this revulsion and urge to wash occurred even when the patient watched another person touch a doorknob, implicating the mirror neuron system in the anterior cingulate and/or insula in empathy for disgust. Additionally, the patient felt dramatic relief from anxiety and revulsion when washing her own hand after watching someone else touch the knob. Paradoxically, a lesser reduction of revulsion/compulsion occurred if someone else touched a doorknob and washed his own hand. We are now also including skin conductance response as a measure of physiological arousal.

G18

TEMPORAL AND FRONTAL BRAIN REGIONS IMPLICATED IN DYSLEXIC CHILDREN'S AUDITORY WORD PROCESSING DEFICITS – AN FMRI STUDY *Marc F. Joanisse[1], Randy Lynn Newman[2], Amy S. Desroches[1]; [1]The University of Western Ontario, [2]Acadia University* – Children with dyslexia demonstrate phonological processing difficulties, which have been proposed to be the source of their reading impairment. However, whereas several neuroimaging studies have identified brain regions implicated in dyslexic children's reading deficits, much less is known about the neural bases of these children's spoken language deficits. The address this, we examined phonological impairments using fMRI at 4T. Dyslexic and control children performed a picture-sound matching task. On 'Match' trials, a picture was shown and the corresponding spoken word was played (picture: CONE, word: cone); on the mismatch trials we manipulated the phonological relationship of the target and foil: 'cohort' mismatch (CONE; comb); 'rhyme' mismatch (CONE; bone); and 'unrelated' mismatch (CONE; fox). A key feature of this task was that it provided an implicit measure of phonological ability that emphasized online processing, namely the generation and maintenance of phonological representations and their comparison to an auditory stimulus. Statistical maps were constructed to identify groupwise differences in overall task activation, as well as differences in regions that showed greater response to mismatch stimuli. We observed key differences in activation in both STG and IFG regions, indicating weakened access to phonological perception and memory mechanisms in dyslexic children. We also observed that the dyslexic children showed stronger activation in inferior occipitotemporal regions, suggesting they relied more strongly on semantic processing to compensate for weakened phonological processing. The data are discussed with regard to models of auditory word recognition and phonological deficits in developmental dyslexia.

G19

POSITIVE CHANGES FOLLOWING NEUROFEEDBACK TRAINING IN HIGH FUNCTIONING ASD CHILDREN. *Jaime Pineda, Lee Edwards, David Brang, Dong Suk, Jennifer Tom, Carly Birnbaum, Judith Kaye, Ashley Rork; University of California, San Diego* – Autism spectrum disorders (ASD) occur with wide variation in symptoms and a devastating impact on social skills. The social behaviors affected resemble those associated with mirror neuron activity during the performance and observation of actions, and may be how humans understand the actions of others. An EEG index of mirror neuron activity is the 8-13 Hz mu rhythm measured over sensorimotor cortex. The present study investigated the impact of neurofeedback training (NFT) on high mu rhythm (10-13 Hz) in ASD children. NFT was administered to 14 high-functioning subjects randomly assigned to control or experimental groups. The control group (n=7) received NFT in response to muscle movement and a random artificial mu-like signal. The experimental group (n=7) received feedback in response to muscle movement and increases in mu power. Pre-training assessments included the ADI, ADOS, WASI, QEEG, the TOVA, Apraxia Imitation Scale, Autism Treatment Evaluation Checklist, and Mu Suppression Index. Most ASD subjects exhibited abnormal EEG phase correlation and coherence at temporal sites and inconsistent asymmetries at other sites. Following approximately 15 hrs of training, mu suppression indices showed a distinguishable change in control and experimental conditions, especially in the social perception condition where suppression averaged 32.47% for experimentals. Experimental subjects also improved significantly in their performance in their overall ADHD scores and in their total omission errors, while control subjects performed worse. In summary, these data indicate that NFT produces positive changes in ASD children that are reflected in cognitive and behavioral measures specific to training sensorimotor rhythms.

G20

DEFICIENT INTRAPARIETAL SULCUS ACTIVITY DURING NUMBER COMPARISON IN INDIVIDUALS WITH DOWN SYNDROME *Elizabeth Reynolds[1,2], Joseph Pinter[3], Kami Koldewyn[2], Lien Le[2], Kristina Backer[2], May Tang[2], Susan Rivera[2]; [1]University of California, Los Angeles, [2]University of California, Davis, [3]University of California, Davis, Medical Center* – Areas of the human brain in and around the left intraparietal sulcus (IPS) activate during a variety of mathematical tasks including calculation, estimation and numerical comparison. Additionally, IPS gray matter reduction has been associated with impaired calculation ability. We utilized functional MRI (fMRI) to explore whether abnormal function in the IPS underlies the numerical processing deficits typical in Down syndrome (DS). Participants were a group of individuals with DS (mean age=22.73 yrs) and a group of typically developing (TD) individuals (mean age=15.97 yrs). In the scanner, participants performed a number comparison task which required an overt verbal response. Participants were either asked to make a magnitude judgment between two 2-digit Arabic numerals of a fixed 8-unit numerical distance (experimental) or a luminance judgment between two numbers of identical magnitudes (control). The DS group made significantly more errors than the TD group; however, both groups understood the task and performed with greater than 70% accuracy. Analysis of activation during magnitude relative to luminance judgments revealed areas in the left superior parietal lobule, IPS, superior and middle frontal gyri and middle temporal gyrus active in the TD group. The DS group had peaks of activation in bilateral anterior cingulate gyrus, left superior frontal gyrus and right fusiform gyrus and cerebellum. Strikingly, the DS group lacked any IPS activation. These data suggest that the numerical information processing difficulties experienced by individuals with DS may be due to a lack of functional specialization for magnitude comparison commonly found in TD individuals.

G21

ABNORMAL FMRI ACTIVATION RELATED TO AUDITORY HALLUCINATIONS AND THOUGHT DISORDER: IMPLICATIONS FOR SCHIZOPHRENIA. *Cynthia Wible[1], Duke Han[2], Ryu Hashimoto[1], Alex Preus[1]; [1]Harvard Medical School, [2]Loyola University* – Auditory hallucinations are common in schizophrenia and are usually experienced as voices. Patients also often have thought disorder or loose associations. Because of the linguistic nature of these symptoms, we hypothesized that measures of thought disorder would be correlated with abnormal activity in the temporal lobe regions subserving lexical/semantic processing. We hypothesized that measures of auditory hallucinations would be associated with abnormal activity in speech perception/production regions. A semantic priming task was used in conjunction with fMRI procedures. Eleven chronic schizophrenic and matched control subjects were aurally presented with pairs of semantically related and unrelated words. Results showed that thought disorder was correlated with abnormal activity in the posterior left middle temporal, a region thought to be involved in conceptually driven lexical selection or in the link between auditory word forms and semantic representations. Auditory hallucinations were also correlated with activity in this middle temporal region, and in addition with activity in the inferior parietal and inferior/middle frontal region. These regions are part of speech comprehension/production networks. Results will be compared to those in the literature and we will present a theory that also accounts for symptom clustering patterns and other symptoms such as delusions and flat affect.

G22

ELECTROPHYSIOLOGICAL PROCESSING OF SINGLE WORDS IN TODDLERS AND SCHOOL-AGE CHILDREN WITH AUTISM SPECTRUM DISORDER *Sharon Coffey-Corina[1], Patricia Kuhl[2], Denise Padden[2], Geraldine Dawson[2]; [1]UC Davis, [2]University of Washington* – Four groups of children participated in an event-related potential (ERP) study. Two groups of children diagnosed with autism spectrum disorder (ASD), as well as 2 groups of age-matched typically developing children. One group consisted of toddlers, 19-20 months old, the other 9- 10 year olds. Data was collected from 20 scalp electrodes using electro-caps. Participants listened to 3 types of words, words whose meaning was comprehended by the child, words the child did not know, and words that were played backwards. Ten different words were in each group, each word was played 6 times, for a total of 180 trials. Stimulus duration was 1000 msec, ISI was 2000 msec. Both groups of children with ASD were subdivided into higher and lower functioning based on behavioral scores of degree of autism and IQ. Analyses of ERP waveforms further elucidated differences between these groups. In both age groups, children with higher functioning autism had similar ERP patterns to typically developing children. Children in the lower functioning autism group showed significant differences between typically developing and higher functioning autism subjects. These differences were evident at an early window between 100- 250 msec for the older children, but not until 300-500 msec for the younger toddlers.

G23

SOCIAL COGNITION IN FRONTOTEMPORAL DEMENTIA: CONVERGING KNOWLEDGE, EXECUTIVE, EMPATHY, AND MOTIVATIONAL DEFICITS *Paul Eslinger[1], Peachie Moore[2], Shweta Antani[2], Chivon Anderson[2], Katie Kwok[2], Murray Grossman[2]; [1]Penn State College of Medicine, [2]University of Pennsylvania School of Medicine* – Introduction. Frontotemporal dementia (FTD) patients with prominent social-executive impairments show progressive loss of social comportment and goal-directed behavior. We tested the hypothesis that profound social impairments in FTD are related to pathophysiology in multiple frontal-temporal systems mediating social knowledge, executive resources, empathy and motivation. Methods. FTD patients diagnosed with prominent social-executive impairments through a specialty care clinic completed measures of social cognition (Theory of mind, social dilemmas), executive functions (Visual Verbal test, Trail Making, Stroop), inventories for empathy and apathy (with parallel caregiver ratings) as well as brain MRI for morphometric analyses. Results. In comparison to age-matched controls as well as other FTD clinical subgroups, FTD patients with social-executive impairments showed significant loss of social knowledge, depletion of executive resources, apathy, and decline in empathic concern as well as perspective-taking. These domains were significantly inter-related but were not correlated with depression. Voxel-based morphometry identified specific regions of atrophy in prefrontal and lateral temporal cortices related to social knowledge, empathy and apathy. Conclusion. FTD patients with clinical diagnosis of prominent social-executive impairments show not only degraded social knowledge but also depletion of executive, interpersonal-empathic, and motivational resources. This pattern of findings was not evident in other FTD subgroups and was related to multiple sites of atrophy in predominantly right orbital and mesial frontal cortex as well as right inferior and lateral temporal cortex. Results support a social cognition model encompassing interacting social knowledge with executive, empathic and motivational resources in a large-scale neural network involving right frontal and temporal regions.

G24

CONSTRAINT-INDUCED PHONOLOGICAL RETRAINING IN SEVERE FLUENT APHASIA: A CASE REPORT *David A. Medler[1], Jeffrey R. Binder[1], Kyle Capizzi[2], Sara Berentsen[2]; [1]Medical College of Wisconsin, [2]University of Wisconsin* – We present behavioral and fMRI data on the effectiveness of a targeted therapy for phonological impairment in fluent aphasia. A 48-year-old right-handed woman (IR) with a large left parietotemporal infarct presented with severe phonemic paraphasia. Following traditional therapy, IR showed normal performance on lexical decision and semantic tasks, but exhibited profound impairment on reading aloud (0% accuracy) and speech repetition tasks (9% accuracy). IR was given intensive training (3 hours per day for 15 days) on nonword repetition with shaping induced by auditory feedback; when repetition accuracy reached 70%, training on reading aloud of words and nonwords was initiated. Reading performance improved steadily, exceeding 50% accuracy, and generalized to novel items. To investigate neurophysiological changes associated with this behavioral improvement, IR performed a reading aloud protocol during fMRI before and after training. In the pre-training scan, activation occurred bilaterally--with modest left hemisphere lateralization--in posterior frontal and posterior parietal areas. In the post-training scan, there was generally more activation, particularly in left prefrontal, perisylvian, and ventral temporal regions near the lesion, including several activation foci bordering on the lesioned area. These differences were quantified by computing lateralization indexes (LIs) for the whole hemisphere as well as for frontal lobe, temporal lobe, and perisylvian (IFG/SMG/STG) ROIs. Whereas the whole brain LI was unchanged, activation in the temporal lobe and perisylvian regions shifted substantially to the left post-training, suggesting that relearning depends primarily on enhancement of processing in spared LH regions, particularly in perilesional areas.

Higher level cognition: Executive functions

G25

THE EFFECT OF THE ASSOCIATION STRENGTH BETWEEN ACTION AND TARGET ON FRN AND P300 IN A GUESSING TASK *Nai-Shing Yen[1,2], Ying-Ru Lai[1], Kaun-Hua Chen[1], Hui-Kuan Chung[1], Tzu-Hsin Yeh[1]; [1]National Chengchi University, Taipei, Taiwan, [2]National Chengchi University, Taipei, Taiwan* – Previous research suggests that the Feedback-Related Negativity (FRN) is sensitive to reward valence while P300 is sensitive to reward magnitude (Yeung & Sanfey, 2004). In the present study, FRN and P300 are examined in a guessing task in that participants were asked to guess which of the four cards would be presented next. We recorded ERPs for correct/incorrect feedback with a time window from 150ms pre-feedback to 550ms after-feedback. The association between action (pressing a specific button) and target (a specific card which was chosen) was manipulated to see if FRN and P300 would be related to the association strength. In the strong association condition (n = 5), the card order was fixed throughout the game. In the weak association condition (n = 5), the card order was randomly arranged on each trial. The results showed that FRN peaked around 270ms for incorrect feedbacks in both conditions, which was consistent with previous studies. However, the magnitude of FRN was identical in both conditions, which indicating that FRN is insensitive to the strength of action-target association. In contrary, a larger P300 for correct feedback was found in the weak association condition. It is important to note that although the P300 effect was considered to be related to feedback magnitude, in our study the P300 reflected a valence processing because it was magnified for correct feedback. This is consistent with Hajcak et al. (2005). Furthermore, we demonstrated that weaken the association between action and target would attenuate the P300 effect.

G26

SUCCESSES AND FAILURES OF COGNITIVE CONTROL ARE PREDICTED BY PRE-TRIAL FMRI ACTIVITY *Andrew B. Leber, Nicholas B. Turk-Browne, Marvin M. Chun; Yale University* – While cognitive control affords great flexibility in adapting to new goals and task challenges, task switching costs show that the exertion of control is not always entirely successful. How can the degree of success be predicted? In this study, we examined the possibility that pre-trial fMRI activity might reflect the current capability to implement control. Subjects were scanned while performing task switching; on each trial, a cue informed them to make either a parity or magnitude judgment on a subsequent target digit presented 1000 ms later. This procedure yielded robust behavioral costs of switching. A fronto-parietal and cingulate "task-switching network" was identified by contrasting the BOLD responses associated with switch vs. repeat trials. Within this network, greater BOLD signal in the single volume immediately preceding the task cue predicted smaller task switching costs; specifically, greater pre-trial activity led to a selective decrease in response time on switch trials. Using a data-driven approach, we then searched the whole brain for regions exhibiting this behavioral interaction with pre-trial activity, again finding only regions in the task-switching network. Further analyses ruled out contributions of recent trial history, instead linking the result to gradual shifts in tonic states. We conclude that one's moment-to-moment capacity to mobilize cognitive control is directly measurable in the neural activity within the control network, and this activity serves as a key predictor of cognitive control success.

G27

CUE VALIDITY MODULATES RESPONSE-RELATED CONFLICT IN A GO-NOGO INHIBITION OF RETURN TASK *David Prime, Pierre Pierre Jolicoeur; Université de Montréal* – In spatial-cueing experiments with uninformative cues, reaction-time to cued-location targets is facilitated, relative to uncued-location targets, at short cue-target stimulus onset asynchronies (SOAs) and inhibited at longer SOAs. This latter effect is called inhibition of return (IOR). Explanations of IOR can be broadly classified into two groups, perceptual/attentional and response-selection/motor. In the present study we utilized event-related potentials (ERPs) to investigate the effect of IOR on response-selection related processes. In a visual cue-target paradigm with a long cue-target SOA participants were required to make speeded responses to frequent Go-targets and to withhold responses from infrequent NoGo-targets. In addition to the expected IOR reaction time effect, we observed that the fronto-central NoGo N2 was significantly larger for uncued-location targets than for cued-location targets. Consistent with previous studies, a dipole source estimate localized the N2 to anterior cingulate cortex. Recent evidence suggests that the NoGo N2 arises from a conflict monitoring process sensitive to competition between response alternatives. If so, the current results indicate that withholding the response on NoGo trials elicited greater conflict on uncued trials than on cued trials. This suggests that IOR may arise in part from relatively greater response activation for uncued targets than for cued targets. Possible mechanisms will be discussed.

G28

ELECTROPHYSIOLOGICAL CORRELATES OF EVENT SEGMENTATION: HOW DOES THE HUMAN MIND PROCESS ON-GOING ACTIVITY? *Richard Sharp[1], David Donaldson[2]; [1]University of Edinburgh, [2]University of Stirling* – Research using videos of everyday activities and fMRI has identified a network of brain regions that are sensitive to the perceptually salient boundaries between events (Zacks et al., 2001). Here we present an electrophysiological investigation into the neural correlates of event segmentation using scalp recorded Event-Related Potentials (ERPs). Three studies investigate the influence of top-down knowledge (e.g. activity goal) and bottom-up influences (e.g. object involvement), on event segmentation. Task knowledge levels were manipulated by showing participants videos of activities that were familiar (e.g. making the bed), unfamiliar (e.g. setting up a microscope), or recently learned (building a table). In each case participants were required to view the videos passively, and then to view whilst making coarse and fine grained segmentations. Segmentation points were extracted and overlaid onto passive viewing data to allow ERPs to be formed time-locked to the segmentation boundaries. Analysis of coarse grain segmentation revealed a modulation over right-frontal electrodes, relatively positive going during the processing of unfamiliar activities and negative going during the processing of familiar and recently learned activities. In addition, fine grained segmentation was associated with a modulation over left parietal electrodes, negative going during familiar and unfamiliar objects relative to recently learned. The ERP differences demonstrate the activation of topographically dissociable neural components associated with fine and course grained event segmentation. Moreover, these ERP components are differentially sensitive to the amount of knowledge and experience that participants have about the activities being viewed.

G29

DIFFERENTIATING THE FUNCTION OF POSTERIOR DORSOLATERAL PREFRONTAL CORTEX AND MID DLPFC: BIASING POSTERIOR CORTEX VERSUS SELECTING BETWEEN REPRESENTATIONS. *Anson Whitmer, Marie T. Banich; University of Colorado at Boulder* – This experiment examined the hypothesis (Milham, Banich, & Barad, 2003) that posterior regions dorsolateral prefrontal cortex (pDLPFC) (BA 8/6) and mid-DLPFC (BA 9/46) play distinct roles in attentional selection. It is posited that pDLPFC is critical for top-down biasing towards task relevant processing by activating regions of posterior cortex (e.g. V4) that process task-relevant information (e.g. color information). In contrast, it is hypothesized that mid-DLPFC (BA 46/9) is involved in selecting which of the specific representations are task-relevant representations and should be used to guide behavior. To investigate this hypothesis we used a cued Stroop task. In this task, participants saw a cue 10.5 seconds before a stimulus. The cue indicated whether they were to identify the ink color of the subsequently presented word or the color represented by the subsequently presented word. Consistent with a role in top-down biasing towards task relevant processes, posterior DLPFC was more activated before than during presentation of the stimuli. Further supporting the idea that pDLPFC is biasing activation towards posterior areas processing the task-relevant dimension in the prestimulus period, color processing areas were activated after a cue to identify the ink color and word processing areas were activated after a cue to identify the color names by the word. Also, in line with mid-DLPFC's hypothesized role of selecting between specific representations, mid-DLPFC was more activated at the time of stimulus presentation than in the pre-stimulus period. These data provide strong evidence differentiating the functions of mid and posterior DLPFC in attentional control.

G30

DISSOCIABLE NEURAL MECHANISMS OF INTERFERENCE-RESOLUTION: PERCEPTION AND MEMORY *Derek Nee, John Jonides; University of Michigan* – The ability to select relevant from irrelevant information is paramount to goal-directed behavior. Information can take various forms from perceptual representations, to memory representations, to motor representations. The efficiency of working memory is thought to depend upon the capacity to select among these representations. Previous work has suggested that the processes that select among different forms of representations are separable. However, the mechanisms by which we select appropriate representations and resolve interference from irrelevant representations remain unclear. Here, we modify a verbal item-recognition task to include either distracting perceptual information or distracting memorial information. Interrogating probe-related activity related to perceptual versus memory lures produced a dissociable pattern of results. Whereas perceptual lures activated posterior regions of the brain including occipital and temporal cortex, memory lures activated medial and lateral frontal regions, as well as posterior dorsal parietal cortex. These results suggest distinct mechanisms of control depending upon the nature of interference.

G31

PROCESSING OF TASK-IRRELEVANT INFORMATION WITH POST-TRAUMATIC STRESS DISORDER (PTSD) *Myeong-Ho Sohn[1], Jeong Ryu[2], Donghoon Lee[3], Byeong-Taek Lee[4], Byung-Joo Ham[5], In-Kyun Lyoo[6], Namhee Choi[7]; [1]George Washington University, [2]Yonsei University, [3]Indiana University, [4]Seoul National University, [5]Hallym University, College of Medicine, [6]Seoul National University, Medical School, [7]Seoul Women's College of Nursing* – Post-traumatic stress disorder (PTSD) develops after a terrifying ordeal that involves (the threat of) physical harm. Among other symptoms, people with PTSD repeatedly relive the trauma in their thoughts during the day and in nightmares. These flashbacks consist of images, sounds, smells, or feelings, and are often triggered by ordinary occurrences (i.e., a door slamming or a car backfiring on the street) that are salient enough to draw attention and yet not the focus of the current task. In this fMRI study, we asked whether the flashback memory of PTSD is related to the prefrontal function that filters out or suppresses task-irrelevant information. Using a spatial version of the negative priming task, we compared a group of survivors of the 2003 subway explosion in Taegu, Korea, with a control group. Behaviorally, the PTSD group did not show any sign of positive or negative priming effects, while the positive priming effect was more evident than the negative priming effect in the control group. The behavioral results suggest that the ability to filter out distracting information may have been impaired in the PTSD group. The imaging results of the control group revealed that the activations in the frontal-parietal circuits were higher when greater processing load was required to process disctractors. However, this pattern was not observed in the PTSD group. The imaging results, consistent with the behavioral results, also suggest that the flashback memory of PTSD may be due to inability to suppress or filter out task-irrelevant information.

G32

MULTITASKING OF ATTENTION AND MEMORY IN PREFRONTAL CORTEX. *Adam Messinger[1], Mikhail Lebedev[2], Jerald Kralik[1], Steven Wise[1]; [1]National Institute of Mental Health, [2]Duke University* – We recorded single neurons in the dorsolateral prefrontal cortex (PFdl) of two rhesus monkeys. On each trial, a visual cue appeared initially either up, down, left or right of a central fixation point. The cue then moved smoothly to another of these positions, which the monkey had to attend covertly, during a delay period, to detect a subtle luminance change. Brightening of the cue instructed a saccade to its initial position, called the remembered location. Dimming instructed a saccade to the cue's final position, called the attended location. Two-way ANOVA (main effects) showed that neuronal firing rates during the delay period were significantly modulated by the remembered location only (10% of 957 neurons), the attended location only (30%), or both (17%). We calculated each neuron's preferred direction (PD) for attention and for memory by vector averaging the firing rates over the four locations. Of the neurons tuned to both attended and remembered locations, many (35%, 57/165) had memory PDs that were nearly opposite their attention PDs (150-180 degree differences), twice what would be predicted for a uniform distribution. Thus, this subpopulation of PFdl neurons did not have just one preferred location, but instead were tuned to both a remembered and an attended location. That is, the cells discharged when the monkey remembered one location or attended to a distinct, often diametric location. The results indicate that some PFdl neurons can simultaneously contribute to the processing of attentional and mnemonic signals, a phenomenon known as multitasking.

G33

NEURAL CORRELATES OF RESPONSE INHIBITION DEPEND UPON THE WORKING MEMORY LOAD OF THE TASK. *Stephanie Powell[1,2], Sunaina Fotedar[1], Joanna Blankner[3], James Pekar[1,4], Martha Denckla[1,4], Stewart Mostofsky[1,4]; [1]Kennedy Krieger Institute, [2]St. Louis Children's Hospital, [3]Tennessee College of Medicine, [4]Johns Hopkins University School of Medicine* – Studies have shown that the neural correlates of motor response inhibition may be task-dependent. This study compared fMRI activation during Go/No-go tasks with different working memory demands. Sixteen adults (10F, mean age=27.2 years) completed two event-related fMRI Go/No-go tasks: 1) a "Simple" task which minimized working memory demands by using only two stimuli with well-ingrained stimulus response association (green=go; red=no-go), and 2) a "Multicolor" task in which 13 different colored stimuli (excluding green and red) were used (3 no-go, 10 go). For both tasks, Go-activation was seen in left primary sensorimotor cortex, right cerebellum and bilateral occipital cortex. For the Simple task, No-go activation was seen in right pre-SMA (BA6), right middle frontal gyrus (BA9/10), left motor cortex (BA3/4), left caudate, bilateral occipital cortex, and right posterior cerebellum. For the Multicolor task, No-go activation was evidenced in broader frontal areas bilaterally and right anterior/posterior cerebellum. Contrast between the two tasks revealed greater Multicolor No-go activation in right inferior frontal (BA47), left premotor (BA6), bilateral occipito-temporal (BA19) and right anterior/posterior cerebellar areas. The results suggest that the neural correlates of response inhibition vary with task demand, with greater prefrontal and cerebellar activation noted under conditions of higher working memory load. For both tasks, No-go activation in the pre-SMA, middle prefrontal areas and anterior cerebellum suggests the involvement of these regions in motor responses inhibition. Increased Multicolor No-go activation in inferiolateral prefrontal cortex suggests the importance of this region when there is increased demand for working memory to guide response inhibition.

G34

PROBING THE ROLE OF POSTERIOR CINGULATE CORTEX IN ECONOMIC DECISION-MAKING WITH MICROSTIMULATION *Benjamin Hayden, Vinod Venkatraman, Michael Platt; Duke University Medical School* – Neurons in posterior cingulate cortex (PCC) signal both the expected value of orienting to visual targets and the motivational consequences of orienting to those targets (McCoy et al. 2003). These data suggest that PCC serves to bind motivational information to locations in space. If so, then microstimulation during the period prior to choice should increase the likelihood of choosing the target associated with stimulation. Moreover, stimulation or during reward delivery should increase the frequency of monkeys choosing the stimulated target on future trials. We recorded choices made by three monkeys confronted with two spatially distinct targets associated with equal rewards. On a subset of trials, we delivered microstimulation to sites in PCC. We found that microstimulation prior to choice biases choices towards the contralateral target. Moreover, we found that microstimulation during the reward period increases the probability of choosing the contralateral target on future trials. These results suggest that artificial activation of PCC neurons enhances the motivational salience of contralateral space, thus supporting the idea that PCC binds value to spatial locations.

G35

DEPRESSIVE FEEDBACK UTILIZATION: THE ERROR-RELATED NEGATIVITY AS AN INDEX OF THE 'CATASTROPHIC RESPONSE TO PERCEIVED FAILURE' *Robert Buzan, Michelle Phillips, Scott Meek; University of South Carolina* – Brain event-related potentials (ERPs) were used to investigate whether the error-related negativity (ERN) can serve as an index of the 'catastrophic response to perceived failure' (Elliott et al., 1996) present in depressed individuals. Prior research has demonstrated that the error-related negativity ERP component occurs in response to perceived errors and negative feedback and may be suppressed in depressed individuals who commit consecutive errors. It may also serve as an index of the strong emotional response to negative feedback exhibited by depressed individuals. The present study served to extend these findings in a college-aged population using a two-stimulus autobiographical deception paradigm modified to include feedback. Task difficulty was varied by manipulating the time available to respond. HD-ERPs were recorded with a High-density geodesic sensory net (Electrical Geodesics, Inc), and then analyzed using principal components. The ERN was identified in both deceptive conditions, and during conditions in which errors occurred. Evidence from this study is used to explore the relationship of inter-trial feedback on subsequent deceptive responses.

G36

ECONOMIC PRINCIPLES UNDERLYING THE VALUATION OF SOCIAL INFORMATION *Michael Platt, Breanna Gawrys, Benjamin Hayden; Duke University Medical School* – Socially relevant information is essential for adaptive decision-making and is thus intrinsically valuable. Nonetheless, the mechanisms underlying decisions about social information remain almost completely unknown. The goal of the present study was to determine whether the value of social information follows the same economic principles as other types of consumable goods. Here we show that humans temporally discount the opportunity to view photographs of members of the opposite sex Moreover, the degree of discounting is inversely correlated with the physical attractiveness of the photograph, a result analogous to magnitude effects on discounting of monetary rewards. . These results suggest that the value of viewing social information is processed in a similar fashion to other rewards including money. To test this ideafurther, we quantified the financial value of the opportunity the view photographs of other people using a pay-per-view task. People implicitly paid money to view photos of physically attractive people, but needed to be paid to view photos of physically unattractive people. Finally, we measured the effort subjects would exert for the opportunity to view photographs. Again, effort scaled with physical attractiveness. Collectively, these results indicate that a common set of principles guides decision-making about social information and other goods like food or money. These observations intimate that similar neural mechanisms process social and non-social rewards.

G37

NEURONAL OSCILLATORY ACTIVITY RELATED TO MOTOR PREPARATION AND EXECUTIVE CONTROL *Elisa Dias[1], Stephan Bickel[2], Pejman Sehatpour[1], Daniel Javitt[1]; [1]Nathan Kline Institute, [2]Institute of Anatomy, University of Zurich, Switzerland* – Modulation of neuronal synchronization may be a fundamental process underlying motor preparation and executive control. In this study, we analyzed the modulation of oscillatory activity during performance of AX- continuous performance tasks (AX-CPT) that create different expectancies of response that are reflected in the evoked potentials. AX-CPT is frequently used in neuropsychiatric evaluation, and schizophrenia patients show specific deficits in performance. Neuronal activity was recorded with a high-density array of scalp electrodes while subjects performed parametric variations of AX-CPT. Oscillatory activity was analyzed by time-frequency decomposition. Changes in expectancy of response clearly modulated oscillatory activity of alpha and beta frequency bands. The most conspicuous effect was a fronto-central beta event-related desynchronization (ERD) that increased with time in the period between cue and probe presentation, suggesting preparatory activity. This ERD increased with the probability of a response and was correlated with reaction time. Gamma oscillatory activity was strongest in the frontal pole, but was not much modulated by task conditions. Beta activity desynchronization has been associated with motor and preparatory activity, and possibly attentional mechanisms, which are also influenced by modulation of gamma activity. Our data indicate that AX-CPT provides a good model for investigating the underlying oscillatory activity related to these functions. In addition, studies of modulation of oscillatory activity in executive control-challenging tasks such as AX-CPT may be a good way to evaluate neuronal dysfunction underlying executive control deficits and preparatory abnormalities in pathological conditions such as schizophrenia. Support: MH49334 and MH01439

G38

CAUSAL CONNECTIVITY WITHIN A COGNITIVE CONTROL NETWORK DURING PERCEPTUAL DECISION MAKING *Michael Cole, Walter Schneider; University of Pittsburgh* – A consensus from across hundreds of published studies indicates that a common set of cortical regions is involved in many kinds of cognitive control demands (Wager, et al., 2004). These regions include dorsolateral prefrontal cortex (DLPFC), anterior cingulate cortex / pre-supplementary motor area (ACC/pSMA), dorsal premotor cortex (dPMC), anterior insular cortex (AIC), and posterior parietal cortex (PPC). Previous work has shown 1) these regions form a functional network, as defined by correlations in fMRI activity during resting state, and 2) activity within this network is strongly modulated by response selection difficulty during visual search (Cole, Schneider, in preparation). We used Granger causality, a measure of effective connectivity, to determine the influences among the nodes of this cognitive control network during task performance. Further, we separated the motor from the decision making stage in a visual line search task to distinguish motor response selection from decision making in general. Results using fMRI indicate that the network is modulated by abstract, non-motor decision making as decision difficulty increases (i.e. as foils become more similar to targets), as well as (to a lesser extent) all other events in the visual search task. The Granger causality analysis indicated a dominant causal influence from ACC/pSMA to DLPFC, supporting a view that ACC/pSMA monitors the need for cognitive control and boosts DLPFC activity as necessary. These results suggest that each event is evaluated by the network, the need for control is determined, and activity is increased (via ACC/pSMA to DLPFC connectivity) as necessary for task performance.

G39

TIME COURSE DISSOCIATION OF BRAIN ACTIVATIONS RELATED TO INTERFERENCE AND RESPONSE INHIBITION IN CHILDREN AND ADULTS *M. Rosario Rueda, Purificacion Checa; Universidad de Granada* – Two important processes related to the ability to monitor our actions in order to accomplish goals and instructions are the inhibition of prepotent but inappropriate responses and the suppression of irrelevant information. The paradigms more widely used to study these two processes include Go-Nogo tasks, in which holding the response to particular (Nogo) trials is required in a context of frequent responses to similar stimuli, and Conflict tasks, in which relevant information is presented together with competing stimulation. Electrophysiological studies conducted with either Go-Nogo or Conflict tasks have shown quite overlapping effects in the ERPs, suggesting that both processes may be related to the same underlying brain mechanism. In our study, we have combined the two paradigms in a single task in order to examine possible differences in the time course of the brain activations related to the two processes. Our data show that both response inhibition and interference suppression processes manifest in similar ERPs components (N2 and a more pre-frontal negative component). However, we found differences in the time course for each of these two processes. This time course dissociation is similar for 12 year olds children and adults despite a general delay of the ERP components shown by the children.

G40

CONTEXT AFFECTS BEHAVIOR AND BRAIN ACTIVITY DURING SACCADE TASKS *Kara A. Dyckman, Jazmin Camchong, Jennifer E. McDowell, Brett A. Clementz; University of Georgia* – The present study evaluated the effect of context on behavior and brain activity in an anti-saccade task. FMRI and eye movement data were collected while 36 participants completed three runs in a block design: (1) fixation alternating with pro-saccades, (2) fixation alternating with anti-saccades, and (3) pro-alternating with anti-saccades. Using Independent Component Analysis, a set of task-related data-driven regressors was derived, which were then used in GLM analyses. Brain activity associated with anti- was compared to activity associated with pro-saccades under both single task (runs 1 and 2) and mixed task (run 3) conditions. Brain areas consistently found to be associated with anti-saccades, including cuneus, precuneus, lateral and medial FEF, SEF, PFC, basal ganglia, and thalamus showed significantly greater percent signal change during the fixation/anti- compared with the fixation/pro-saccade run. During the pro/anti run, however, only SEF, FEF, and precuneus showed greater activation during the anti-saccade trials. This is a clear demonstration that the saccade-related neural circuitry is affected by context. Behavioral results suggest that performance on saccade tasks is also affected by context. Participants made more direction errors on pro-trials that followed anti-trials than on pro-trials that followed fixation. Results from this study indicate that SEF, FEF, and precuneus, which showed anti-saccade-related activity during both comparisons, may be more important for supporting this more complex behavioral response. Other brain regions, such as PFC, however, which showed anti-saccade-related activity during only the single task comparison, may be more involved in executive control and context updating processes.

G41

MIGHT NEGATIVE PRIMING MASK THE CONFLICT ADAPTATION EFFECT? *Julie Bugg; Washington University* – A fascinating question in cognitive neuroscience concerns how the brain controls cognitive control. Conflict monitoring theory (Botvinick et al., 2001) posits that the anterior cingulate monitors for conflict, heightening control on the basis of its detection. The conflict adaptation effect, wherein performance is faster on incompatible trials that are preceded by another incompatible trial (i.e. II trial) as opposed to a compatible trial (i.e. CI trial), supports the existence of a conflict driven control mechanism. However, recent findings indicate that such adaptation effects may be limited to complete repetition II trials (Mayr et al., 2003), leading to the notion that repetition priming is the basis of the effect. On the other hand, conflict adaptation may indeed be occurring on non-repetition II trials, but is being masked by opposing factors such as negative priming. To examine this possibility, 62 undergraduates completed an Eriksen Flanker task, in which the primary methodological features of Mayr et al. were preserved, though neutral trials were incorporated in the paradigm. A comparison of reaction times on II non-repetition trials and NI non-repetition trials revealed a significant 18 ms negative priming effect. In a second experiment with a larger stimulus set, conflict adaptation was observed for both repetition and non-repetition II trials. Along with the findings of Ullsperger et al. (2005), the current results suggest that conflict adaptation effects are not limited to repetition trials, but rather are revealed on non-repetition trials under conditions that reduce the likelihood of negative priming. Theoretical implications will be discussed.

G42

IS TASK SWITCHING NOTHING BUT CUE PRIMING? EVIDENCE FROM ERPS *Kerstin Jost[1], Ulrich Mayr[2], Frank Rösler[1]; [1]Philipps-University Marburg, [2]University of Oregon* – The present study measured event-related potentials (ERPs) in a cued task-switching paradigm in order to disambiguate cue switching and task switching on a neurophysiological level. Participants (n=16) switched between color discrimination and shape discrimination; and each of the tasks could be signaled by two arbitrary letter cues, allowing to compare no-switch, cue-switch, and task-switch transitions. The cue-stimulus interval (CSI) was set to either 200 or 1000 ms. In both CSI conditions the electrophysiological correlates of switch costs could be unambiguously split up into two components: an early negative deflection that was attributable to a cue switch, and a late one that was due to the actual task switch. This dissociation suggests that task-switch costs not only represent more of the same of what is already captured by cue-switch costs, but that task switching involves a unique set of mental processes. In addition to this differentiation, ERPs during the long CSI elicited a positive deflection whose amplitude varied with the necessity to switch and was related to task performance. This result provides evidence for active task-set reconfiguration during the cue-stimulus interval.

G43

NEURAL BASIS OF ANALOGICAL REASONING: EVENT-RELATED FMRI YIELDS EVIDENCE OF PREFRONTAL SUBSTRATE FOR RELATIONAL INTEGRATION AND INTERFERENCE RESOLUTION *Soohyun Cho, Teena Moody, Russell Poldrack, Tyrone Cannon, Barbara Knowlton, Keith Holyoak; University of California, Los Angeles* – Integrating relational information and resolving interference are hypothesized to be key requirements for analogical reasoning. We examined the impact on brain activations of increasing demand for both processes during performance of a pictorial analogy task. Each problem consists of two pairs of human cartoon characters that can be described by four binary traits. The subject's task was to determine whether or not the analogy is valid, based on a subset of traits randomly selected for each trial. Participants were instructed to solve each problem based on relevant traits only, inhibiting processing of irrelevant traits. Number of to-be-attended traits defines level of relational complexity (1 or 3); number of to-be-ignored traits supporting an incorrect response defines level of interference (0 or 1). Participants were less accurate and slower for problems requiring integration of multiple relations or interference resolution. Solution time was increased in an over-additive fashion by simultaneous demand for both processes. Regions in the left frontal pole and the right middle frontal gyrus were selectively activated by increased relational complexity. Distinct, but partially overlapping, regions in the bilateral inferior prefrontal cortex were activated by interference resolution and relational integration, independently, and also by the simultaneous increase in demand for relational integration and interference resolution. By manipulating both processes within individual analogy problems, it proved possible to isolate prefrontal loci engaged when demands for two component processes of analogical reasoning are increased simultaneously. These results shed light on the core components of analogical reasoning.

G44

FREQUENT CHANGE CAN BE GOOD FOR YOU: TASK SWITCH PROBABILITY AFFECTS COGNITIVE CONTROL *Michael Bersick[1], Doreen Nessler[1], Ray Johnson Jr.[2], David Friedman[1]; [1]New York State Psychiatric Institute, [2]Queens College/CUNY* – Juggling multiple tasks causes performance deficits; cognitive control models of this behavior emphasize the role of anticipatory processes in dynamically allocating limited resources. For example, foreknowledge of task order ameliorates switching costs by allowing preparation of the appropriate task set. Thus, we investigated how switching frequency affects participants' utilization of such task order knowledge. Sixteen young adults participated in a task switching paradigm. In different conditions, switch and stay trials occurred in predictable or unpredictable sequences, were preceded by informative or uninformative cues, and were either equiprobable or non-equiprobable. The ratio of switch to stay trials varied from 1:1 (switch after 1-3 trials) in equiprobable blocks to 1:3 (switch after 3-5 trials) in non-equiprobable blocks. Mixing costs (pre-switch RT minus pure task RT) were larger for equiprobable whereas switch costs (switch RT minus pre-switch RT) were larger for nonequiprobable blocks. Unpredictability increased mixing costs and decreased switch costs. These data suggest that both task sets remained more activated during equiprobable and unpredictable blocks. Informative cues minimized mixing and switch costs in both equiprobable and non-equiprobable blocks. A switch-related, P3-like, positivity 400-700 ms after informative cues presumably indexed task-set updating but was absent for predictable, equiprobable blocks. Participants did not simply ignore predictable cues, because they reduced mixing costs relative to similar blocks with an uninformative cue. When task sequences are fixed and short enough to keep in working memory any required updating of the task-related information, even on switch trials, is apparently infrequent or minor.

G45

DECREASED RISK-TAKING DURING AMBIGUOUS DECISION-MAKING IN PATIENTS WITH SEVERE TRAUMATIC BRAIN INJURY *Shirley Fecteau[1], Hatiche Kumru[2], Monste Bernabeu[2], Alberto García Molina[2], Teresa Loig[2], Alvaro Pascual-Leone[1], José Maria Tormos[2]; [1]Beth Israel Deaconess Medical Center, Harvard Medical School, [2]Guttmann Institute, Barcelona, Spain* – Cognitive abilities related to frontal lobes remain chronically impaired in most patients with traumatic brain injury (TBI) despite improvements in several other cognitive functions, and can often critically impact the patients' independent living, and overall functional rehabilitation. In the present study, we assessed risk-taking under ambiguity, a function related to prefrontal cortex, in 20 patients with severe TBI and 8 healthy volunteers. Participants performed the Balloon Analogue Risk Task (BART), which has convergent validity with real-world risk-related situations. Participants had to pump a computerized balloon, which can explode at any moment, and to decide after each pump whether to keep pumping or not. Money is accumulated with each pump, but is lost in case of explosion. Participants have to decide when to stop pumping and settle on a given pay-off. Results revealed a group difference in the number of pumps ($p=0.03$): patients pumped less number of times than controls. For the amount of money earned, there was also a group difference ($p=0.007$): patients earned less money than controls. The results of Stroop interference – the control task – showed no group difference ($p>.8$), suggesting that the group differences on the BART task were not due to difference in motor inhibitory control as assessed by the Stroop test. Finally, there was no group difference in the amount of time needed to perform the BART ($p>.8$). In sum, patients with TBI displayed a risk-averse response style. Such overly cautious decision-making behaviors can impact real-life matters and contribute to difficulties in social rehabilitation.

G46

MEASURING THE EFFECT OF DUAL-TASK DEMANDS ON PREDICTIVE SMOOTH PURSUIT EYE TRACKING IN MILD TBI PATIENTS *Rachel Kolster[1,2], Sambrita Basu[2], Ranjeeta Sarkar[2], Richard Ivry[3], Bruce McCandliss[1], Jamshid Ghajar[2,4], Minah Suh[4]; The Cognitive and Neurobiological Research Consortium in Traumatic Brain Injury (CNRC-TBI) ; [1]Sackler Institute, Weill-Cornell Medical College, [2]Brain Trauma Foundation, [3]University of California, Berkeley, [4]Weill-Cornell Medical College* – Mild traumatic brain injury (TBI) is known to produce subtle attentional deficits, yet these deficits are often elusive under typical assessment conditions. Predictive smooth pursuit eye movements (SPEM), which may be dependent upon attentional processes, are often atypical in mild TBI patients. The potential role of attention in explaining such deficits, however, has not been directly tested. To more directly assess the degree to which such deficits are related to attention, we present a novel investigation of the impact of dual-task demands on predictive SPEM measures. We used a highly predictable circular smooth pursuit paradigm with a simultaneous verbal working memory task to examine the generation of predictive SPEM under conditions of varying cognitive load in mild TBI (n=19) and control subjects (n=10). Under higher load conditions, control subjects showed slightly improved predictive SPEM performance. In contrast, higher load conditions led mild TBI patients to show increased velocity error and intra-individual SPEM variability. This finding suggests that predictive SPEM measures are influenced by attention, and that the sensitivity of these measures to mild TBI is mediated by attentional processes. Futhermore, California Verbal Learning Test (CVLT-II) scores correlated with the degree to which cognitive load impacted SPEM in mild TBI patients, suggesting that increased severity of cognitive deficits was a function of attention. Overall, our results suggest that smooth pursuit eye movements are a sensitive metric for attentional deficits in mild TBI.

G47

THE TEMPORAL TRAJECTORY OF AGE-RELATED DECREASES IN EXECUTIVE FUNCTION: ERP AND BEHAVIORAL EVIDENCE *Doreen Nessler[1], Ray Johnson Jr.[2], Michael Bersick[1], Dave Friedman[1]; [1]NY Psychiatric Institute, NY, NY, [2]Queens College/CUNY, Flushing, NY* – Although aging negatively impacts executive control processes such as inhibition and working memory, the time course of these changes is not well known. Hence, these processes were examined in young (mean age 24.7, N=16), young-old (65.9, N=13) and old-old adults (76.9, N=16) while they performed variants of a task-switching paradigm. Interference created by the alternative task set and, hence, the need for inhibitory control should to be greater when task switches are required by targets following uninformative cues and when more time has been spent on the alternative task (non-equiprobable blocks). Working memory processes were expected to benefit performance when stay and switch trials followed a predictable pattern. The results showed that increases in switch costs (switch RT minus pre-switch RT) were age invariant for uninformative compared to informative cues in equiprobable blocks. However, when the need for inhibitory control increased (uninformative cue, non-equiprobable condition), both older groups showed increased switch costs relative to the young. Predictable switches decreased mixing costs (pre-switch RT minus single task RT) in equiprobable blocks for young and young-old but not old-old adults. This behavioral effect was associated with a cue-related frontal ERP negativity that preceded targets for young and young-old but not for old-old adults, possibly reflecting working memory processes in anticipation of the upcoming response. In sum, inhibitory control appears to be less efficient relatively early in the aging process, while working memory functions do not appear to decline until relatively later in the aging process.

G48

ANALYSIS OF DRD4 AND DAT POLYMORPHISMS AND BEHAVIORAL INHIBITION IN HEALTHY ADULTS: IMPLICATIONS FOR IMPULSIVITY *Eliza Congdon[1], Jason-Flor Sisante[1], Klaus-Peter Lesch[2], Turhan Canli[1]; [1]Stony Brook University, [2]Molecular and Clinical Psychobiology, University of Würzburg, Würzburg, Germany* – Impulsivity, a highly prevalent symptom in multiple psychiatric disorders, is a partially heritable trait influenced by specific biological mechanisms. In particular, dopamine is proposed to play a role in impulsive behaviors and recent studies have implicated functional polymorphisms of dopamine-related genes in impulsive behaviors across different clinical and behavioral classifications. Despite evidence elucidating the specific neural network underlying behavioral inhibition, the most direct expression of impulsivity, most studies looking at the relationship between dopamine-related genes and impulsive behavior have not isolated the impulsivity construct per se as a biologically-based and measurable endophenotype. The present study was therefore undertaken in healthy adults to investigate the influence of two candidate dopaminergic gene polymorphisms (DRD4 and DAT) on the endophenotype of impulsivity, which we operationalized as behavioral inhibition during the Stop-signal task. We report significant differences in inhibitory control between individuals with at least one 7-repeat allele of the DRD4 polymorphism, as well as an interaction between DRD4 and DAT genotypes on inhibitory control. Results of the present study further support the influence of dopaminergic variation on impulsive-related measures, and suggest a benefit of using measures which are likely more sensitive to the effects of such genetic variation. Results of the present study lay the groundwork for future studies investigating the relationship between dopamine-related genes and neural activity in brain regions known to underlie behavioral inhibition.

G49

META-ANALYSIS OF FMRI ACTIVATION ASSOCIATED WITH RESPONSE INHIBITION DURING PERFORMANCE OF GO/NOGO TASKS. *Daniel Simmonds[1], James Pekar[1,2], Stewart Mostofsky[1,2]; [1]Kennedy Krieger Institute, [2]Johns Hopkins University School of Medicine* – FMRI studies of response inhibition consistently reveal frontal activation. Localization within frontal cortex, however, varies across studies and appears task-dependent. Activation likelihood estimate (ALE) meta-analysis can be used to establish concurrence across fMRI studies. This study used ALE to investigate concurrence of Nogo-activation in healthy adults during event-related fMRI Go/Nogo tasks that contrasted Nogo with baseline activation, to reveal regions involved in response inhibition. Studies were selected by searching the Pubmed database; after the selection criteria were applied, six studies remained with a total of 145 subjects and 68 foci. The analysis was run in the Brainmap Search&View program using FWHM=15mm; 5000 random permutations were generated to assess statistical significance. The ALE map was thresholded at p=.001. ALE values were imported into AFNI and overlaid onto an anatomical template. Results showed concurrence of activation lateralized to the right-hemisphere, with the highest concurrence seen in the rostral supplementary motor area (pre-SMA;BA6). Concurrence was additionally seen in bilateral inferior parietal regions (BA40), right middle frontal gyrus (BA9/46), right inferior occipital gyrus (BA19), left precentral gyrus (BA6) and left posterior cerebellum (declive). The ALE meta-analysis indicates that a predominantly right-lateralized network is involved in motor response inhibition. Although much attention has been focused on the involvement of right inferior prefrontal regions in response inhibition, the ALE findings suggest greater concurrence in the pre-SMA, important for motor response selection (including selecting not to respond), and inferior parietal regions important for processing the behavioral relevance of stimuli.

Higher level cognition: Other

G50

OCCIPITO-TEMPORAL REGION IS SENSITIVE TO ORTHOGRAPHIC FAMILIARITY *Jennifer Bruno, Allison Zumberge, Frank Manis, Jason Goldman; University of Southern California* – The involvement of the left hemisphere occipito-temporal (OT) junction in reading has been established, yet there is current controversy over the region's specificity for and role in the reading process. The present study tested the hypothesis that the region is sensitive to orthographic familiarity. After localizing the OT region using block design fMRI, we employed an event-related design with 27 adult, right-handed participants to examine phonological judgments (i.e., "does it sound like a word?") to words, pseudohomophones (phonologically familiar yet orthographically unfamiliar), and pronounceable nonwords (phonologically and orthographically unfamiliar). Relative to baseline, activation in OT was equal for pseudohomophones and nonwords. Activation for both of these orthographically unfamiliar conditions was greater than that for words. Further contrasts of orthographic frequency within the word condition revealed that it was only the highly frequent words that contributed to this effect; the low frequency words elicited a response pattern that was not significantly different from the nonwords and pseudohomophones. This overall pattern of activation is not confounded with stimulus difficulty level as evidenced by reaction time differences. These findings support our hypothesis that the region is sensitive to orthographic but not phonological familiarity. Specialization in this area for recognition of frequent letter strings may support the development of reading expertise.

G51

DIFFERENT CONTRIBUTIONS OF DORSAL AND VENTRAL MEDIAL PREFRONTAL CORTEX TO INFERENCES ABOUT OTHERS' THOUGHTS AND FEELINGS *Adrianna C. Jenkins, Jason P. Mitchell; Harvard University* – The medial prefrontal cortex (MPFC) has been consistently observed during tasks in which participants infer the mental states of another person (i.e., mentalize). Although emerging evidence suggests that MPFC may comprise several subregions that contribute differently to mental state inference, it is not known what characterizes these functional distinctions. One possibility is that different cognitive processes subserve mentalizing judgments as a function of the kind of mental state being inferred: specifically, whereas some aspects of MPFC may respond preferentially to mentalizing about cognitive states (thoughts and beliefs), others may respond preferentially to mentalizing about affective states (feelings and emotions). In the current study, participants (n=20) were scanned using fMRI while reading short vignettes describing common experiences. Following each story, a question prompted consideration of either the protagonist's thoughts or feelings. In both conditions, participants also read explicit information about the protagonist's thoughts and feelings, allowing us to decouple the neural response associated with active mental state inference from that associated with the passive receipt of mental state information. Results demonstrated a cognitive-affective gradient in MPFC, such that regions were differentially sensitive to inferences about feelings vs. beliefs as a function of their position along the ventral to dorsal axis. The results contribute to the ongoing process of identifying distinct subregions of MPFC that subserve distinct aspects of inferring the contents of others' minds.

G52

FRONTOPOLAR CORTEX AND CREATIVE THINKING: AN FMRI STUDY OF THE USES-OF-OBJECTS TASK *Adam Green[1], Jonathan Fugelsang[2], David Kraemer[3], Kevin Dunbar[3]; [1]Yale University, [2]University of Waterloo, [3]Dartmouth College* – Essential for scientific innovation and artistic inspiration, the construct of creativity has historically been a prominent subject in psychology, following largely from Hudson's (1966) seminal work with the uses-of-objects task. However, very little contemporary neuroscientific research has examined the neural underpinnings of creativity. This is largely because it has been difficult to make constrained, a priori predictions about brain regions that underlie this inherently unconstrained type of cognition. Here, we used a non-verbal variant of the uses-of-objects task with performing arts and non-arts students in an event-related fMRI study. We made an a priori prediction concerning a specific region of frontopolar cortex implicated by our recent research examining creative thinking in verbal analogical reasoning. Within this a priori region of interest, the uses-of-objects task elicited significantly greater activity than a matched control task. These new findings indicate a general role for the identified frontopolar region in creative thinking for both verbal and non-verbal modalities.

G53

INTENTIONALITY AND THE BRAIN: UNRAVELING THE THEORY-OF-MIND NETWORK *Anna Abraham[1], Markus Werning[2], Hannes Rakoczy[3], D. Y. von Cramon[1], Ricarda I. Schubotz[1]; [1]Max-Planck-Institute for Human Cognitive and Brain Sciences, [2]Heinrich-Heine University Düsseldorf, [3]Max-Planck-Institute for Evolutionary Anthropology* – Much imaging research has been directed at uncovering the neural underpinnings of theory-of-mind. While a number of brain regions are consistently activated across different experimental paradigms, there are many unanswered questions concerning the actual contribution of each area in the network. Using functional magnetic resonance imaging with a novel behavioral paradigm, we tried to shed further light on this issue by attempting to determine which areas are involved when processing mental state or intentional metarepresentations as distinct from those that are involved as a function of the presence of any person-based information. Using non-intentional representations such as spatial relations between persons and objects as a contrast, a selective involvement of the medial prefrontal cortex and the temporal poles was found in the processing of intentional representations. The anterior superior temporal sulcus, the precuneus and the temporo-parietal junction, on the other hand, were implicated when processing representations that were only commonly characterized by the sheer presence of persons. Moreover, the evidence suggests that even without explicit references to mental states, the mere presence of person information could, under specific conditions, evoke default mental state reasoning. Finally, preliminary results from a parametric contrast of the intentional conditions point to the involvement of dissociable areas in relation to processing belief relative to desire representational relations. These findings help clarify some of the issues that are pertinent for the theory of mind domain while also paving the way for new directions of exploration in the field.

G54

DIFFERENT BRAIN CIRCUITS UNDERLIE TIME PROCESSING FOR ACTION AND PERCEPTION *Domenica Bueti[1], Vincent Walsh[1], Chris Frith[2], Geraint Rees[3]; [1]Institute of Cognitive Neuroscience, University College London, [2]Wellcome Department of Imaging Neuroscience, Institute of Neurology, University College London, [3]Institute of Cognitive Neuroscience and Wellcome Department of Imaging Neuroscience, Institute of Neurology, University College London* – In everyday life, temporal information is used for both perception and action, but whether these two functions reflect the operation of similar or different neural circuits is unclear. We used functional MRI (fMRI) to investigate the neural correlates of processing temporal information for action and perception in the human brain. Participants viewed two identical sequences of visual stimuli and used the information differently to perform either a temporal reproduction or a temporal estimation task. By comparing brain activity evoked by these tasks and control conditions, we explored commonalities and differences in brain areas involved in reproduction and estimation of temporal intervals. The basal ganglia and cerebellum were commonly active in both temporal tasks, consistent with suggestions that perception and production of time are subserved by the same mechanisms. However, only in the reproduction task activity was observed in a wider cortical network including right preSMA, left middle frontal gyrus, left premotor cortex, with a more reliable activity in right inferior parietal cortex, left fusiform gyrus, and the right extrastriate visual area V5/MT. Our findings point to a role for parietal cortex as an interface between sensory and motor processes and suggest it may be a key node in translation of temporal information into action. Futhermore, we discuss the potential importance of extrastriate cortex in processing visual time in the context of recent findings.

G55

THE INFLUENCE OF PROFICIENCY IN ARTIFICIAL GRAMMAR LEARNING: INSIGHTS FROM COMBINED ROC AND ERP MEASUREMENTS *Juliane Hofmann, Bertram Opitz; Saarland University* – It is suggested that artificial grammar learning (AGL) is based on two mechanims: learning item-specific information on the basis of superficial similarity and learning by abstracting a representation of the underlying rules. The impact of both mechanisms on newly learned grammatical knowledge can be estimated by using Receiver Operating Characteristics (ROCs). Aside the behavioural measurement, event-related potentials (ERP) could give information about the quality of the underlying neural processes. It has been shown that a small system of artificial grammatical rules can be syntactically instantiated by adult speakers in a way that strongly resembles native-speaker sentence processing as reflected in similar ERP components elicited by violations in natural and artificial grammar systems, namely an early negativity and a P600 component. Furthermore, the participant's proficiency level is discussed as an important factor for native-speaker-like processing. Recently it has been proposed that highly proficient L2 speakers with native-speaker-like ERPs rely on their grammatical rule knowledge to master L2, whereas low proficient speakers use different strategies to compensate for their difficulties in the syntactic and phonological domain. In a previous behavioural study we found actually that high proficient AG learners used more rule knowledge than less proficient participants. Thus, rule knowledge and proficiency seem to correspond. In the current study ERPs and ROCs were measured while learning an artificial grammar. ERP data will be presented depending on the participant's proficiency level and acquired rule knowledge. More rule knowledge and higher proficiency should be reflected in a greater P600 component indicating controlled syntactic processes.

G56

HOW THE BRAIN TRANSLATES MONEY INTO POWER: AN FMRI STUDY OF IMPLICIT MOTIVATION *Mathias Pessiglione[1], Liane Schmidt[1], Bogdan Draganski[2], Raffael Kalisch[2], Hakwan Lau[2], Ray Dolan[2], Chris Frith[2]; [1]INSERM U610, Hôpital de la Salpêtrière, Paris, France, [2]Wellcome Department of Imaging Neuroscience, London, UK* – Motivation can be construed as a process through which an expected reward is converted into behavioural activation. Many studies have investigated explicit motivational processes, like the estimation of an effort/benefit ratio in order to decide whether an action is worthwhile or not. However, it is still unclear whether humans can be motivated by potential rewards that they are not aware of. Here we harness implicit motivational processes within a novel paradigm, where we manipulate the amount and the visibility of the monetary reward for which subjects have to make an effort. We show that, even when subjects cannot report how much money is at stake, they nevertheless deploy more effort for higher amounts. This motivational effect is underpinned by engagement of the pallidum, which drives cortical motor areas leading to muscular effort. We conclude that our brain is able, via pallidal activation, to boost our behaviour towards implicit rewards.

G57

WHATCHA LOOKING AT? THE NEURAL REPRESENTATION OF ANOTHER PERSON'S GAZE TARGET *Antonia Hamilton[1], Stephanie Ortigue[2], Anna Bekker[1], Scott Grafton[2]; [1]Dartmouth College, [2]UCSB* – When two people look at one another and then at a common object, a state of joint attention arises, facilitating social interaction and learning. Converging evidence implicates the superior temporal sulcus in detecting the left / right direction of gaze, but neural sensitivity to the object of gaze, e.g. if the eyes fixate on an orange rather than a toy, has rarely been examined. In the present study, we used a repetition suppression method to localize the neural representation of the object of gaze. Experiment 1 (20 participants) used event-related fMRI while experiment 2 (18 participants) used the same stimuli and method during 128-channel event-related potential recording, thus providing both spatial and temporal localizations of gaze target. On each trial of the neuroimaging studies, participants saw an actress look up and straight at the participant, and then towards either an orange or a toy, one on the left and one on the right. The direction of gaze and the identity of the gazed-upon object varied from trial to trial in a one-back repetition suppression design. fMRI results revealed that the superior temporal sulcus responds preferentially to observation of human gaze shifts and encodes the direction of gaze, but the middle frontal gyrus encodes the identity of the gazed-upon object. Similarly, ERP analysis revealed significant early effects of direction of gaze in occipito-temporal regions, and a later effect of gazed-upon object in frontal regions. Results are discussed in relation to current theories of gaze coding and joint attention.

G58

EVENT-RELATED POTENTIALS IN A SEMANTIC TASK RELATE METACOGNITION TO THEORY OF MIND (TOM) *Marie Prévost[1,2], Louis Renoult[1,2], Mathieu Brodeur[3,2], Claire Lionnet[2], J. Bruno Debruille[1,2]; [1]McGill University, [2]Douglas Hospital Research Center, [3]Université de Montréal* – The aptitude to infer mental state of others has been shown to be linked to syntactic and semantic processes (Hale and Tager-Flusberg, 2003). The initial aim of this study was to determine if the integration of semantic information indexed by the N400 event-related potential varies as a function of the awareness of the mental state of another person. Three brief questions evaluating the extent to which the subject was aware that the examiner mind was focused on his or her behaviour during the experiment were answered by every participant. Subjects were split into two groups, those who said they were more (ToM+) and those who said they were less (ToM-) aware of the examiners' mental state. The semantic task consisted of deciding whether target words belong to the 'animal' semantic category. A classical N400 effect was observed for all subjects. However, no group effect or interaction with group was found on this ERP. The main result was a larger positivity between 600 and 1100 ms after stimulus onset in the ToM+ than in the ToM- subjects. On the other hand, the awareness that the examiner was focused on the subject was found to be positively correlated with the scores to the delusion proneness items of the schizotypal personality questionnaire (Raine, 1991) Therefore, this study did not confirm the relation between semantic processes and a particular aspect of ToM ability. The awareness of others' mental state was rather found to affect the late positivity, which is thought to index metacognitive processes.

Memory: Memory systems

G59

INVESTIGATING ENCODING AND RETRIEVAL DYNAMICS IN THE MEDIAL TEMPORAL LOBE DURING CONTINUOUS RECOGNITION WITH MULTIPLE STIMULUS PRESENTATIONS *Michael Yassa, Craig Stark; Johns Hopkins University* – The medial temporal lobe (MTL) is known to play an essential role in declarative memory. Although memory encoding and retrieval can be thought of as separate process, it has been challenging to determine whether there is structural and functional specificity within the medial temporal lobe for these processes. We attempted to overcome difficulties associated with traditional attempts to isolate these processes (e.g. effects of incidental encoding or of task demands) by using a continuous yes/no recognition task of novel and familiar scenes that presented each stimulus several times during fMRI scanning (both experimentally-familiar and pre-experimentally familiar scenes were used). We hypothesized that monotonic decreases in activity over presentations would be more likely related to amount of information encoded, whereas monotonic increases in activity would be more likely related to amount of information retrieved (or memory strength). Within this framework, retrieval success would be associated with a step-function increase in activity associated with hits, regardless of presentation number. fMRI data showed monotonic decreases in activity (consistent with encoding) bilaterally in the parahippocampal cortex and monotonic increases in activity (consistent with retrieval) bilaterally in the posterior portions of perirhinal/entorhinal cortex. Data also showed bilateral activation in the anterior portions of perirhinal / entorhinal cortex most consistent with a combination of encoding and retrieval effects. We discuss how these dynamics give rise to learning over multiple trials.

G60

COGNITIVE PROCESSES UNDERLYING ROUTINE AND NOVEL NATURALISTIC ACTION PERFORMANCE IN STROKE PATIENTS *Sabrina Lombardi, David Gold, Catherine Labrish, Norman Park; York University* – Naturalistic actions are defined as goal-directed, multi-step series of actions requiring the manipulation of objects. Routine naturalistic actions (NAs) are familiar types of actions that are performed repeatedly over the course of a person's life (e.g., making coffee), whereas new tasks that are unfamiliar prior to viewing them being enacted (e.g., transferring from a wheelchair) are referred to as novel naturalistic actions (NNAs). The aim of this study was to examine the cognitive processes underlying NA and NNA enactment performance. Previous research by Schwartz and colleagues showed a similar pattern of NA performance across different groups of neurologically impaired patients, and that accomplishment scores, the total number of errors, errors of omission, but not commission errors (e.g., reversals) were best predicted by general measures of cognitive impairment. Based on the similarity in performance across patient groups, they concluded that a common factor was responsible for impaired performance. Our NA findings with stroke patients replicated results reported by Schwartz and colleagues. We extended this work by showing similar patterns of NA and NNA performance and that both NAs and NNAs were affected by severity of cognitive impairment. In contrast, individual patient performances on routine and novel measures were non-significantly correlated. Further examination of individual patient performance showed a double disassociation between NA and NNA performance in two patients. We conclude that NA and NNA are mediated by different cognitive processes and that similar patterns of enactment performance may result from disruptions of different cognitive processes.

G61

SOURCES OF INDIVIDUAL VARIABILITY IN BRAIN ACTIVITY DURING EPISODIC ENCODING AND RETRIEVAL *Christa-Lynn Donovan[1], Scott Geurin[1], Meghan Roarty[1], Rich Mayer[1], John Van Horn[2], Michael Miller[1]; [1]University of California, Santa Barbara, [2]Dartmouth College/ Psychological and Brain Sciences* – Most neuroimaging studies report common areas of activation across a group of participants to determine brain areas that underlie the process under investigation. However, we have previously shown extensive individual variability in brain activations during episodic retrieval. The individual activations were observed to be stable over time at intervals of up to a year (Miller et al., 2002). This suggests they were not just due to noise but may reflect processes that are uniquely individual and perhaps necessary for the individual to perform the task. Analysis of this variability can give us another level of complexity in our understanding of the neural basis underlying higher order cognitive functioning. The purpose of this study was to identify factors that can account for variability in brain activity underlying episodic encoding and retrieval. After the scanning session, subjects completed a battery of questionnaires so that we could classify their encoding strategy as either visualizing or verbalizing. Our results concerning the extensive variability of individual brain activity during episodic memory replicated our previous study. In addition, we found that a significant portion of the variance in task-related activity could be explained by differences in encoding strategy, but not by differences in anatomy, as assessed by the normalized high resolution anatomical scans. These results demonstrate that individuals can recruit widely dispersed brain regions during an episodic memory task, and that the recruitment of any particular region by an individual may depend on their unique mnemonic strategy.

G62

HIGH-RESOLUTION FMRI OF THE HUMAN PERIRHINAL CORTEX DURING PAIRED-ASSOCIATE LEARNING *W. Kyle Simmons[1], Sean Matlis[1], Patrick S.F. Bellgowan[1], Jerzy Bodurka[2], Lawrence W. Barsalou[3], Alex Martin[1]; [1]Laboratory of Brain and Cognition, NIMH / NIH, [2]Functional MRI Facility, NIMH / NIH, [3]Emory University* – Recent neurophysiology findings in the macaque have demonstrated that the perirhinal cortex plays an important role in learning associations among stimuli by binding together their representations in brain regions outside the medial temporal lobes. Unfortunately, because standard-resolution fMRI is subject to susceptibility-related signal artifacts in medial temporal regions, there is little extant human fMRI evidence to date demonstrating the perirhinal cortex's role in associative learning. In the present study, we examined the role of human perirhinal cortex in paired associate learning by capitalizing on the ability of high-resolution multi-channel fMRI to reliably measure BOLD signal in perirhinal cortex. In three training sessions prior to scanning, participants learned associations between abstract line drawings and either photographs of unfamiliar abstract sculptures or unfamiliar nonsense sounds. Participants were also shown abstract line drawings that did not have paired-associates. During scanning, subjects were simply shown the abstract line drawings in a fast event-related design, and asked to indicate if the stimulus had a visual, auditory, or no associate. Importantly, the left perirhinal cortex was more active when subjects made judgments about line drawings with either auditory or visual associates, relative to judgments about line drawings without paired associates. This finding, taken together with previous neurophysiology studies, demonstrates that during paired-associate learning the human perirhinal cortex binds property representations together both within and between modality-specific regions.

G63

IDENTIFYING THE DIFFERENT COGNITIVE PROCESSES MEDIATING FAMILIAR AND UNFAMILIAR NATURALISTIC ACTIONS IN STROKE PATIENTS *Norman Park, David Gold, Sabrina Lombardi; York University* – Naturalistic actions are multi-step actions requiring the manipulation of objects in order to achieve a goal. Routine naturalistic actions (NAs) are familiar actions that have been enacted many times over the course of a person's life (e.g., making tea), whereas new tasks such as constructing a birdfeeder that are unfamiliar prior to viewing, are referred to as novel naturalistic actions (NNAs). In a previous study with stroke patients, we showed that NNAs and NAs show similar patterns of enactment performance on several measures. Both types of action were also affected in similar ways by cognitive severity. Despite these similarities, the correlation between NA and NNA performance by the same set of patients was statistically non-significant, suggesting that different psychological processes may mediate NA and NNA performance. The purpose of this study was to identify cognitive processes that are differentially involved in NA and NNA enactment in stroke patients. Based on theories of apraxia (e.g., Buxbaum, Goldenberg), we hypothesized that NA enactment is more strongly mediated than NNA enactment by lexical/semantic cognitive processes, but that NNAs are more strongly mediated visuospatially. We tested this hypothesis by correlating lexical/semantic and visuospatial scores and measures of NA and NNA performance. As predicted, psychological test (visuospatial, lexical/semantic) interacted with type of action (NA, NNA). NAs were more strongly correlated than NNAs with lexical/semantic scores, whereas the opposite pattern was obtained for visuospatial scores. We conclude that NAs have a stronger conceptual or semantic memory representation than NNAs. Implications of these findings will be discussed.

G64

FEATURE OVERLAP AND SHORT-TERM MEMORY IN AMNESIA: AN EXAMINATION OF THE PHONOLOGICAL SIMILARITY EFFECT *Craig Brozinsky, Charan Ranganath, Andrew Yonelinas, Neal Kroll; University of California, Davis* – According to the Complementary Learning Systems (CLS) approach (e.g., Norman & O'Reilly, 2003), the neocortex can support recognition for distinct items, but additionally requires the hippocampus to discriminate stimuli with a high degree of feature overlap. Here, we examine whether these predictions are unique to recognition tests using long retention intervals, or extend to tests more traditionally believed to tap verbal short-term memory. For example, the phonological similarity effect (PSE) is a classic short-term memory phenomenon whereby memory is worse for rhyming letters than non-rhyming letters. Across three experiments, PSE's were compared between controls and seven patients with damage to the medial temporal lobes. First, we examined memory span for phonologically similar and distinct letters, separately analyzing performance for the number of recalled letters and for positional accuracy. Second, we examined probe recognition for short sets of phonologically similar and phonologically distinct letters. To ensure that the results generalized beyond closed pool lists (i.e., letters), we examined the group's PSEs in the third experiment by comparing recall between four-item lists of rhyming words and non-words, a manipulation additionally intended to clarify patient's abilities to maintain novel stimuli. The results indicate that at least some aspects of the PSE are exacerbated in medial temporal patients, and suggest a role for medial temporal lobe regions in the short-term retention of verbal materials.

G65

EFFECTS OF COMT GENOTYPES ON PREFRONTAL AND HIPPOCAMPAL ACTIVITY DURING SUCCESSFUL RELATIONAL MEMORY ENCODING AND RETRIEVAL *Nancy A. Dennis[1], Sheena W. Waters[1], Anna Need[2], Kevin S. LaBar[1], David B. Goldstein[2], Roberto Cabeza[1]; [1]Duke University, [2]Institute for Genome Science and Policy, Duke University* – Genetic neuroimaging has the potential to characterize the effect of genetic variability on mechanisms of cognitive processing. As such its usage has potential for identifying functional markers of cognitive decline. The current study investigated the molecular pathways underlying cognition by assessing whether differences in geneotype are associated with both cognitive and functional differences amongst individuals for a relational memory task. Our present investigation focused on the effect of the naturally occurring genetic variation of catechol-O-methlytransferase (COMT), a gene involved in regulating prefrontal dopamine, which in turn modulates the response of prefrontal neurons. The expression of the COMT 'val' allele compare to the 'met' allele has been associated with poorer memory performance, reduced medial temporal lobe (MTL) recruitment and increased frontal recruitment during encoding and retrieval of item memory. While previous studies have used blocked designs, the current study uses event-related functional Magnetic Resonance Imaging (fMRI) to assess activity associated with successful relational memory performance at both an encoding and retrieval. Results revealed that the COMT 'val' allele is associated with decreased activity in left hippocampus and increased activity in frontal regions for successful encoding. A similar pattern is found for successful retrieval, with decreased MTL activity occurring bilaterally. Results suggest that the expression of the COMT gene can significantly influence functional activations during relational memory performance. Genetic modulation of encoding and retrieval networks may explain individual differences in memory performance and functional activations and serve as an indicator of early cognition decline.

G66

EFFECTS OF AGING ON NEURAL CORRELATES OF ITEM AND RELATIONAL MEMORY *Scott M. Hayes[1], Nancy A. Dennis[1], Steven E. Prince[1], Scott A. Huettel[1], David J. Madden[2], Roberto Cabeza[1]; [1]Duke University, [2]Duke University Medical Center* – Recent evidence suggests reduced neural specialization in category specific visual processing areas in older adults (OA; Park, 2004). In addition, OA show pronounced impairment in relational relative to item memory (Spencer & Raz, 1995; Zacks, Hasher, Li, 2000). Evidence for the neural correlates of age-related impairments in relational memory is sparse, and the neurobiological substrates of age-related memory changes are a topic of debate. Thus, there were two main goals of the current experiment: to investigate the effect of age on category specific brain regions such as the fusiform face area (FFA), occipital face area (OFA), and the parahippocampal place area (PPA) and to assess age-related changes in successful encoding (subsequent memory effect) of item (face, scene) and relational (face/scene) information. To address these issues, we presented pictures of faces, scenes, and face-scene combinations to YA and OA while undergoing functional Magnetic Resonance Imaging (fMRI). During face encoding, YA, relative to OA, exhibited greater activation in the FFA and OFA. Furthermore, successful face encoding was associated with greater activation in the FFA in YA relative to OA. Similarly, scene encoding and successful scene encoding elicited greater activation in the parahippocampal place area (PPA) in YA relative to OA. Finally, during relational memory encoding, YA showed greater activation in FFA, OFA, and PPA. Importantly, during successful relational encoding, greater hippocampal activation was observed in YA relative to OA. Overall, these results suggest that OAs' memory impairment could be attributed to reduced activation in stimulus specific processing areas and reduced hippocampal function.

G67

COGNITIVE CONTROL AND EPISODIC RETRIEVAL: ELECTROPHYSIOLOGICAL MEASURES OF THE COMPONENTS AND CONSEQUENCES OF SELECTIVE REMEMBERING *Brice Kuhl, Janice Chen, Anthony D. Wagner; Stanford University* – Episodic retrieval often involves selection of a target amidst interference from competing memories. One behavioral consequence of selective retrieval is the weakening, or suppression, of competing memories (Anderson, Bjork, & Bjork, 1994). In a previous fMRI study, we observed that repeated selective retrieval of target memories is associated with decreased engagement of frontoparietal structures known to mediate cognitive control. Moreover, dynamic changes in the engagement of frontoparietal cortices tracked the extent to which competing memories were suppressed; these rapidly emerging dynamic changes constitute immediate neural markers that a memory was suppressed. In the present study, electroencephalography (EEG) was used to assess the electrophysiological correlates of such dynamic changes in mnemonic competition that occur with repeated acts of selective retrieval. Behavioral data replicated the standard retrieval-induced forgetting effect, with practiced items recalled better than unpracticed items, and unpracticed "competitors" recalled more poorly than unpracticed baseline items. Initial EEG results indicate that changes in mnemonic competition that occur with repeated selective retrieval are reflected in the event related potentials (ERP's) over right frontocentral and left parietocentral sites. These ERP changes over frontocentral sites emerged early (within 200 ms) and were sustained throughout the act of selective retrieval, whereas changes over parietocentral sites onset later (after 300 ms), suggesting a frontally-mediated regulation of mnemonic competition that gives rise to target remembering and competitor suppression.

G68

THE EFFECT OF THE INFORMATIONAL VALUE OF FEEDBACK ON CAUDATE ACTIVATION *Elizabeth Tricomi[1], Mark E. Wheeler[2], Julie A. Fiez[2]; [1]California Institute of Technology, [2]University of Pittsburgh* – Although the caudate nuclei are involved in processing performance feedback, much remains to be known about which aspects of feedback processing determine activation in this region. For example, it is not known whether the amount of information carried by feedback affects caudate activation. To address this issue, brain activation was examined using functional magnetic resonance imaging (fMRI) during a feedback-based paired associate word learning task involving distinct trials with either two or four response options. Importantly, with two response options, positive and negative feedback provide equal amounts of information, since the correct answer can be determined from either feedback type. In contrast, with four response options, positive feedback provides more information than negative feedback because the correct answer cannot be deduced from negative feedback. Differential responses to positive and negative feedback were observed in the caudate nuclei in the 4-choice condition. However, responses to positive and negative feedback were not differential in the 2-choice condition and were similar in magnitude to the response elicited by positive feedback in the 4-choice condition. These results indicate that rather than simply reflecting whether feedback indicates a correct or incorrect response, the caudate signal is sensitive to the informational value of the feedback. This suggests that caudate activation is modulated by the degree to which the outcome of a response helps to achieve the individual's goal.

G69

TEMPORAL DYNAMICS OF CORTICAL ERPS DURING EPISODIC AND INCREMENTAL LEARNING *Janice Chen, Daphna Shohamy, Anthony Wagner; Stanford University* – Episodic memory and incremental learning depend on distinct "memory systems". Episodic memory – conscious memory for events – depends on the medial temporal lobe (MTL), whereas incremental learning – gradual acquisition of stimulus-response regularities through error-correcting feedback over multiple trials – depends on the basal ganglia (BG). Prefrontal cortex (PFC) interacts with both MTL and BG, and is thought to play an important modulatory role in both forms of learning. The present study investigated the temporal profile of electrophysiological responses over PFC during episodic and incremental learning using scalp-recorded EEG measures that permit fine-grained temporal assessment of stimulus-locked, response-locked, and feedback-locked ERPs. On each trial, subjects viewed a stimulus (a visual scene) and pressed a key to predict one of two outcomes ('dollar bill' or 'dollar coin'), followed by response-contingent feedback. Stimuli were either perfect predictors of an outcome (p=1.0) or probabilistic predictors of an outcome (p=0.7). Preliminary analyses of stimulus-locked ERPs revealed a bilateral frontal N400 effect that differentiated between correct vs. incorrect trials irrespective of associative condition. Feedback-locked ERPs also revealed a frontal negative-going response during error-correcting feedback; this negativity was greater on probabilistic than on deterministic trials, for both negative and positive feedback. Planned response-locked analyses will assess whether prospective signals over PFC that predict the response temporally shift over the course of learning to occur progressively earlier. Collectively, these distinct ERP effects suggest that modulatory mechanisms subserved by PFC contribute differentially to episodic and incremental learning.

G70

CONTRASTING ACTIVATIONS IN CORTICAL-HIPPOCAMPAL SYSTEMS DURING ENCODING AND MEMORY OF FACE NAME ASSOCIATIONS *Melissa Robinson[1], Jianli Wang[1], Qing Yang[1], Mark Meadowcroft[1], Xavier Golay[2], Paul Eslinger[1]; [1]Penn State College of Medicine, [2]Johns Hopkins University* – Introduction. We hypothesized that conditions of face-name encoding and recognition memory would engage distinctive regions of activation in visual association cortex. Neural network models of learning and memory suggest that sensory association and limbic system structures interact differently during learning and memory consolidation processes. In the case of face-name associations, we suspected that visual cortices would show some overlapping activation but also distinctive features for encoding and memory phases. Methods. Five healthy adults were presented novel face-name pairs during encoding blocks, followed by intervening baseline and memory recognition blocks. Each face was presented with 4 name choices during recognition. Data were collected in a Philips 3T magnet, with analysis via SPM2 software. Results. For both encoding and recognition memory phases, significant activation clusters were identified in primary and secondary visual cortices, hippocampus, and prefrontal cortex bilaterally, with the largest clusters in visual cortices. Contrast analysis revealed that the right fusiform gyrus and right hippocampus had significantly higher activity levels during encoding while the lingual gyrus bilaterally was significantly more active during recognition memory. Conclusion. Encoding and recognition memory of face-name pairs engaged a network of structures that included visual cortices, hippocampus, and prefrontal cortex bilaterally. Encoding was also associated with activation increases in the right anterior and posterior fusiform gyrus and the right hippocampus. In contrast, recognition memory was specifically associated with increased activity in the lingual gyrus bilaterally. Findings suggest that memory consolidation causes changes in visual cortex activity that can be distinguished from learning and perception.

G71

THE MATURATION OF FAMILIARITY AND RECOLLECTION IN EPISODIC MEMORY: AN ERP DEVELOPMENTAL APPROACH *Marianne de Chastelaine, David Friedman, Yael Cycowicz, Cort Horton, Brenda Malcolm; New York State Psychiatric Institute, NY* – Recognition memory is thought to be supported by two qualitatively distinct processes: an acontextual sense of familiarity and the retrieval of contextual details ('recollection'). Recollection is thought to show a longer developmental trajectory than familiarity. We employed ERPs to investigate the development of these two processes using unfamiliar and unnameable symbols. Children (9-10 years) and young adults (20-26) memorized the same 40 items in each of 4 study-test blocks. Symbols were always shown in the same spatial location: left/right of fixation during study and centrally during test. Adults' old/new and source (location) performance were superior to that of children. The mid-frontal episodic memory (EM) effect, the putative index of familiarity, observed only in adults, did not vary across the 4 test blocks. For both groups, an early (300-500 ms) and later (500-700 ms) parietal EM effect, the putative index of recollection, increased over test blocks in association with an increase in recognition and source performance. We suggest that, in adults, while familiarity initially appears to be the primary basis for the recognition judgment, recollection becomes increasingly relied upon as the memory traces strengthen, consistent with their increasingly liberal decision criteria across the 4 tests. In contrast, children appear to rely mainly on recollection to make this judgment concordant with their conservative decision criteria across tests, suggesting they responded 'old' only when they recollected information diagnostic of an item's memory status. We conclude that adults' superior performance reflects their flexible and interchangeable use of familiarity and recollection according to task demands.

G72

CATEGORY-SPECIFIC EFFECTS OF AUTOMATIC AND CONTROLLED SEMANTIC PROCESSING: AN EVENT-RELATED POTENTIAL INVESTIGATION OF NORMAL AND REVERSED SEMANTIC PRIMING EFFECTS *William C. Heindel[1], Victor V. Long[1], Elena K. Festa[1], Jason R. Taylor[2]; [1]Brown University, [2]University of California, Davis* – The N400 is influenced both by current semantic context held within working memory and by context-independent feature representations within semantic memory. The relative dependence of living and nonliving object concepts on these mechanisms was examined using a semantic priming paradigm that placed these mechanisms in direct opposition. Participants viewed prime-target word pairs (20% related) and made living/nonliving judgments to targets (50% living, SOA= 200 or 500ms). Semantic expectancy was manipulated by varying stimulus-set conditions (Low-Expectancy: large set, non-repeated; High-Expectancy: small set, repeated). Expectancy-based context effects should produce reverse priming due to the high likelihood that a living prime will be followed by a nonliving target (and vice-versa), whereas feature-overlap between related primes and targets should produce normal (automatic) priming despite the low relatedness proportion. In the Low-Expectancy condition, normal behavioral priming was found at the short SOA for living but not nonliving items, suggesting that priming for living items is mediated by automatic processes. Normal N400 priming effects were similarly observed for living but not nonliving targets. In the High-Expectancy condition, reverse behavioral priming was found at the long SOA for both living and nonliving items. While nonliving items displayed a reverse N400 effect paralleling the behavioral effect, living items continued to display a normal N400 effect. These results confirm the presence of two independent contributions to the N400, and suggest that living items are processed automatically on the basis of feature representations within semantic memory whereas nonliving items are dependent on controlled processing of semantic context within working memory.

G73

THE BENEFICIAL EFFECT OF AFFIRMATIVE RESPONSES ON EPISODIC MEMORY ENCODING *Bernhard Staresina, Lila Davachi; New York University* – It has been reported that items for which subjects provide an affirmative response during encoding tasks will be better remembered on subsequent memory tests than items given a non-affirmative response (Schulman, 1974; Craik and Tulving, 1975), and it has been suggested that this effect results from enhanced elaboration/relational encoding during congruent encoding trials. In order to further understand the processes supporting this mnemonic benefit, we used fMRI while subjects performed two different encoding tasks and compared brain activation for encoding trials given an affirmative response to those given a non-affirmative response. In one task (plausibility task), subjects were asked to decide whether a given word/color combination was plausible or implausible, while in another task (valence task), they were asked to indicate whether the combination was appealing or unappealing. After encoding, memory for the study words and related episodic details was assessed. The behavioral results replicate previous reports in showing that a greater proportion of affirmative responses from both tasks were later recognized compared to non-affirmative responses (both p's < .02). Furthermore, this effect was statistically more pronounced for hits accompanied with episodic detail (both p's < .005). Interestingly, initial fMRI analyses of the encoding trials reveal enhanced engagement during affirmative compared to non-affirmative responses in a set of brain regions including the anterior left inferior frontal gyrus (LIFG). Given the putative involvement of LIFG in controlled semantic retrieval, our data suggest that affirmative responses may enhance memory encoding by enhancing semantic elaboration or relational integration of each encoding unit.

G74

RELATIONSHIPS BETWEEN MEDIAL TEMPORAL VOLUME AND RECOGNITION TESTED WITH YES-NO AND FORCED-CHOICE FORMATS IN PATIENTS WITH MILD COGNITIVE IMPAIRMENT *Carmen E. Westerberg[1], Susan M. Florczak[1], Todd B. Parrish[1], Sandra Weintraub[1], M-Marsel Mesulam[1], Andrew R. Mayes[2], Paul J. Reber[1], Ken A. Paller[1]; [1]Northwestern University, [2]University of Manchester* – Recognition can be guided by recollection, which occurs when retrieval is sufficient to support the full experience of remembering an episode, or by familiarity, a restricted form of retrieval devoid of contextual recall. Both are thought to depend on the medial temporal lobe (MTL), but the contribution of specific MTL subregions to each is highly controversial. Recollection and familiarity may both rely on integrated processing across MTL subregions, or alternatively, distinct areas of the MTL may be specialized for different types of memory processing. We recently observed that in patients with mild cognitive impairment (MCI), a stage of increased memory loss preceding Alzheimer's disease, recollection is impaired but familiarity-based recognition is preserved. We tested forced-choice and yes-no recognition using silhouette object drawings with high target-foil resemblance, and theorized that forced-choice but not yes-no recognition could be mediated by familiarity alone. To investigate the neural basis of familiarity in MCI, we measured atrophy in MTL subregions, including entorhinal, perirhinal, and parahippocampal cortices and the hippocampus. These regions were drawn on structural MRI scans according to anatomical criteria, yielding volume measures for each region. Compared to age-matched controls, MCI patients exhibited impaired yes-no but not forced-choice recognition, indicating a preservation of familiarity-based recognition. Furthermore, across-subject correlations between forced-choice recognition and volumes of specific MTL regions implicated brain areas relevant for processing of familiarity signals. Results are discussed with respect to neurocognitive theories of recollection and familiarity, and to ideas about neural disruption responsible for memory deficits in MCI.

G75

NEURAL CORRELATES OF FAMILIARITY-BASED ASSOCIATIVE RECOGNITION: EFFECTS OF UNITIZATION DURING ENCODING *Andy Haskins[1], Andy Yonelinas[1], Joel Quamme[2], Charan Ranganath[1]; [1]University of California at Davis, [2]Princeton University* – Recognition memory can be supported by assessing the familiarity of an item, and by the recollection of associated information. Recent data from neuroimaging, human amnesics, and animal models suggest that the perirhinal cortex encodes representations that support familiarity-based item recognition, whereas the hippocampus encodes representations that specifically support recollection. However, some findings suggest that the perirhinal cortex may be sufficient to support associative recognition under some circumstances. Although associative recognition relies heavily on recollection, there is evidence that familiarity can support associative recognition when items are encoded as a single coherent unit, or "unitized". Here, we tested the hypothesis that the perirhinal cortex can support familiarity-based recognition of unitized associations. Functional magnetic resonance imaging (fMRI) was used to examine brain activity while participants performed two encoding tasks: one in which they encoded noun-pairs as a single compound noun ("unitized"); and another in which they encoded the pairs as separate lexical units in a sentence ("non-unitized"). Analysis of behavioral data from the subsequent associative recognition test showed that unitization disproportionately increased familiarity ratings, with little increase in recollection. fMRI analyses identified a region in left perirhinal cortex that was more active for unitized trials and where encoding activity monotonically increased with subsequent familiarity ratings. Critically, activation in this region was predictive of subsequent familiarity ratings, but not recollection. This finding is consistent with the idea that perirhinal cortex encodes item representations that can support familiarity-based recognition of unitized associations.

G76

AN FMRI STUDY OF AGING AND QUALITATIVE CHARACTERISTICS OF MEMORIES *Suzanne M. Bloise, Karen J. Mitchell, Carol L. Raye, Erich J. Greene, Shannon M. Turbidy, Marcia K. Johnson; Yale University* – We investigated age-related differences in memory for complex pictures and associated neural activity using fMRI and objective and subjective memory measures. In an incidental encoding task, older (n = 13) and younger (n = 16) participants studied a set of complex photographs accompanied by short descriptive labels. Following a brief delay, participants saw a list of studied and new labels and made three judgments of subjective experience about their memory for each item - old/new, perceptual detail, and feelings/reactions - using a Memory Characteristic Questionnaire (Johnson et al., 1988). Participants were scanned during study and test. Younger and older adults showed different patterns of neural activity at test associated with rating perceptual information and emotional information. We compare correlations between brain activity during encoding and during remembering with subjective memory ratings for younger and older adults and discuss the implications of these correlations for age differences in the subjective experience of remembering.

G77

CAN FORCED-CHOICE RECOGNITION PERFORMANCE BE SUPPORTED BY IMPLICIT MEMORY? *Ken A. Paller[1], Joel L. Voss[1], Carol L. Baym[2]; [1]Northwestern University, [2]University of California, Davis* – Explicit memory can be assessed using yes-no and forced-choice recognition tests. However, memory-impaired patients who perform poorly on yes-no tests can sometimes succeed on forced-choice tests with similar foils. These findings have been taken to indicate that familiarity-based recognition is intact in these individuals. Can forced-choice recognition in these circumstances be supported by fluency-related implicit memory? Under this scenario, when a studied item is presented simultaneously with similar foils, fluent processing might provide a cue to select the old item, irrespective of experiences of recollection or familiarity. We examined recognition of kaleidoscope images in two experiments using an attentional-load manipulation during encoding (concomitant auditory N-back odd/even judgments). Prior results suggest that such manipulations can impact both recollection and familiarity, but sometimes not implicit memory. Encoding under divided-attention compared to full-attention conditions produced a drastic reduction in yes-no recognition and, remarkably, an enhancement in forced-choice recognition. This crossover interaction could not result merely from differential sensitivity of recollection and familiarity to attentional load at encoding. With poor encoding, subjects may alter strategies at test to preferentially rely on implicit memory or fluency signals. We cannot rule out the possibility that poor encoding also influences the type of information available at test. When nameable objects were used in a third experiment, yes-no performance was disproportionately diminished by attentional load. The crossover interaction, however, was restricted to kaleidoscope recognition, suggesting that a potential role for implicit memory in recognition performance may be restricted to special circumstances.

G78

BRAIN REGIONS INVOLVED IN THE RETRIEVAL OF SPATIAL VERSUS NONSPATIAL INFORMATION IN EPISODIC AND SEMANTIC MEMORY: AN FMRI STUDY *Siobhan Hoscheidt[1], Jessica Payne[2], Lee Ryan[3], Lynn Nadel[3]; [1]University of Arizona, Tucson, AZ, [2]Harvard University, Boston, MA, [3]University of Arizona, Tucson, AZ* – The hippocampus is thought to be critical for episodic but not semantic memory retrieval. This difference may arise due to the confounding influence of spatial context. To examine the role of the hippocampus in the retrieval of spatial context, we experimentally varied spatial information in a semantic and episodic memory retrieval task. Subjects (N=18), aged 20-30, recalled 30 autobiographical events during an interview. A week later, during an fMRI scan, participants answered "True/False" questions regarding autobiographies and world knowledge. Varying spatial content of semantic and episodic items yielded 4 conditions: Spatial episodic, Nonspatial episodic, Spatial semantic, and Nonspatial semantic. Images were collected on a General Electric 3.0T Signa VH/i scanner, 30 axial sections covering whole brain, 4mm skip 0, TR=2040, TE=30ms, FOV=240. Data were analyzed using SPM99. Spatial compared to nonspatial conditions yielded greater hippocampal activation regardless of memory type. These results are consistent with the notion that the hippocampus participates preferentially in the retrieval of spatial compared to nonspatial information and suggests that this is true for both episodic and semantic memory. However, within the hippocampus differences were observed between memory conditions; episodic retrieval eliciting activation in the posterior hippocampus and semantic retrieval eliciting activation in anterior hippocampus. Other regions showed differential activation during spatial and nonspatial retrieval in episodic but not semantic memory tasks. These regions include the left parahippocampal gyrus, medial frontal gyrus, precuneus, and anterior cingulate. Activation observed in the latter three regions was left lateralized for nonspatial retrieval and bilateral during retrieval of spatial information.

G79

TRIAL-BY-TRIAL COMPUTATIONAL MODEL OF CATEGORY LEARNING APPLIED TO FMRI DATA *Emi Nomura[1], W. T. Maddox[2], D. R. Gitelman[1], T. B. Parrish[1], M. M. Mesulam[1], P. J. Reber[1]; [1]Northwestern University, [2]University of Texas, Austin* – Visual category learning can be accomplished in a number of different ways depending on the category structure. In rule-based (RB) learning the categories are defined by a verbalizable rule. In information-integration (II) learning the category definition is less verbalizable and depends on integrating 2 or more stimulus dimensions. Whole-brain event-related fMRI of these learning processes revealed distinct neural correlates in the MTL and the posterior caudate here (31 participants; 3T GE MRI, TR=2000ms, TE=25ms, 40 3mm axial slices) and in a previous study (Nomura et al., 2006) during successful RB and II category learning, respectively. These structures are also components of a cognitive model of category learning: the COVIS model (COmpetition between Verbal and Implicit Systems) proposed by Ashby (Ashby, Alfonso-Reese et al. 1998). In this model, 2 learning systems compete to provide a response: an explicit, rule-based system dependent upon working memory and attention; and an implicit, procedural learning system. To test the psychological reality of this model, we developed a computational model based on COVIS that attempts to represent the cognitive state of the participant on every trial. The model assumes that both RB and II systems attempt to learn the categories, so within a given subject, trials (and associated fMRI activity) can be selected that more cleanly reflect an RB or II strategy. By combining fMRI and computational modeling in this way, we are attempting to make the connection between cognitive models of behavior and specific neural representations.

G80

NEURAL CORRELATES OF DECISION-MAKING DURING FACE RECOGNITION *Itamar Kahn[1,2], Randy Buckner[1,2]; [1]HHMI at Harvard University, [2]Martinos Center for Biomedical Imaging, MGH* – Recognition memory depends on the medial temporal lobe and is supported by processes associated with the recovery of information from memory. However, neuroimaging studies have also demonstrated that retrieval is accompanied by activation in prefrontal cortex, and lateral and medial parietal cortices that may play a role in integrating such information during memory decisions. This possibility motivated the present effort to characterize the relation between memory and such modulatory and decision-making processes. In the current study, we used fMRI (n=37; 3T 12-channel coil) to assess the contribution of cortical regions to recognition of previously encountered faces. At encoding, participants made female/male gender judgment about presented novel faces. Following a 15-min retention interval, a surprise recognition memory test for the studied faces was administered. At test, participants were required to make recognition memory judgments by pressing one of four buttons providing a sliding scale of how confident they were the face was encountered previously. The neural data were assessed for effects of recognition memory, graded neural responses correlated with the subjective perception that faces are old, and judgment confidence. Results revealed that lateral and medial parietal responses are sensitive to the subjective perception that the faces are old. In contrast, prefrontal responses, along the anterior end of the inferior frontal gyrus were sensitive to confidence, but not memory status of the faces. These results indicate that the parietal cortex and prefrontal cortex differentially contribute to recognition memory decisions. Supported by: HHMI.

G81

LEFT FRONTAL CORTEX ACTIVITY DURING TASK IRRELEVANT STIMULUS REPETITION: AN OPTICAL IMAGING AND ELECTROPHYSIOLOGICAL ANALYSIS *Trevor Penney[1], Chun-Yu Tse[2], Kwun-Kei Ng[3], Ming Lui[4]; [1]National University of Singapore, Singapore, [2]University of Illinois at Urbana Champaign, [3]The Chinese University of Hong Kong, SAR, [4]Northwestern University* – Stimuli are typically classified more quickly on second, as compared to first, presentation. FMRI experiments indicate that this behavioral priming effect is accompanied by reductions in neural activity across a range of cortical areas including the prefrontal cortex and electrophysiological studies reveal that stimulus repetition elicits increased positivity in the event-related potential (ERP) waveform. Proposed accounts for the repetition effect include that it reflects tuning of neural representations and that it is a consequence of rapid learning of previous responses. To examine the spatial and temporal characteristics of the repetition suppression phenomenon, we simultaneously recorded the event-related optical signal (EROS), a measure of the phase changes that occur in frequency modulated near-infrared light as it passes through activated brain tissue, from the left frontal cortex and ERPs from midline electrode sites while participants performed a stimulus classification task. Specifically, participants classified pictures of objects according to whether or not their real-world equivalents were longer than one meter. Two thirds of the stimuli were repeated and these repetitions were either immediate (50%) or followed a lag of 3-6 pictures. Preliminary analysis of the optical data from twelve participants, collapsed over immediate and lagged repetitions, revealed that stimulus repetitions elicited reduced left frontal activity from 350 to 400 ms after stimulus onset. We have subsequently recorded data from an additional 16 participants and will present analyses of immediate and lagged repetitions as well as analyses of the correspondences between reaction time, EROS, and ERP measures.

G82

EVENT-RELATED FUNCTIONAL-MRI SHOWS ACTIVATION OF COMMON NETWORKS FOR PERSON IDENTITY WITH FACES AND NAMES *Kristy A. Nielson[1,2], William L. Gross[2], Amelia Gander[2], Leslie Guidotti[3], John L. Woodard[3,2], Michael Seidenberg[3,2], Sally Durgerian[2], Stephen M. Rao[2]; [1]Marquette University, [2]Medical College of Wisconsin, [3]Rosalind Franklin University of Medicine and Science* – This study examined the functional networks associated with processing faces and proper names, and how those networks are distinguished by semantic processing for person identity. Twenty healthy adults (10 female; age = 27.6 years, s.d. = 6.71; education = 17.1 years, s.d.=2.4) performed a person recognition task consisting of 100, 3.8 s, randomly ordered trials including 25 famous names, 25 unfamiliar names, 25 famous faces and 25 unfamiliar faces. Thirty-six contiguous 4-mm axial echo-planar images were collected at 3.0 T (TR = 2 s; TE = 25 ms; flip angle = 77 degrees; FOV = 24 mm; matrix 64x64) with SPGR anatomic co-localization. Deconvolution analysis extracted a hemodynamic response function for each stimulus type, allowing area-under-the-curve analysis (4-8 s post-stimulus) by ANOVA between conditions. Although there were activation similarities, faces produced greater activation than names principally in right hemisphere regions (e.g., lateral occipital, inferotemporal and medial frontal), while names produced greater activation than faces in extensive left and bilateral regions (e.g., bilateral medial occipital and fusiform, bilateral hippocampal, and left superior and inferior parietal, temporal-parietal junction, insula, and prefrontal gyri). Famous stimuli of either type produced greater activation than unfamiliar stimuli in the bilateral posterior cingulate, left superior and medial frontal gyri, left temporal pole, right middle temporal gyrus, right hippocampal region, left insula, and the left temporal-parietal-occipital junction. Few interactions resulted between stimulus conditions. The study supports differential pre-semantic processing of faces and names, but common processing for accessing the semantic associations of person identity.

G83

IMPAIRED CATEGORY LEARNING IN PATIENTS WITH DAMAGE TO PREFRONTAL CORTEX *David Schnyer[1], Shawn Ell[2], Sarah Davis[3], Todd Maddox[1], Mieke Verfaellie[3]; [1]University of Texas, [2]University of Maine, [3]Boston VA Healthcare System and Boston University School of Medicine* –

Previous research has demonstrated that patients with damage to the basal ganglia are impaired at rule-based (RB) category learning due to the inefficient application of decision strategies (Ell, et al, 2006). While BG structures play a demonstrated role in category learning, the effective implementation of decision rules has also been shown to be critically dependent on regions of prefrontal cortex. The current study examined the role of prefrontal cortex in category learning. Six non-amnesic patients with damage primarily to medial prefrontal regions were found to be significantly impaired both in the rate of category learning as well as the overall level of learning relative to matched controls. Additionally, this impairment was found to extend to both the rule based (RB) learning, previous demonstrated to be impaired with BG damage, and that based on perceptual information integration (II). These results demonstrate that in addition to the BG, the prefrontal cortex also plays a critical role in the acquisition and implementation of new category learning. Work continues with additional medial and laterally damaged frontal patients in order to more fully understand possible dissociations in the structure/function relationships between RB and II category learning.

G84

MEMORY ENHANCEMENT BY REWARD DEPENDS ON REWARD FEATURES *Bianca Wittmann[1], Emrah Duzel[2,3]; [1]Wellcome Department of Imaging Neuroscience, Institute of Neurology, University College London, [2]Institute of Cognitive Neuroscience, University College London, [3]Otto von Guericke University, Magdeburg* – Items associated with monetary reward have been shown to elicit higher episodic memory performance. To investigate the features of rewarding events that are relevant for this memory enhancement, we used two paradigms that differed in the cue character of the study stimuli. 150 neutral words were presented in each study, followed by a potentially rewarded number comparison task. One third of the trials were associated with no reward, _0.20, or _0.40, respectively. Participants received feedback after each rewarded trial. In the first paradigm, the reward status of each trial was indicated by the color of the study word, and participants made a living/object judgement on the word to ensure deep encoding. In the second paradigm, the reward status was indicated by the semantic category of the word, which was indicated by the participants. One day later, memory for all words was tested using a remember/know procedure. In the first paradigm, there was no improvement of either recognition or recollection by either of the reward magnitudes. In the second paradigm, reward increased both recognition and recollection, and increasing reward was associated with increasing memory performance. These data indicate that the strength of the association between the study stimulus and the upcoming reward determines the memory effects of reward, and that the magnitude of the memory improvement relates to the magnitude of reward.

G85

MODELING WORKING MEMORY SPAN WITH AN ATTRACTOR NEURAL NETWORK *Scott Weems[1], Ransom Winder[2], Michael Bunting [1], James Reggia[2]; [1]University of Maryland, [2]University of Maryland* – Working memory capacity is limited to roughly four items, although capacity varies with individual, as well as with the efficacy of the working memory task to minimize articulatory rehearsal. The goal of the current work is to measure working memory capacity in a computational model performing a simulated running memory span task, in which rapidly presented letters are retained for later recall. Running memory span is particularly useful because it provides a memory capacity measure generally free of rehearsal. Unlike previous modeling efforts that use a local representation and competitive inhibition to induce capacity limitations, our auto-associative model uses a distributed representation and activity decay. Memory limitations in the model stem from both limited model size (i.e., number of nodes relative to number of items to be stored), as well as rapid decay of connection weights between nodes. These features are intended to mirror capacity limitations due to memory interference and forgetting in humans, respectively. Model results resemble performance in humans collected separately, with strong retention for recent items but capacity limitations reducing availability for older items. We conclude that limited network size and decay interactively influence memory capacity, suggesting that working memory capacity limitations in humans are an inherent trait of a distributed representation when the representation is subject to interference and forgetting.

Memory: Other

G86

SLEEP AND MEMORY CONSOLIDATION FOR SEMANTICALLY-RELATED VERSUS UNRELATED WORD PAIRS *Jessica Payne[1,2], Matthew Walker[2], Jeffrey Ellenbogen[2], Daniel Schacter[1], Robert Stickgold[2]; [1]Harvard University, [2]Harvard Medical School* – Whether sleep influences the consolidation of declarative memory is of interest to both the sleep- and memory-research communities. Recent studies suggest that sleep plays a beneficial role in the consolidation of verbal declarative memories. However, these studies typically test memory after 3 hours of early-night sleep, or after 3 hours of late-night sleep (e.g. Plihal and Born, 1997, 1999). Few verbal memory studies have shown that declarative memory is facilitated across an entire night of sleep. Plihal and Born (1997, 1999) used a paired-associate list-learning task in which the word-pairs were semantically related to one another. Here, we compared performance on these original, semantically-related word-pairs to performance on a matched list of unrelated word-pairs after 12 daytime hours spent awake, 12 nighttime hours containing a full night of sleep, or after 24 hours as a circadian control. Interestingly, participants recalled significantly more unrelated words after a period of sleep than after an equivalent period of wake. Thus, while verbal declarative memories appear to benefit from a full night of sleep, it was the semantically unrelated words that showed the greatest enhancement. Our results suggest that sleep might benefit new semantic relationships, and the consolidation and integration of these relationships into pre-existing neocortical memory stores.

G87

EMOTIONAL MEMORY DISRUPTION FOLLOWING PREFRONTAL TRANSCRANIAL MAGNETIC STIMULATION *Katherine Vytal[1], Charles Epstein[2], Andrew Ehrenberg[2], Stephan Hamann[1]; [1]Emory University, [2]Emory University School of Medicine* – Evidence from functional magnetic resonance imaging and lesion studies implicates the left prefrontal cortex (PFC) in positive emotion processing and the right PFC in negative emotion processing (Davidson, 1999). We used transcranial magnetic stimulation (TMS) to examine the effect of transient inactivation of the left or right dorsolateral PFC (DLPFC) on memory encoding for positive and negative words. We predicted that stimulation of the right DLPFC would interfere with processing of negative emotion and thus reduce the memory enhancement typically observed for negative emotional stimuli. We also predicted that stimulation of the left DLPFC would reduce the memory enhancement typically observed for positive emotional stimuli. Subjects viewed lists of emotional and neutral words presented in different quadrants of a computer screen. At 200ms and 350ms post-stimulus onset, participants were stimulated (110% motor threshold) at three different sites: left DLPFC, right DLPFC, or vertex. Free recall, recognition, and source memory (item location) were tested after each list. Consistent with predictions, the expected emotional memory effect for negative words was found for stimuli encoded during vertex TMS, but was absent following right and left DLPFC stimulation. Enhanced emotional memory for positive words observed during vertex TMS and was reduced following left DLPFC stimulation but not right DLPFC or vertex stimulation. These findings are broadly consistent with theories emphasizing prefrontal emotion-related hemispheric asymmetries and suggest that TMS can interfere with emotional episodic memory encoding.

G88

RELATIONAL ENCODING LEADS TO GREATER ENGAGEMENT OF PREFRONTAL CORTEX IN LOWER THAN HIGHER-PERFORMING ELDERLY *Eric Leshikar[1], Angela Gutchess[2], Andrew Hebrank[1], Bradley Sutton[1], Robert Welsh[3], Denise Park[1]; [1]University of Illinois-Urbana-Champaign, [2]Harvard University, [3]University of Michigan* – The present study examined the impact of task difficulty during encoding on neural activations in older adults. Eighteen elderly adults incidentally encoded 120 pairs of line-drawings in an event-related fMRI design. Objects in each pair were either semantically related or unrelated, and subjects were instructed to form associations between the two items using a sentence integration task. For the unrelated condition, both groups exhibited poorer behavioral performance in the integration task, and poorer subsequent recognition of the unrelated pairs, relative to the related pairs, demonstrating that the unrelated task was more difficult. A median split based on recognition accuracy was used to divide the elderly into performance groups. Using a random effects analysis, neural activations associated with unrelated items were contrasted with related items. The lower-performing elderly exhibited bilateral anterior prefrontal and left dorsolateral prefrontal activity to a greater extent than the higher-performing elderly for the encoding of unrelated compared to related pairs. The higher-performing group showed no significant activation greater than that of the lower-performing group. In contrast to previous findings, increased cortical recruitment was associated with lower-performing and not higher-performing older adults. The results suggest that increased activity in frontal areas is compensatory, and that the initial level of ability of a subject combined with task difficulty may determine whether compensatory circuitry is activated by higher- or lower-performing elderly. In this case, it appears the semantic integration task was not so challenging that higher ability elderly required compensatory neural activity to perform it, unlike the lower ability elderly.

G89

AN EEG STUDY OF IMPLICIT LANDMARK RECOGNITION DURING VIRTUAL NAVIGATION *Matthew Mollison, Joshua Jacobs, Igor Korolev, Michael Kahana; University of Pennsylvania* – We studied implicit landmark recognition by having participants take on the role of a taxi driver in three-dimensional virtual reality (VR) environments. During the task, electrical activity on the scalp was measured at 128 locations while we recorded their navigation throughout the environment. Event-related potentials (ERPs) were calculated for a time period surrounding the appearance of target and non-target locations on the computer screen, showing the cortical activation during the implicit recognition of these landmarks. Statistical tests reveal that scalp-recorded stimulus-locked voltage fluctuations are significantly more positive in the left parietal area of the scalp during the viewing of target (match) as opposed to non-target (mismatch) locations, and in the right frontal area with mismatch voltage being greater than that of match events, with a deflection in the ERP waveform beginning at approximately 400--500 ms. The topographies of the match/mismatch recognition modalities seen here are similar to the those first described in Squires et al. (1975) for the P300 recognition effect. Bayliss & Ballard (2000) found a P300 recognition effect over a centro-parietal site in a VR task, and building on this literature, we believe that we are seeing the same effect. Our findings provide evidence for significant differences in neural activity between two related, but functionally different, conditions in a complex spatial navigation task.

G90

THE DEFAULT MODE ENIGMA: ACTIVITY IN LATERAL PARIETAL AND POSTERIOR MIDLINE REGIONS IS BENEFICIAL FOR EPISODIC RETRIEVAL BUT DETRIMENTAL TO ENCODING *Steven Prince[1], Sander Daselaar[2], Roberto Cabeza[1]; [1]Duke University, [2]University of Amsterdam* – The posterior midline region (PMR) and lateral parietal cortex (LPC) tend to show deactivation during demanding cognitive tasks, and have been associated with the default mode of the brain. Understanding when default regions are activated and deactivated clarifies the processes comprising the default mode. Interestingly, PMR and LPC activity has been associated with successful episodic retrieval but also with unsuccessful episodic encoding. These findings suggest that successful retrieval is a component of the default mode of the brain, but successful encoding is not. Here, we directly tested the prediction that PMR and LPC would be more activated for hits than for misses during retrieval but less activated for subsequent hits than for misses during encoding. In four different fMRI experiments using faces, scenes, word pairs, and single words we found reliable phase (encoding/retrieval) x success (hit/miss) interactions in both PMR and LPC. Confirming our prediction, during encoding, activity in these regions was greater for subsequent misses than for subsequent hits, whereas during retrieval, activity was greater for hits than for misses. The results suggest that successful retrieval is a component of the default mode whereas successful encoding is not. In fact, successful encoding is associated with a disengagement from the default mode. These findings have direct implications for current memory models, and clarify the function of a component of the default mode network. Currently, individual trial correlation analyses separated by mnemonic outcome (hit vs. miss) are being conducted to shed more light on default mode connectivity during encoding and retrieval.

G91

CAN YOU FORGET ANYTHING YOU WANT? ERP CORRELATES OF DIRECTED FORGETTING OF UNPLEASANT WORDS *Anne Hauswald, Johanna Kissler; University of Konstanz* – Directed forgetting experiments show 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 both behavioural and electrophysiological measures (ERPs), we address the question whether the costs and benefits of intentional forgetting can be found with emotionally unpleasant material. EEG was recorded from 64 channels while 22 subjects learned four lists of words varying in emotional content (neutral or unpleasant). F-lists consisted of negative words and were followed by R-lists of neutral words. A control condition included two R-lists, the first consisting of unpleasant, the second of neutral words. Directed forgetting occurred in spite of the unpleasant content of the words. Additionally, ERPs recorded during learning displayed an enhanced sustained central negativity between 850 and1250 ms when a list was preceded by an R-list which had to be held in memory. This effect was absent for lists learned after the F-lists which subjects did not have to keep in memory. Thus, in normal volunteers directed forgetting can extend to emotionally unpleasant contents, resulting both in forgetting of the unpleasant material learned and enhanced memory of subsequently learned material. The ERP results suggest that availability of memory capacity can explain the benefits.

G92

DO MEN AND WOMEN USE DIFFERENT STRATEGIES FOR LARGE-SCALE ENVIRONMENTAL LEARNING? *Amy Shelton; Johns Hopkins University* – Sex differences in spatial skills have long been reported in the literature (Montello et al., 1999). However, in large-scale environmental learning, we have found only limited evidence for differences between men and women in behavioral performance (Fields & Shelton, 2006; Shelton & McNamara, 2004). The present study explored whether the similarity in behavioral performance should be taken as evidence against sex differences, or if the similarity might be due to the use of different but equally effective encoding strategies (Lawton, 1994,1996; Pazzaglia & DeBeni, 2001). During fMRI scans, participants learned two different large-scale virtual environments from the ground-level and aerial perspectives. Overall, the different encoding conditions replicated previously observed brain distinctions. The brain activation patterns for men and women were contrasted for each encoding type and control conditions. Despite finding no sex differences in the post-scan memory performance, results revealed significant differences between men and women in the activation of prefrontal, parietal, and medial temporal lobe structures. Moreover, these sex differences varied for ground-level and aerial encoding conditions, supporting hypotheses about strategies and spatial preferences. Measures of individual differences on other spatial skills were also related to activation differences in these regions, but they could not account for all of the observed sex differences. The findings weigh in on sex difference in spatial skills but also address the more general notion of having equivalent alternative strategies for learning.

G93

UNDERSTANDING DOPAMINE FUNCTION IN COGNITIVE SEQUENCE LEARNING: DISSOCIATION BETWEEN SEQUENCE LEARNING AND WORKING MEMORY LOAD *Monica Andrawis[1], Catherine Myers[1], Martin Guthrie[1], Mauricio Delgado[1], Mark Gluck[1], Daphna Shohamy[2,3]; [1]Rutgers University-Newark, [2]Stanford University, [3]Columbia University* – Electrophysiological studies suggest that dopamine neurons respond to unexpected rewards and cues that predict reward. This dopamine response shifts backwards in time to signal the earliest predictor of reward among a sequence of stimuli. Parkinson's disease (PD) involves loss of dopaminergic neurons and may therefore disrupt learning to predict rewards based on a sequence of stimuli. Previous studies have shown that unmedicated PD patients are impaired at learning a sequence of stimuli (doors in colored rooms) that leads to a reward, and their impairment increased with increasing sequence lengths. One question is whether this deficit reflects a problem with sequence learning, or with working memory. Additionally, in the original task, punishment may have been inadvertently provided for wrong responses during intermediate phases, rather than being withheld until the end of the sequence. Here, we have revised the task to dissociate sequence length from memory load components of the task and to withhold all feedback until the end of the sequence. In healthy young adults the revised task was no more difficult than a control version with equivalent working memory load but no sequence learning. There was no correlation between sequence learning and dopamine function estimated by Cloninger's Tridimensional Personality Questionnaire (TPQ). This suggests that PD patients' deficit on the prior task may have been due to impairments in working memory rather than chaining. Future studies are planned to test PD patients on this task to investigate their ability to learn a sequence in the absence of intervening feedback.

G94

HUMAN ENTORHINAL NEURONS ENCODE ROUTE INFORMATION *Joshua Jacobs[1], Michael Kahana[1], Arne Ekstrom[2], Matthew Mollison[1], Itzhak Fried[2]; [1]University of Pennsylvania, [2]University of California, Los Angeles* – This work studies the neuronal correlates of route navigation in humans. We recorded single-neuron activity from epilepsy patients while they played Yellow Cab, a spatial-navigation video game. In this variant of Yellow Cab, subjects used a handheld joystick to drive between randomly selected stores arranged on the outside of a square track. The center of this track was closed, limiting movement to either clockwise or counterclockwise directions. We compared the activity of each neuron with the subject's simultaneous behavior in the task. We identified neurons that were preferentially active during a particular movement direction (e.g., a "clockwise cell" had a greater firing rate when the subject was driving in a clockwise direction than when they were driving in a counterclockwise direction). These cells were especially prevalent in the entorhinal cortex (EC). These findings indicate that the EC plays an important role in route-based navigation, and supports the idea that the EC plays a general role in cognition by representing contextual information.

G95

AN EXPLORATION OF DECISION PROCESSES USING PROLONGED RECOGNITION TASKS *Elisabeth Ploran[1], Steve Nelson[2], David Donaldson[3], Steve Petersen[2], Mark Wheeler[1]; [1]University of Pittsburgh, [2]Washington University at St. Louis, [3]University of Stirling* – Recognition requires the gradual accumulation of evidence in support of memory decisions, yet is often associated with the experience of a sudden insight or realization. We examined activity associated with the moment of recognition, and the time course of activity leading up to recognition. Masked word and picture items were revealed gradually over 14 seconds and subjects responded with a button press at the moment they could identify the items. Subjects verified their earlier recognition decision with a second button press at the end of the trial. Recognition decisions were spread across a relatively wide temporal window to account for the low temporal resolution of fMRI. We compared within-trial recognition and verification events to identify regions that were more active during the moment of recognition than verification. We then sorted trials based on the time of recognition and extracted time courses over the entire length of the trial. Using a hierarchical cluster analysis, we found three notable patterns of activity. First, activity in some visual regions increased gradually as the amount of visual information increased, peaking activity near the end of the trial regardless of recognition timing. Second, activity in bilateral inferior parietal lobe, thalamus, and precuneus gradually increased up to the point of recognition. Third, bilateral anterior insula / frontal operculum, anterior cingulate, and caudate showed transient activity at recognition. The findings indicate three distinct neural processes related to recognition: perceptual accumulation, evidence accumulation, and the moment of recognition.

G96

WHEN UNWANTED MEMORIES INTRUDE: REACTIVE CONTROL OVER STOPPING RETRIEVAL *Benjamin J. Levy, Michael C. Anderson; University of Oregon* – Preventing an unwanted memory from entering awareness makes that memory harder to recall later (Anderson & Green, 2001). This finding has been explained by the recruitment of executive control mechanisms that inhibit the avoided memory and make it less accessible. Subjects frequently report, however, that on some trials they fail at this suppression task and the unwanted memory “intrudes” into conscious awareness. Here we investigate how these “intrusions” relate to successful inhibition by adapting the “think/no think” (TNT) procedure. Specifically, after each trial we had subjects report to what extent the corresponding memory came to mind. In Exp. 1, we found that subsequent memory impairment was predicted by the rate at which subjects’ intrusions declined in frequency with practice at suppressing these memories. This suggests that the ability to down-regulate intrusions may be key to successful inhibition. In Exp. 2, we attempted to manipulate the frequency of intrusions by varying the prepotency of the to-be-suppressed memory. As expected, strengthening initial learning successfully increased the frequency of intrusions. Finally, in Exp. 3 we used fMRI to identify the neural markers of the intrusion experience, allowing us to characterize the pattern of activity related to both successful inhibitory control and failed inhibitory control for control-related regions (e.g., lateral prefrontal cortex) and neural targets of suppression (e.g., hippocampus).

G97

THE EXPRESSION OF HIPPOCAMPALLY-DEPENDENT LEARNING IN NREM SLEEP AND ITS RELATION TO SLEEP MENTATION *Erin J. Wamsley, John S. Antrobus; The City College of New York* – Despite accumulating evidence that consolidation of declarative memories is facilitated by the neural “replay” of experiences during sleep, little empirical work has addressed the speculation that dreaming may represent a cognitive component of this memory consolidation. Here, we experimentally induced hippocampally-mediated memory reactivation during NREM sleep and observed the effects of this manipulation on EEG and heart-rate conditioned responses (CR’s) as well as on dream content. “Trace” conditioning is a hippocampally-dependent task which provides a simple model of declarative memory. In contrast, traditional “Delay” conditioning is not hippocampally dependent. Prior to sleep, subjects underwent either Trace or Delay differential auditory fear conditioning. The conditioned stimulus cue (CS+) and control cue (CS-) were then presented to subjects during stage 2 NREM sleep. Dream reports were elicited following each cue presentation. Both Delay-conditioned and Trace-conditioned participants exhibited conditioned responses (CR’s) during post-training sleep. Brief (<5 sec) EEG arousals were more likely to occur in response to the CS+ than to the CS- in both Trace and Delay participants ($F_{1,35}=6.21$, $p=.02$). Delay participants also exhibited conditioned heart rate acceleration ($t_{18}=2.14$, $p=.04$, post-stimulus beats 4-6), whereas Trace participants exhibited conditioned K-complex responses ($t_{17}=2.05$, $p=.05$). In Trace-conditioned participants, where CR’s were hippocampally-mediated, dreamed emotions were significantly more negative in response to the CS+ as compared to the CS- cue on early trials ($t_{17}=2.66$, $p=.02$). These findings strongly support the hypothesis that hippocampally-dependent declarative learning can be accessed during NREM sleep, and suggest that hippocampally-mediated memory reactivation directly influences qualitative characteristics of ongoing sleep mentation.

G98

SLEEP DEPENDENT CONSOLIDATION OF SEMANTIC AND NON-SEMANTIC DECLARATIVE INFORMATION: THE IMPORTANCE OF ADEQUATE ENCODING *Matthew Tucker, William Fishbein; The City College of New York* – The present study examined the effect of a daytime nap containing exclusively non-REM sleep on semantically unrelated paired associates and two non-semantic declarative memory tasks (the Rey-Osterrieth complex figure task and a spatial maze learning task). Additionally, for the paired associates task we assessed depth of stimulus encoding as a modulator of the effect of sleep on memory – 1/3 of the word pairs were studied with immediate retest (“tested” word pairs), while the remaining word pairs were studied without immediate retest (“studied” word pairs). The results show that recall of studied word pairs was similar for nap and wake subjects ($p=.2$). However, for tested word pairs nap subjects showed a significant improvement in performance compared to wake subjects ($p=.02$). Overall, nap and wake subjects demonstrated similar improvement on the two non-semantic declarative memory tasks. However, performance on both tasks was enhanced after a nap if subjects encoded the tasks strongly (<50th percentile) during the learning session (p values<.05). This encoding effect was also observed for the paired associates task ($p<.05$). Overall, the results indicate that NREM sleep facilitates performance on semantic and non-semantic declarative memory tasks if information is adequately encoded prior to sleep, either through immediate testing (as with the paired associates task), or through other possible factors (e.g., heightened motivation, greater intelligence, etc.). These findings suggest that in addition to the memory domain tested, depth of encoding and subject variables should also be considered as potentially important modulators of the effect of sleep on memory.

G99

SLEEP AND TIME OF DAY EFFECTS IN AN EXPLICIT SEQUENCING TASK AND A DECLARATIVE MEMORY TASK. *Aysha Keisler[1], James Ashe[2], Daniel Willingham[1]; [1]University of Virginia, [2]Veterans Affairs Medical Center* – The role of sleep in memory and learning has received considerable interest in recent years. However, it is difficult to separate the effects of sleep from the effects of time of day and fatigue. The current research attempts to detangle these factors. Using handheld computers, we measured learning multiple times across two days on an explicit sequencing task and a declarative memory task. By observing performance at many different times of day before and after sleep, we were able to separately asses the contributions of each factor. We discuss the relative contributions of sleep and time of day in explicit and declarative learning.

Linguistic processes: Lexicon

G100

SEX DIFFERENCES IN VISUAL FIELD LATERALIZATION: WHERE ARE THEY? *Christine Chiarello[1], Laura K. Halderman[1], Suzanne Welcome[1], Janelle Julagay[1], Christiana M. Leonard[2]; [1]University of California, Riverside, [2]University of Florida, Gainesville* – It is frequently claimed that women have a more bilateral organization for language as compared to men. However, experimental support for this conjecture has been mixed. Although sex differences are sometimes obtained in visual half-field experiments, they rarely replicate, and a recent large-scale study found little evidence for sex differences in functional lateralization (Boles, 2005). The Biological Substrates for Language Project affords the opportunity to investigate this issue in another large-scale study. Male and female participants completed seven divided visual field lexical tasks (word and nonword naming, lexical decision, masked word recognition, semantic decision, verb and category generation). The predictors of reaction time and accuracy asymmetries were examined for each task using multiple regression in a preliminary analysis of 110 participants. Of 14 total regressions, only two found a significant effect of sex: women had larger asymmetries for lexical decision accuracy, and smaller asymmetries for category generation accuracy, as compared to men. We will report findings from our total sample of 200. Our data thus far provide little support for the view that women have reduced behavioral asymmetries as compared to men. Although there are clear individual differences in lateralization, sex does not appear to be a major contributing factor. We attribute prior findings of sex differences to small sample sizes that may not be representative of the population.

G101

ARE VOWELS AND CONSONANTS PROCESSED DIFFERENTLY? ERP EVIDENCE WITH A DELAYED LETTER PARADIGM *Manuel Carreiras, Margaret Gillon-Dowens, Marta Vergara, Manuel Perea; Universidad de La Laguna, Tenerife, Spain* – Previous patient data have shown a dissociation for consonant and vowel processing, suggesting that they are categorically different at some processing level (e.g., Caramazza et al, 2000). Specifically, vowels may increase prosodic processing while consonants may increase lexical-semantic processing. In the present study, Event Related Potentials (ERPs) were recorded to investigate the neuronal basis of consonant and vowel processing while reading words and pseudowords in a lexical decision task. The stimuli were displayed in three different conditions: a) simultaneous presentation of all letters (baseline condition); b) presentation of all letters, except that two internal consonants were delayed for 50 ms (delayed consonant condition); and c) presentation of all letters, except that two internal vowels were delayed for 50 ms (delayed vowel condition). The behavioral results showed that, for words, lexical decision times in the delayed consonant condition were longer than in the delayed vowel condition, which, in turn, were longer than in the baseline condition. For nonwords, there were no significant differences across conditions. The ERPs showed that, starting as early as 150 ms, words in the delayed consonant condition produced a larger negativity than the delayed vowel condition. This negativity was sustained up to 550 ms after target presentation. In contrast, ERPs for pseudowords were virtually the same in the two delayed letter conditions. Latency differences were found between the baseline and the two delayed letter conditions, both for words and pseudowords. We examine the implications of these results for models of reading.

G102

HEMISPHERE DIFFERENCES IN THE TIME COURSE OF PHONOLOGICAL AND ORTHOGRAPHIC PROCESSES: A BACKWARD MASKING INVESTIGATION. *Laura Halderman[1,2], Christine Chiarello[2]; [1]University of Pittsburgh, [2]University of California, Riverside* – Backward masking was used to investigate how the right and left cerebral hemispheres recognize visually presented words pre-lexically. Target words (e.g. crew) were backward masked by nonwords that were orthographically and phonologically similar (e.g. CRUE), orthographically similar (e.g. CRAE), phonologically similar (e.g. KROO), or unrelated (e.g. FAMS). The stimuli were presented to either the right or left visual field using the divided visual field technique. Two SOAs, 20 ms and 60 ms, were investigated to track how orthographic and phonological processes change over time. Participants identified the target word using a two-alternative choice response (e.g. crew/grew). The results revealed the right hemisphere gained access to both phonology and orthography during the earliest moments of word recognition (20 ms SOA). However, the right hemisphere was benefited to a greater degree by orthographic similarity than by phonological similarity at both the short and longer SOAs. The left hemisphere also demonstrated access to phonology and orthography during the initial moments of word recognition. The effect of both orthographic and phonological similarity (e.g. CRUE) was not greater than the effect of each type of similarity alone (e.g. CRAE or KROO) until later moments of word recognition (60 ms SOA). This suggests the left hemisphere does not summate these two forms of information until slightly later during word recognition at which point a deeper representation is available. The results suggest each hemisphere makes a meaningful contribution to word recognition prior to lexical access.

G103

LEFT POSTERIOR SUPERIOR TEMPORAL GYRUS PARTICIPATES SPECIFICALLY IN ACCESSING LEXICAL PHONOLOGY *William Graves[1], Thomas Grabowski[2], Sonya Mehta[2], Prahlad Gupta[2]; [1]Medical College of Wisconsin, [2]University of Iowa* – Patients with Wernicke aphasia have an inability to understand or produce meaningful speech. Careful testing usually reveals intact semantics, suggesting that the deficit lies in a disruption in either the mapping from semantics to phonology, or in the phonological representations themselves. Previous studies suggest that the word frequency effect (where lower frequency words elicit longer reaction times than higher frequency words) arises at the level of lexical (word-level) phonological access in word production. In the current fMRI study we used repetition priming and neural adaptation in an auditory pseudoword repetition task as a semantics-free model of the word frequency effect. In each run (group of trials), half the stimuli were presented for the first time and half were repeated from the previous run, for a total of six exposures across the runs. The task was to repeat each pseudoword aloud as quickly and accurately as possible. As expected, we observed repetition priming in terms of decreased reaction time and adaptation in terms of reduced neural activity. To test if the areas exhibiting neural adaptation are relevant to real word production, we submitted these results to a conjunction analysis with data from a separate fMRI experiment which manipulated word frequency in picture naming (Graves et al., in press). The sole activation to survive this conjunction was in the left posterior superior temporal gyrus, suggesting that this area participates specifically in accessing lexical phonology.

G104

DOES THE VWFA COMPUTE AN ABSTRACT ORTHOGRAPHIC REPRESENTATION? - AN ERP STUDY *Cristina Rosazza, Qing Cai, Yves Paulignan, Tatjana Nazir; Institut des Sciences Cognitives, CNRS, Lyon, France* – The visual word form area (VWFA) is a region in the occipito-temporal cortex that is particularly responsive to visual words. It is supposed to compute an abstract representation of graphemes that is insensitive to variations of surface features such as position, font and size (Cohen & Dehaene, 2004). However, given that words are generally presented in a horizontal, familiar format, it is not clear whether the VWFA computes an abstract representation independently of variations in format. The aim is to study the effects of format variations on the recognition of orthographic stimuli (words, pseudowords, consonant-strings) by analysing event-related potentials (ERPs) in a lexical decision task. If word recognition is based on the computation of an abstract representation that is independent from surface variations, ERPs should show similar sensitivity to orthographic stimuli displayed vertically and horizontally. Our results showed that the N1 discriminated stimulus format irrespective of the type of letterstring. In the latency range 190-240ms, ERPs to horizontal letter-strings started to differ as a function of lexicality in the left occipito-temporal area, with the strongest negativity observed for words, followed by pseudowords and then by consonant strings. Corresponding ERPs to vertical letter-strings, by contrast, did not capture the difference between words and pseudowords. In particular, the interaction between format and type of letter-string was significant and left-lateralized. The findings suggest that the VWFA is tuned to the visual familiarity with which letterstrings are encountered in a specific format (Dehaene et al., 2005), rather than computing an abstract representation of graphemes.

G105

VOWEL PROCESSING IN VISUAL WORD RECOGNITION: ERP EVIDENCE FOR EARLY PHONOLOGICAL REPRESENTATIONS IN SKILLED READING *Jane Ashby; University of Massachusetts at Amherst* – It is commonly accepted that skilled readers rely on orthographic processing to identify words during silent reading. According to this view, if skilled readers activate phonological representations for common words, they do so mainly for purpose of post-lexical processing. In contrast to this claim, the present study indicates that skilled readers are sensitive to subtle phonological information quite early in word recognition. Participants silently read single 5 letter words in a masked priming paradigm; they saw a forward mask, the prime (45 ms), a backward mask, and the target (800 ms). The primes were orthographically matched pseudowords that had a phonologically similar or different vowel than the target word. Participants were instructed to read the target words silently. They made semantic judgments to filler items. Analyses of ERP waveforms revealed that the phonological similarity of the prime's vowel to the target's vowel modulated waveforms beginning around 150 ms post-target onset. This broadly distributed increase in negativity in the vowel-different condition, compared to the vowel-similar condition, peaked at 200 ms and persisted until 300 ms. Greater negativity for targets in the vowel-different condition also appeared significant around 500 ms post-target onset. This result suggests that skilled readers activate phonological representations early in word recognition even when reading relatively simple words. Furthermore, it appears that these early representations can be biased toward particular phonological vowels by the surrounding consonant context.

G106

CORTICAL ASYMMETRY IN A WORD-READING TASK: THE EFFECTS OF WORD FREQUENCY ON NEURAL ACTIVATION IN BILINGUAL CHILDREN. *Noemi Aznar-Bese, Arturo E. Hernandez; University of Houston* – Previous studies have proposed an extensive network of structures subserving the processing of word reading in monolingual children. In addition, several behavioral studies indicate significant differences in the processing of high- versus low-frequency words in both monolinguals and bilinguals. A prior fMRI study in our laboratory revealed larger frequency effects in a first language than a second language in bilingual adults. In this fMRI study, we examined the differential neural response to the processing of visually presented high- and low-frequency words in bilingual children (ages 8-14). Our results reveal significant frequency effects related to the age of acquisition of the second language that are reflected in hemispheric asymmetries when reading high- versus low-frequency words. High-frequency words in the participant's first language (Spanish) revealed a strong lateralized pattern of activation in the right hemisphere that included several areas of the middle frontal and superior temporal gyri. In a second language (English), high-frequency words recruited a similar area in the right middle frontal gyrus in addition to the left primary auditory cortex (BA 41). While low frequency words in the first language didn't reveal any supra-threshold positive activation, low frequency words in the second language also activated the primary temporal cortex (BA 41). These results indicate differential effects in children and adults suggesting that word reading in a second language progresses from a primary stage centered in phonological decoding to a more integrated system as language proficiency is attained.

G107

FUNCTIONAL NEUROIMAGING OF GRAMMATICAL CLASS: AMBIGUOUS AND UNAMBIGUOUS NOUNS AND VERBS *Martha W. Burton, Donna Krebs-Noble, Rao P. Gullapalli, Rita S. Berndt; University of Maryland School of Medicine* – Grammatical class distinctions among words are critical elements of lexical knowledge that support language's most important function: its ability to create infinite combinations of words to produce meanings. Although there has been much interest in how grammatical class is mapped onto brain regions, the results of aphasia studies and those of neuroimaging have yielded ambiguous results due to inconsistency in lesion site location and differences in tasks and stimulus selection. The current fMRI study compared auditory grammaticality judgments of carefully matched ambiguous and unambiguous nouns and verbs preceded by either "the" or "to." Behavioral data indicated that accuracy was high across conditions, but there was a significant interaction between ambiguity and class in which participants were less accurate on ambiguous noun trials than any other type. Neuroimaging results showed that regions associated with auditory processing (bilateral superior temporal gyri) were significantly activated by all conditions. Unambiguous nouns and verbs activated a network of regions typically associated with language processing, but did not differ in magnitude of percent signal change. Only the posterior superior temporal gyrus indicated a marginally significant difference in which unambiguous verbs were more activated that unambiguous nouns. Ambiguous noun phrases produced significantly greater percent signal change that was correlated with accuracy in the left inferior frontal gyrus, but few other differences in language areas. The results suggest that significant grammatical class effects may depend on task and stimulus factors that were not tested in the current study, including stimulus inflection and semantic characteristics. Supported by NIH R01DC00262.

G108

STAGES IN LEXICAL ACTIVATION: MEG CORRELATES OF REPETITION PRIMING *David Poeppel[1], Diogo Almeida[2]; [1]Universtity of Maryland College Park, [2]University of Maryland College Park* – Despite suggestive results (e.g. Pylkkänen & Marantz, 2003; Beretta et al. 2005; Fiorentino & Poeppel, in press), the functional interpretation of the M350 as an index of lexical activation remains unclear (see Pulvermüller et al., 2004 for earlier lexicality effects in the evoked MEG signal). For instance, Embick et al (2001) and Stockall et al. (2004) report conflicting findings about M350 modulation by lexical frequency. This might stem from the prevalent use of factorial designs in which only a small number of variables are manipulated. Such designs result in distinct list compositions for each condition. Therefore, the attribution of differences between conditions to the experimental manipulation relies on the assumption that (most of) the confounding variables are controlled across lists. Yet the number of variables that is normally controlled in experiments is much smaller than the number of variables shown to influence performance in lexical tasks (Cutler, 1981; Balota et al. 2004). In order to circumvent this concern, priming paradigms are typically used, with each item serving as its own control. Few such experiments are reported using MEG (eg. Pylkkänen et al. 2001). A medium-distance repetition priming experiment embedded in a continuous lexical decision task was conducted while subjects were undergoing MEG recording. Data from 10 subjects show, as expected, reaction time facilitation. Moreover, the M350 response shows systematic latency reduction associated with word repetition. This supports the view that the M350 reflects the activation of lexical representations. Supported by R01 DC05660 to David Poeppel.

G109

LEXICAL ACCESS IN SIGNERS: MEG EVIDENCE *Diogo Almeida[1], Joseph Hill[2], Jon Sprouse[3], Deborah Chen Pichler[2], David Poeppel[3]; [1]Universtity of Maryland College Park, [2]Gallaudet University, [3]University of Maryland College Park* – MEG experimentation on lexical access has shown that a particular response, the M350, is elicited by visual (eg. Stockall et al., 2004) and auditory words (Bowles & Poeppel, 2005), but its interpretation remains controversial. If the M350 reflects lexical search or activation, as proposed by Pylkkänen & Marantz (2003), then it should be found for sign languages as well. We tested this hypothesis in a comparative MEG study between native deaf users of American Sign Language (ASL) and monolingual hearing English speakers. We predicted the M350 would be elicited in signers responding to ASL signs, but not in English speakers responding to the same material (analogous reports are found in the N400 literature, where non-linguistic strings of characters do not elicit the response – see Kutas & Federmeier, 2000 for review). We employed a medium-distance repetition priming paradigm in a continuous lexical decision task conducted while subjects were undergoing MEG recordings. This priming paradigm allows for each item to serve as its own control, and also attenuates some of the effects that strategy and low level sensory coding have on immediate priming (eg. Pallier et al, 2001). Data from 7 deaf and 16 hearing participants show robust priming in reaction time latencies for both populations, both for signs and non-signs, even though the hearing population displays very poor discrimination in the lexical decision task. Correlates of this priming effect are found in the MEG data, but differ in dipolar distributions across populations. Supported by R01-DC05660 to David Poeppel.

G110

VIOLATING INFLECTIONAL EXPECTATIONS & MORPHOLOGICAL (IR)REGULARITY: AN ERP STUDY *John Drury[1], Karsten Steinhauer[1], Michael Ullman[2]; [1]McGill University, [2]Georgetown University* – The study of (ir)regularity in morphology has been a centerpiece in debates regarding the neurocognitive basis of language. Previous event-related potential (ERP) studies have manipulated inflection and (ir)regularity in different ways to create violation paradigms. For example: (i) (ir)regularization of (ir)regulars (e.g., The torpedo *sinked/sank the ship or He *blunk/blinked his eyes); (ii) uninflected verbs in contexts demanding inflection (e.g., He *walk/walked over there; He *dig/dug a hole); or (iii) inflected forms in contexts where inflection is not permitted (e.g., The man will *worked/work...). Interpretation of previous ERP results is problematic because all studies have confounded differences in form with the violation itself. Here we used a symmetric 2x2x2 design (Good/Bad x Regular/Irregular x +/-Inflected), which allows the possibility of comparisons in which the target verb form is identical across bad/good contrasts, and additionally allows comparisons of the sort examined in some previous studies. Preliminary analyses suggest that both regular and irregular stem violations (*kick vs. kick; *find vs. find) showed a LAN/P600 pattern. Regular inflectional violations (*kicked vs. kicked) also showed an early negativity followed by a subsequent positivity. Although this negativity was also left lateralized, it was considerably more broadly distributed than the negativities elicited by the stem violations, extending substantially into the right hemisphere. Strikingly, irregular inflection (*found vs. found) showed only a late positivity. These and other results will be discussed in relation to previous findings in the context of competing models of inflectional (ir)regularity and morphological processing.

G111

MORPHOLOGICAL STRUCTURE IN THE MENTAL LEXICON *Sarah VanWagenen; UCLA* – Two competing perspectives on the nature of lexical representations have emerged. The morphological perspective asserts that there exists an abstract level of representation, distinct from semantics and form around which the lexicon is organized. The similarity perspective adopts a view of lexical representations as mappings between semantics and form. Relationships between lexical items are similarity- rather than identity-based. While previous repetition priming experiments have sought to empirically distinguish these perspectives, the problem of high correlation between semantic/formal relatedness and morphological relatedness has often made results difficult to interpret. Our two priming studies avoid this confound by 1) using pairs of stimuli which are morphologically related, but not semantically or phonologically related and 2) employing a paradigm shown to yield morphological effects in the absence of semantic and phonological effects. Both studies use a lexical decision task in a delayed repetition priming paradigm where an average of twenty items intervene between prime and target. The first study establishes that words that are unrelated except for sharing a derivational affix show facilitatory priming effects ($t(65) = 3.47$, $p < .001$), whereas semantically or formally related words showed no priming effects. The second study shows that derivational affixes only prime each other when the affixed stem is semantically consistent with a free stem, even when the semantic contribution of the affix is consistent in prime-target pairs. These results cannot be accounted for in a similarity based model of lexical representation, rather, they support a morphologically organized model of the mental lexicon.

G112

KNOWLEDGE TRANSFER OF SECOND LITERACY BETWEEN TRADITIONAL AND SIMPLIFIED CHINESE CHARACTER READING: AN ERP STUDY *Yi-Min Tien[1,2], Daisy L. Hung[2], Ovid J. L. Tzeng[2,3]; [1]Chung Shan Medical University, Taichung, [2]National Yang-Ming University, Taipei, Taiwan, [3]Academia Sinica, Taipei, Taiwan* – Learning to read is essentially learning to map between the spoken form and print form of the language. Recent research has shown that learning to read two alphabetic languages such as Spanish and English concurrently rests on common phonological processes; thus these phonological skills can be transferred from one language to the other (Durgunoglu, 2002 for a review). Chinese provides a case of high contrast for alphabetic systems, because Chinese character typically represents a syllable morpheme. Reading a character may activate both meaning and pronunciation. We address the issue of biliterate knowledge transfer across two syllable-morphemic scripts by adopting traditional (Wr1)and simplified (Wr2) Chinese characters. These two scripts represent virtually the same spoken language but simplification of Chinese characters may cause lost or preservation of orthographic, phonological, and/or lexical semantic knowledge. Behavioral as well as event-related potentials (ERPs) were used to examine brain activities of skilled reader of Wr1 who have only limited experience of reading Wr2. Participants were asked to do lexical recognition task for both Wr1 and Wr2. The results revealed that Wr2, in comparison to Wr1, elicited a P200 in pseudo-characters and non-characters but not real characters, while Wr2 elicited an N400 in real characters only. Our research suggests Wr1 readers adopt orthographic knowledge and lexical-semantic knowledge to decode Wr2. Whether there is possible meta-linguistic knowledge involved were discussed.

G113

MEASURES OF "PARTIAL WORD KNOWLEDGE" IN CHILDREN AND ADULTS: AN EVENT-RELATED POTENTIALS STUDY *Gwen Frishkoff, Charles Perfetti; University of Pittsburgh* – We present data from two experiments in which adults (18+ years) and children (8-10 years) made lexical decisions to words that varied in degree of familiarity. To represent the full spectrum of word knowledge among adults, we used very rare words (such as "nutant") that were matched in orthographic form with low-frequency words (such as "abject"). Words in turn were orthographically matched with pseudowords. Response times and d′ measures of accuracy were computed on each trial. Performance on each measure — as well as scores on several reading and language assessments — were then stastically related to the ERP effects. Adults and childern showed similar ERP components that were sensitive to familiarity and language skill, including a left anterior "N3", a frontal "MFN/fN400" and a parietal "P600" component. In adults, there was a Lexicality and Vocabulary Skill at ~600ms over posterior temporal sites. High-skilled, but not average or low-skilled, subjects showed differentiation between familiar and unfamiliar words over this region. Children did not show this effect, but rather showed a right-hemisphere effect that differentiated words that were not consciously recognized as words (i.e, "misses") and pseudowords. We relate these findings to theories of vocabulary development and concepts of graded or "partial" word knowledge.

Linguistic processes: Other

G114

USING NEURAL NETWORK MODELS TO MODEL CEREBRAL HEMISPHERIC DIFFERENCES IN PROCESSING AMBIGUOUS WORDS *Larry Manevitz[1], Orna Peleg[1], Zohar Eviatar[2], Hananel Hazan[2]; [1]University of Haifa, [2]Haifa University* – Neuropsychological studies have shown that both cerebral hemispheres process orthographic, phonological and semantic aspects of written words, albeit in different ways. The left hemisphere (LH) is more influenced by the phonological aspect of written words whereas lexical processing in the right hemisphere (RH) is more sensitive to visual form. In addition, homonyms (e.g., bank) were found to result in different time-lines of meaning activation in the two hemispheres: The LH quickly focuses on a single salient meaning, whereas the right hemisphere maintains alternate meanings. We explain these phenomena by postulating that in the LH, orthography, phonology and semantics are interconnected. In the RH, however, phonology is not connected directly to orthography and hence its influence must be mediated by semantic processing. This hypothesis was tested using dual computational neural network models, architecturally derived from Kawamoto's [1993] model. The LH network incorporates Kawamoto's version in which the entire network is completely connected. In the RH network, direct connections between orthographic and phonological units were removed. The two networks successfully simulated the time course of lexical disambiguation in the left and right hemispheres. We conclude that asymmetries in written word processing are due to RH inability to derive phonology directly from print.

G115

ELECTROPHYSIOLOGICAL EVIDENCE ON PRELEXICAL PHONOLOGICAL PROCESSING IN PRE-SCHOOL CHILDREN. *Barbara Wagensveld[1,2], Nina Davids[1,2], Ludo Verhoeven[1], Miranda van Turennout[1,2]; [1]Behavioural Science Institute, Radboud University Nijmegen, The Netherlands, [2]F. C. Donders Centre for Cognitive Neuroimaging, Nijmegen, The Netherlands* – In normal language development, children show the ability to attend to the sounds of language as distinct from their meaning. This so-called phonological awareness is assumed to gradually develop from awareness of rhyme, to awareness of syllables and individual phonemes. The present ERP study investigates the neural representation of prelexical phonological information in preschool children using an adaptation paradigm in combination with the mismatch negativity (MMN). Pre-school children (5 years of age) passively listened to series of high frequent words presented in isolation while EEG recordings were being made. A trial consisted of three identical repetitions of the context word followed by a fourth critical target word. All words were monosyllabic and contained three phonemes. To examine the nature of phonological representations, phonological overlap between context and target words was varied in four experimental conditions. Target words either differed in onset, nucleus or offset, or were identical to the context words. Comparing MMNs elicited by identical words with the measures of the three overlap conditions provided evidence for the neural coding of onset and rhyme specific information. The results showed that compared to the identical condition, MMN's were elicited by all phonological mismatch conditions. The latency of the MMN was modulated by the moment at which mismatching phonological information became distinguishable. These data indicate that preschool children are already able to discriminate between small changes in consonants and vowels, independent of their position in the word, providing a basis for early development of phonemic awareness.

G116

FUNCTIONAL-ANATOMICAL ORGANIZATION OF PREDICATE METAPHOR PROCESSING *Evan Chen[1], Page Widick[1], Anjan Chatterjee[1]; [1]University of Pennsylvania* – In this functional MRI study, we tested the hypothesis that the processing of predicate metaphors has the same right hemisphere laterality as postulated for the processing of nominal metaphors. The greater portion of the research on the cortical organization of metaphorical language has focused on determining the hemispheric laterality of nominal metaphor processing. Deficit-lesion and neuroimaging studies on metaphors like "This job is a jail" point to the right hemisphere as the primary locus, though this conclusion is not uncontested (e.g., Giora et al., 2000, Rapp et al., 2004, Schmidt et al., in press). It is not clear, however, if this hemispheric advantage also exists for predicate metaphors of implicit motion like "The man ran for office." This experiment examined predicate metaphors as compared to literal sentences of motion like "The man ran for the bus" in an event-related, functional MRI study of 14 college-aged normal participants. Our results demonstrated greater activation in the left inferior frontal cortex and left temporal lobe for predicate metaphors, while no differences were seen in the right hemisphere homologues. Greater activation for literal sentences was seen bilaterally in both the occipital-temporal and medial occipital cortices. Based on these results, we conclude that the processing of predicate metaphors has a left hemisphere advantage, contrary to the original hypothesis. We discuss how the results support a more general functional-anatomical organization principle for abstract motion processing that has been demonstrated at the word-level in which greater abstraction proceeds anteriorly along the lateral occipital temporal cortex.

G117

DISTINCT PATTERNS OF ACTIVATION FOR CORRECT AND PARAPHASIC RESPONSES BY PATIENTS WITH APHASIA IN A FUNCTIONAL MAGNETIC RESONANCE IMAGING STUDY OF OVERT NAMING *Whitney Anne Postman[1,2], Rasmus Birn[1,3], Randall Pursley[1,4], John Butman[1,4], Joe McArdle[1,2], Jiang Xu[1,2], Allen Braun[1,6]; [1]National Institutes of Health, [2]National Institute on Deafness and Other Communication Disorders, [3]Neurocircuitry Section, National Institute of Mental Health, [4]Signal Processing & Instrumentation Section, Center for Information Technology, [6]Chief, Language Section, National Institute on Deafness and Other Communication Disorders* – Patients with aphasia due to stroke can achieve varying degrees of language recovery. Yet the neural mechanisms underlying recovery, specifically the contributions of perilesional and contralesional brain areas to language performance in chronic stages post-stroke, remain unclear. To address this issue, we compared chronic aphasic patients' accurate to inaccurate responses within a single scan session by tracking their performance during data acquisition on a trial-by-trial basis. In this event-related single-trial fMRI study using Blood Oxygen Level Dependent imaging, three patients with aphasia due to left middle cerebral artery infarction at least 3 years prior to testing, named 144 object drawings overtly and without delay into a fiber-optic microphone through which their responses were recorded. All patients (2 female, age range 48-68 years) were right-handed native English speakers with nonfluent aphasia but excellent comprehension. Four age-matched control subjects also participated. Patients achieved 53% to 75% correct responses. Analysis of the functional images registered to each patient's structural brain images, revealed that while both correct and incorrect responses were associated with perilesional activation, incorrect responses were consistently associated with greater activity in contralesional areas. In particular, the right inferior frontal gyrus was activated for paraphasic responses, but neither for patients' correct responses nor controls' responses. These results demonstrate the feasibility of measuring activation for accurate and inaccurate performance during a scan session. They support the hypothesis that right-hemisphere activation represents maladaptive effort when left perilesional areas are insufficient rather than a compensatory mechanism for long-term effective language recovery.

G118

CEREBRAL ASYMMETRIES FOR CO-REFERENTIAL PROCESSING: AN ERP STUDY *Natalie Kacinik[1], Peter Gordon[2], Tamara Swaab[1]; [1]University of California, Davis, [2]University of North Carolina, Chapel Hill* – A series of recent eye-tracking and ERP experiments have shown that co-referential priming effects for repeated names can be disrupted if the greater discourse model is not conducive to the establishment of co-reference (e.g., Camblin et al., in press; see Ledoux et al., 2006, for a review; Swaab et al., 2004). Specifically, a repeated name penalty (RNP) was found to occur for repeated names when the antecedent was linguistically prominent (e.g., Mary ate dinner after Mary came home from work) compared to when it was non-prominent as part of a conjunctive phrase (e.g., Mary and John ate dinner after Mary came home from work). The present study combined lateralized presentation of critical names while recording ERPs in order to investigate hemispheric differences in constructing discourse-level representations of sentence meaning. Of particular interest was determining which visual field would show a larger RNP, suggesting greater involvement of the corresponding contralateral hemisphere in building a discourse model. Although we did not find the expected posterior and centrally distributed RNP N400 effect for either visual field, the later 500-800 ms time window showed a more pronounced anterior negativity for single names than names repeated after a conjunctive phrase. Furthermore, this effect was larger when names occurred in the LVF/RH than when they were presented in the RVF/LH. This result is interpreted as an indication that the RH recruited additional resources in the course of processing the more difficult to integrate single-name condition.

G119

SPATIOTEMPORAL CHARACTERISTICS OF LARGE-SCALE SYNFIRE CHAINS FOR LANGUAGE PROCESSING *Friedemann Pulvermuller[1], Yury Shtyrov[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge* – We report here a new brain signature of memory trace activation in the human brain revealed by magnetoencephalography and distributed source localization. Memory circuits distributed over distant cortical areas can activate these areas in a fine-grained temporal order, similar to the spatio-temporal patterns previously known from local cortical circuits called synfire chains. The large-scale spatio-temporal patterns can be picked up in the source images underlying magnetic brain responses. We found that acoustic signals perceived as speech sounds elicited a well-defined spatio-temporal pattern of sequential activation of superior temporal and inferior frontal cortex, whereas the same identical stimuli, when perceived as noise, sparked the same areas without a significant difference in activation delays. The strength of local cortical sources reflected additional lexical, semantic and syntactic features of speech. We conclude that spatio-temporal patterns, especially cortical activation latencies in the millisecond range, represent a brain code of memory circuits.

G120

IS THE MISMATCH NEGATIVITY TO PHONEMIC STIMULI CONTEXT-DEPENDENT? *Nina Davids[1,2], Holger Mitterer[3], Ludo Verhoeven[1], Hans van Balkom[1], Jan de Moor[1], Miranda van Turennout[1,2]; [1]Behavioural Science Institute, University of Nijmegen, The Netherlands, [2]F.C. Donders Centre for Cognitive Neuroimaging, Nijmegen, The Netherlands, [3]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands* – Previous research has shown that the mismatch negativity (MMN) is sensitive to phonological changes in a series of speech stimuli. A major methodological advance in measuring the MMN is the oddball paradigm with multiple deviants. In this paradigm, frequent, standard stimuli are intermixed with different types of infrequent, deviant stimuli. The present study investigates whether the inclusion of different types of deviant stimuli affects the phoneme-related MMN. ERPs were recorded from 12 participants while they passively listened to series of speech stimuli. Stimuli included standard /i/ sounds. To create different contexts, standard stimuli were intermixed with either two phonemic (/u/ and /y/) and a pitch deviant, or three different pitch deviants. The results showed that the pitch deviants elicited an early negativity (100-150 ms) overlapping with the N1, which increased in amplitude for larger pitch differences. Interestingly, the early negativity elicited by pitch deviants in the context of other pitch deviants did not differ significantly from the negativity elicited in the context of other phonemes. In contrast with the early negativity observed for pitch deviants, phonemic deviants elicited a clear MMN in the typical MMN time window 150-200 ms. Although the phonemic deviants (/y/ and /u/) differed in phonemic distance with the standard (/i/), the MMNs elicited by the phonemic deviants were equivalent. Our results indicate that the MMN elicited by phonemes is reasonably independent of other deviants presented in the same oddball series.

G121

THE INTERPLAY OF PROSODY, SYNTAX AND SEMANTICS IN SENTENCE PROCESSING: AN ERP-STUDY *Sara Bögels, Dorothee Chwilla, Roel Kerkhofs, Herbert Schriefers; NICI, Radboud University Nijmegen* – In this study we measured Event-Related Potentials while participants listened to locally ambiguous Dutch sentences like (1) "De verpleegster hielp de zieke te lopen" (The nurse helped the patient to walk) and (2) "De verpleegster hielp de zieke te vervoeren" (The nurse helped to transport the patient) with either a prosodic break (PB) right after the first verb ("hielp") or no PB. In (1), a PB suggests that the NP "zieke" (patient) is not the object of "hielp" (helped), but this syntactic expectation is eventually contradicted by the verb "lopen" (walk) because it is intransitive. By contrast, in (2), PB fits with the eventual syntactic analysis while the absence of PB might trigger an incorrect analysis. Steinhauer and colleagues (1999) in a similar comparison in German reported a biphasic N400/P600 pattern. As expected, the PB elicited a Closure Positive Shift. More importantly, in sentences with a PB, no biphasic pattern but only an N400 effect was found for a prosody-syntax mismatch as in (1), compared to the match in (2). This "pure" N400 effect suggests that the PB provides such a strong cue for a certain syntactic parse that - in case of a mismatch - the disambiguating verb is picked up as a semantic anomaly, without triggering revision. Thus, a mismatch of prosodic and syntactic information does not necessarily trigger a syntactic reanalysis (as reflected by the absence of a P600 effect), but can lead to a semantic integration problem when an unexpected intransitive verb is encountered.

G122

GAZE DURING CONVERSATIONAL EXCHANGE *David H. McFarland, Rose-Hélène Sigouin Université de Montréal; Université de Montréal* – Conversational turn taking requires precisely coordinated movements between conversational partners acting alternately as speakers and as listeners. Wilson and Wilson (2005) have suggested that coupled endogenous neural oscillators in the brain of speakers and listeners act as timing devices for these precisely timed moments. We also know that visual attention (gaze) is a key aspect of normal conversational exchange and shifts in gaze of speakers towards listeners create brief "micro collaborations" (Bavelas et al., 2002). It could be predicted, therefore, that gaze and shifts in gaze play a regulating role in turn taking collaboration and interactional synchrony. To address this issue, we studied the timing and orientation of gaze patterns in 8, French speaking, conversational dyads (16 subjects). Audio and split-screen video recordings allowed for reliable measures of direct gaze and gaze away. Results revealed that subjects spent a great deal of the time looking directly at their conversational partners, particularly while listening (95% of total listening time; 77% of total speaking time). However, rapid shifts in gaze were common and were often associated with turn taking and other conversational elements such as gestures, pauses, and hesitations. Different but consistent patterns and timing of gaze shifts were observed for turn taking transitions from speaking to listening vs. listening to speaking and there was a very tight temporal correspondence between gaze shifts and turn and utterance initiation. The implications of these data in understanding the cognitive-linguistic and motor factors that underlie conversational turn taking and interpersonal synchrony will be discussed.

G123

MEG AS A MEASURE OF NEURAL PLASTICITY IN VERB LEARNING *Stefanie Enriquez-Geppert, Markus Junghöfer, Pienie Zwitserlood, Christian Dobel; University of Münster* – We demonstrated in an earlier study (Dobel et al., 2007) how novel words become integrated into existing conceptual-lexical networks by employing a statistical learning procedure (Breitenstein & Knecht, 2002). In the present study, we were interested if the same learning principles lead to successful acquisition of novel action verbs. Photos of actions involving different actors were paired with meaningless pseudowords. More frequent pairing of an action with a specific pseudoword resulted in stable connections of action and newly learned pseudowords. These effects were further investigated with MEG measurements before and after learning. In the pretest, presentations of actions primed by pseudowords were clearly accompanied by an M400. For actions primed by German verbs a weaker M400 was found if word and action didn't match compared to a match. Most importantly, after learning the M400 upon actions primed by learned-pseudowords was clearly attenuated compared to the pretest. Thus, statistical learning of novel action verbs resulted in neurophysiological responses similar to words of one's native language. We take these results as evidence that statistical learning is an effortless and fast way to integrate new verbs into existing networks of lexical and conceptual representations.

G124

INTERACTION BETWEEN SEMANTIC AND SYNTACTIC PROCESSING IN SPECIFIC LANGUAGE IMPAIRMENT: ELECTROPHYSIOLOGICAL EVIDENCE *Fabrizio Pizzioli[1], Bruno Rossion[1], Marie-Anne Schelstraete[1], Hiroko Nakano[2]; [1]Université catholique de Louvain, [2]Saint Mary's College of California* – Children with SLI show difficulties in thematic processing; here we used event related potentials (ERP) to investigate how these children use semantic and syntactic information on-line in oral sentence comprehension. Four groups were tested: 14 French speaking children with SLI (M=10y), 14 children matched on chronological age, 14 matched on receptive vocabulary scores (M=7y) and 20 young adults. ERP were recorded while participants listened to sentences some of which contained anomalous verbs. We monitored the latency and amplitude of the N400 component, a marker of semantic integration and the P600, often associated with structural syntactic re-analysis. Relative to their context the verbs were: (a) congruous (e.g. The fireman extinguished the fire…), (b) incongruous and semantically unrelated (e.g. The tree extinguished the fire…), (c) incongruous but thematically related (e.g. The fire extinguished the fireman…), and (d) syntactically violated (e.g. The mother fed/food* the baby). We reported a dissociation in the modulation of N400 and P600 during sentence comprehension in SLI: in contrast with the three control groups, they failed to show a P600 in response to incongruous but thematically related verbs (c); nonetheless they showed a P600 -though reduced- in response to the categorical violation at the verb (d). On the contrary the N400 effect to incongruous unrelated verbs was the same in patients and controls. Data suggest an abnormal interaction between semantics and syntax in children with SLI: they consistently used semantic information but not the structure dictated by syntax, although they retain a certain capacity to process syntax.

G125

ELECTROPHYSIOLOGICAL EVIDENCE FOR EARLY CASE INVARIANCE IN WORD RECOGNITION USING AN ADAPTATION PARADIGM *Marina Mariol, Corentin Jacques, Marie-Anne Schelstraete, Bruno Rossion; Catholic University of Louvain (UCL)* – Fluent readers can recognize words across changes in size, case, font and retinal location while maintaining a high sensitivity to the letter identity and letter position within the word. The present experiment attempts to evaluate the time course of invariant word recognition using an adaptation paradigm. We recorded brain potentials during repeated stimulation of the same stimulus in the same case, same stimulus in a different case and another stimulus in the same or different case. By manipulating orthogonally the identity and case of primes and targets we evaluate the invariance of this code. The results show that when subjects are presented with the same stimulus (RAGE/RAGE) we observe a maximal reduction in the electrophysiological signal, at the N170 level in occipital regions, that could correspond to the suppressed response of neurons with repetitive stimulus presentation, a phenomenon termed "mnemonic filtering". This reduction is also observed when the same stimulus but in a different case (i.e., rage/RAGE) is presented even if smaller than that found for strictly identical stimuli whereas the presentation of another stimulus in the same (i.e., COUP/RAGE) or different case (i.e., coup/RAGE) do not produce any reduction in the recorded signal. Our findings are threefold: we observed adaptation both for identity and for cross-case in occipital regions around 170 ms and this adaptation occurs in left but not right regions. Altogether these results show that an invariant representation for size and case is reached around 170 ms, left lateralised in occipital regions.

G126

DOES THE BRAIN DIFFERENTIATE BETWEEN INTENTIONAL AND CAUSAL INFERENCES IN TEXT? *Robert Mason, Marcel Adam Just; Carnegie Mellon University* – Cortical activity associated with the generation of an inference was measured using fMRI. Participants read three-sentence passages that differed in whether or not an inference was to be drawn. Critically, the source of the inference was either based on a protagonist's intention or on a physical consequence of a character's action. Activation in Theory of Mind (ToM) brain regions was expected for the protagonist intention passages. The physical consequence passages could possibly activate imagery processing areas to a greater extent. Cortical activity related to the reading of the critical inference sentence demonstrated a recruitment of a common cortical network for the both types of inferences. This general inference-related activation appeared in the typical discourse-level language processing areas: bilateral inferior frontal gyrus, bilateral anterior temporal gyrus and left posterior temporal gyrus. Activation was also present in the medial frontal gyrus, which has been found to be active in ToM tasks. The activation of a ToM region in general inference processing precluded an ability to find that region as being more active in the intentional passages than the physical passages, however intentional inference related activation was present in the cortex in an area superior to the medial frontal gyrus and slightly anterior to the right temporo-parietal junction (also a ToM related region). This could indicate that adjacent tissue was recruited due to the ToM regions already being used. Additionally, the physical passages recruited the left parietal lobe whereas the intentional did not, suggesting a greater involvement of visuo-spatial processing.

G127

THE INFLUENCE OF IMPLICIT CAUSALITY ON THE ESTABLISHMENT OF COREFERENCE: AN EVENT-RELATED POTENTIAL STUDY OF READING *Kerry Ledoux[1], Barry Gordon[1], Mikael Roll[2,3], Tamara Swaab[2]; [1]Johns Hopkins University, [2]University of California, Davis, [3]Lund University* – Implicit causality is a feature of certain interpersonal verbs by which information about the cause of events described by a verb is conveyed implicitly as part of the verb's meaning. We presented participants with sentences containing verbs that were biased towards the person mentioned in the first noun phrase (NP1) or towards the person mentioned in the second noun phrase (NP2). Following the verb phrase, coreference was established by means of a pronoun or a repeated name (the critical word, see examples below), in a manner either consistent or inconsistent with the implicit causality bias of the verb. Sentences were presented visually; participants read the sentences, and answered comprehension questions about them. The critical word elicited a greater positivity (P600) when it was inconsistent with the implicit causality bias of the verb; this effect was larger for repeated names than for pronouns. N400 repetition priming effects were observed to repeated names in both consistent and inconsistent verb conditions. These results have important implications for theories of discourse processing generally and for the establishment of coreference specifically. Verb consistent: NP1 bias: At the track meet Sharon disappointed Murray because Sharon/she did not give her best effort. NP2 bias: During the trial Vivian accused Dwight because Dwight/he had been seen near the scene of the crime. Verb inconsistent: NP1 bias: At the track meet Sharon disappointed Murray because Murray/he had very high expectations. NP2 bias: During the trial Vivian accused Dwight because Vivian/she hadn't found a better suspect.

G128

NEURAL CORRELATES OF CONTINUOUS SPEECH COMPUTATION INVESTIGATED BY MEANS OF FREQUENCY-TAGGED NEUROELECTRIC RESPONSES. *Marco Buiatti[1], Marcela Peña[2,3], Jacques Mehler[2], Ghislaine Dehaene[1,5]; [1]INSERM, U562, SHFJ/CEA, Orsay, France, [2]International School for Advanced Studies, Trieste, Italy, [3]Escuela de Psicología, Pontificia Universidad Católica de Chile, Chile, [5]Service de Neuropédiatrie, Centre Hospitalier Universitaire Bicêtre (AP-HP), Paris, France* – In order to learn a language, humans have to discover words and structural regularities from continuous speech. Our recent investigations suggested that structural properties of words are easily uncovered when continuous speech conveys subliminal acoustic cues (i.e. 25 ms gaps) at the word boundaries, while such learning is much harder when cues are absent. In the present study we investigate the neural correlates of online word segmentation by studying the electrophysiological responses to 9 min streams of artificial speech with a trisyllabic structure, either with or without subliminal acoustic cues. Steady-state power responses at the tag frequency of presentation of single syllables, of bisyllabic and trisyllabic words were therefore evaluated. We show that the introduction of pauses in the continuous speech elicits two effects: 1) a steady-state response at three-syllable frequency, and 2) the suppression of steady-state responses at one- and two-syllable frequencies, typically emerging with nonsense random streams. This suggests that word perception induces both an enhancement of power at the frequency of the perceived word, and an inhibition of power increase at alternative word frequencies. Indeed, as hypothesized, we observe a significant correlation between steady-state responses at trisyllabic word frequency and overtly learned words. When pauses are absent, the suppression of the steady-state response only arises at one-syllable frequency, suggesting that subjects may become aware of the presence of a multi-syllabic structure, but are not able to identify its elementary components.

G129

FIRST LANGUAGE ATTRITION IN SPANISH-ENGLISH BILINGUALS: EVIDENCE FROM FMRI *Talia Daley[1], Kevin Shapiro[2], Lauren Moo[1,2], Albert Costa[3], Alfonso Caramazza[2]; [1]Massachusetts General Hospital, [2]Harvard University, [3]Universitat de Barcelona* – Most fMRI studies of bilingualism have investigated subjects with a dominant native language and a non-dominant second language acquired later in life. Less attention has been devoted to studying "balanced" bilinguals who are equally (or nearly equally) fluent in two languages. Studying such subjects may allow us to disambiguate effects of language dominance and order of acquisition from effects related to linguistic competence. In this experiment we studied balanced bilinguals whose first language was Spanish, but who had spoken English since childhood and who currently spent most of their time speaking English. The subjects' language abilities and habits were assessed with a detailed questionnaire. Participants then performed an fMRI task in both languages, requiring simple noun and verb inflection. The task consisted of two English blocks, during which subjects completed noun phrases of the form "one table / two ..." and verb phrases of the form "he speaks / they ...," and two Spanish blocks with similar phrases such as "una mesa / dos ..." and "él habla / tú ...". Preliminary analyses revealed greater extent of activation during Spanish trials compared to English trials. This pattern is consistent with the phenomenon of first language attrition, which has been documented behaviorally but not previously with functional imaging. Moreover, parametric analyses showed that activation in premotor speech areas was modulated by the age of acquisition of English and by the amount of time subjects currently spent speaking Spanish. This analysis also revealed greater activation for English trials in the left inferior frontal gyrus for subjects who spent more time speaking Spanish.

G130

EVENT RELATED POTENTIALS AND PARAFOVEAL PREVIEW EFFECTS IN READING FROM RIGHT-TO-LEFT *Horacio A. Barber[1], Shir Ben-Tzvi[2], Shlomo Bentin[2], Marta Kutas[3]; [1]University College of London, [2]Hebrew University of Jerusalem, [3]University of California, San Diego* – ERP indices of parafoveal perception (preview) during reading were obtained in a group of 27 native Hebrew speakers. Six-word Hebrew sentences were presented word-by-word on a computer screen at fixation, flanked 2 degrees bilaterally by letter strings. All words but the fourth were flanked by pseudowords. The fourth word in each sentence was flanked by a pseudoword on one side; the flanker on the other side was a pseudoword on 1/3 of the trials (Pseudoword) and a word on 2/3 of the trials, left or right visual field. This so-called preview word was the same as the upcoming fifth word at fixation (Identity) or Unrelated to it. Relative to both Unrelated and Pseudoword conditions, Identity preview words elicited larger P2 (170-285 ms) and smaller N400 (400-450 ms) amplitudes, indicating some perceptual-semantic analysis. Critically, this preview effect was reliably larger when the flanker words appeared to the right than to the left of fixation. This interaction is consistent with the attentional asymmetry observed during reading in writing systems with right-to-left reading, using eye-tracking techniques, but contrasts with results of visual half field studies showing RVF-left hemisphere superiority in Hebrew.

G131

A FREQUENCY ANALYSIS OF EEG RESPONSE TO SPEECH MODULATED BY M-SEQUENCE *Hiroshige Takeichi[1,2], Sachiko Koyama[3], Andrzej Cichocki[1]; [1]RIKEN, [2]University Tokyo, [3]Hokkaido University* – We have developed a technique for assessment of natural verbal comprehension, using electroencephalography (EEG) and m-sequence modulation (Takeichi et al., Neuroscience Research, in press). The technique is superior to the conventional 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 a 51s long news which had been modulated in amplitude by an m-sequence. By computing a circular cross correlation function between the EEG and the m-sequence and by applying independent component analysis (ICA) to the function, a correlation peak at 400 ms delay was found to discriminate the EEG response to comprehensible native speech from the responses to incomprehensible time-reversed or Spanish speech. Here we report a frequency-based reanalysis of the data: an individual component response was estimated for each subject as a product of the separation matrix derived from the group data and the individual cross correlation function between the individual EEG and the m-sequence. The individual component response was estimated and examined for each of the delta, theta, alpha, beta, and gamma band frequency ranges by pre-processing the individual EEG with finite impulse response (FIR) band-pass filters. As a result, a phase offset between the forward and the time-reversed stimuli in the beta frequency range was the most prominent feature that was common to all the subjects. Supported by RISTEX, JST.

G132

HIGHER ORDER LINGUISTIC STRUCTURE IN SEMANTIC DEMENTIA *Peter Garrard; University College London* – The traditional neuropsychological approach to analysing connected speech in patients with language disorders is "top down": output is described in terms of known dimensions, selected in advance for their likely importance (such as the lexical characteristics of the words used, or the syntactic features of the passage). Such analyses have demonstrated the influence of lexical frequency, concept imageability, and grammatical complexity, on the spoken output of patients with semantic dementia (SD) - a focal neurodegenerative condition characterised by the disintegration of word and object meaning. In the early stages of SD, spontaneous speech is characteristically fluent and well-formed, and superficially indistinguishable from that of controls. In this study I present a series of analyses on transcripts of 'Cookie Theft' picture descriptions from SD patients (n=21) and controls (n=16) using a range of "bottom up" approaches taken from the fields of computational linguistics, stylometry and authorship attribution. I compare the techniques of principal components analysis, cross-entropy and n-gram analysis, and their success in identifying consistent differences between patient and control transcripts. By varying the amount of information represented in the input (for instance, by lemmatising texts or replacing word tokens with grammatical descriptors), the importance of lexical, grammatical and morphosyntactic properties to higher order structure is revealed. From correlations between the values of dimensions discovered using such bottom-up approaches and measures of the degree of semantic disintegration, I argue for the existince of an overarching representational system supporting syntax and other aspects of higher order structure, as well as word meaning.

G133

SPATIOTEMPORAL IMAGING OF LEXICAL MEDIATION IN ASSIMILATION CONTEXT EFFECTS *David Gow[1,2], Jennifer Segawa[1]; [1]Massachusetts General Hospital, [2]Salem State College* – Phonological processes including assimilation create lawful, language-specific alternation in how certain phonemes are pronounced in specific contexts. These processes pose potentially serious challenges to word recognition processes that must frequently discriminate between potential lexical candidates that differ by a single phonetic feature. Research to date has shown that listeners' ability to compensate for lawful phonological variation depends on gradient feature change when modification creates potential lexical ambiguity (e.g. when "cone" is pronounced "comb"), but not when modification creates a nounword (e.g. "bone" pronounced "bome"). In this experiment we examined the role of lexical mediation in these effects using multimodal imaging techniques. Subjects were tested twice in a paradigm in which they heard fully, partially or non- assimilated words in two word phrases such as "cone/comb pile" or "bone/bome pup" and then made a 2AFC decision based on visual depictions of two phrases presented after the auditory stimulus. In one session EEG and MEG data were collected simultaneously, and in another fMRI data were collected. Subjects showed reliable context effects, compensating only in appropriate contexts, and showed stronger effects for full assimilation noncompetitor conditions. Activation analyses showed increased superior temporal activation after lexical activation consistent with lexical mediation in non-competitor conditions. The contextual viability of assimilation modulated inferior frontal activation. Gamma phase synchrony and Granger causality analyses were used to identify the components and causal interactions within the transient networks that produced these results. The findings are discussed in the context of current models of spoken word recognition and speech processing.

G134

THE EFFECT OF PHONOLOGICAL NEIGHBORHOOD ON READING AND OBJECT NAMING: AN FMRI STUDY *Goulven Josse[1], Ferath Kherif[1], Anna Woollams[2], Cathy Price[1]; [1]Wellcome Department of Imaging Neuroscience, Institute of Neurology, University College London, UK, [2]Medical Research Council - Cognition and Brain Sciences Unit, Cambridge University, UK* – INTRODUCTION: Several imaging studies have shown that activation in left posterior temporal and inferior parietal regions is higher for reading than picture processing (Vandenberghe et al., 1996; Chee et al., 2000; Bookheimer et al. 1995). Activation in the same regions has also been reported for listening to words with high relative to low phonological neighbours (Okada and Hickock, 2006; Prabhakaran et al. 2006). We therefore hypothesized that increased activation for written words relative to pictures reflects different demands on phonological processing. During reading relative to object identification, for example, there is more competition from phonological processing of visually similar words (monkey, money, monk). In order to test this hypothesis, we used fMRI to investigate whether activation differences for reading relative to object naming are modulated by Phonological Neighborhood (PN). METHODS: Twenty-four right-handed adults (half females) were scanned at 3T while reading and naming 84 items with varying PN. Standard procedures in SPM5 were used to identify the main effect of reading, object naming and PN. RESULTS: Activation in the left posterior superior temporal sulcus was higher for (a) reading relative to object naming; and (b) written words with low relative to high PN. CONCLUSION: The results suggest that increased activation for reading relative to object naming reflects the demands associated with translation of orthography to phonology, particularly when low frequency elements are involved.

G135

A BRAIN FMRI STUDY OF THE STROOP EFFECT IN NATIVE JAPANESE SPEAKERS *Emily Coderre, Christopher Filippi, Paul Newhouse, Julie Dumas; University of Vermont* – The Japanese orthography consists of two scripts: kanji, which uses logographic symbols adopted from Chinese, and kana, which uses phonetic symbols. Research has shown that kanji and kana are processed differently. Kana is similar to phonetic languages like English, but kanji seems to require a completely different processing strategy. Previous work done with the Stroop task in Japanese has proposed that there are differences in Stroop effects for the two scripts. This study investigates the Stroop effect in kanji and kana using fMRI to better understand how logographic and phonetic languages are processed in the brain. Nine native Japanese speakers performed the Stroop task both in kanji and kana scripts during fMRI. Both scripts individually produced significant Stroop effects in the behavioral reaction time data. The imaging data for both scripts showed brain activation in the anterior cingulate gyrus, an area involved in inhibiting automatic processing. A direct comparison was also done between the Stroop effects in kana versus kanji. Though behavioral data showed no significant difference between the Stroop effects, there was a small area of increased activation in the anterior cingulate gyrus for kana versus kanji. The results of the present study suggest that there are processing and brain activation differences between logographic and phonetic scripts in Japanese.

G136

PHONEMIC PERCEPTION IN CHILDREN: AN FMRI AND DTI STUDY *Lisa Conant, Einat Liebenthal, Anjali Desai, Jeffrey Binder; Medical College of Wisconsin* – Speech perception entails recoding of the acoustic waveform into more abstract phonemic representations, resulting in categorical perception (CP), i.e., better discrimination across than within phonemic categories. Categorical discrimination of phonemes has been demonstrated as early as infancy; however, evidence exists suggesting that developmental changes in category representations may continue at least into early childhood. In the current study, brain activation patterns associated with the discrimination of phonemic stimuli (P), specifically CV syllables, were compared with those associated with the discrimination of acoustically matched nonphonemic stimuli (NP) using fMRI in 15 typically developing children, aged 7-12 years. Diffusion tensor imaging was examined in a subset of 13 children. Discrimination performance confirmed that P were perceived categorically whereas NP were not. Phonemic discrimination was associated with primary foci in the left and right superior temporal gyri (STG) and the left inferior frontal gyrus (IFG), where activation was also positively correlated with a CP index (CPI). For NP, the main focus was in right STG. Discrimination of P relative to NP was associated with greater activation in left STG and IFG. Fractional anisotropy was correlated with the CPI in a region of the left inferior longitudinal fasciculus near left MTG. Thus, similar to previous findings in adults, children aged 7-12 demonstrated CP of speech, which was associated with a strongly left lateralized pattern of activation even at this early stage of speech processing. In contrast, in the nonphonemic condition, the children showed greater right lateralization of activation in fronto-temporal regions than the adults.

G137

CAN MANIPULATING INTENTION CHANGE FRONTAL LATERALIZATION FOR WORD PRODUCTION DURING APHASIA TREATMENT? *Bruce Crosson[1,2], Keith McGregor[2], Michelle Benjamin[2], Yu-Ling Chang[2], Anna Bacon Moore[3], Kaundinya Gopinath[4], Kyung Peck[5], Christina Wierenga[6], Ashley Wabnitz[7], Megan Gaiefsky[1], David Soltysik[8], Christina Cavanagh[2], Leslie Gonzalez Rothi[1], Richard Briggs[4], Keith White[2]; [1]Gainesville VA Medical Center, [2]University of Florida, [3]Atlanta VA Medical Center; Emory University, [4]University of Texas Southwestern Medical Center, [5]Memorial Sloan-Kettering Cancer Center, [6]University of California, San Diego, [7]National Institutes of Health, [8]Medical College of Wisconsin* – Intention entails selection and initiation of action. Like attention, intention involves lateralized processes and affects cognitive activities, such as language. The current study used fMRI to determine if an intentional manipulation (complex left-hand movement) during treatment changed lateralization of word production in nonfluent aphasia patients. Five patients with chronic nonfluent aphasia performed overt, event-related category member generation during BOLD contrast fMRI at 3 Tesla, both before and after an intention-based treatment. Conceptually, the treatment was designed to engage right-hemisphere intention mechanisms that would facilitate participation of right lateral frontal structures in word production. Patients initiated picture-naming trials with a complex left-hand movement (opening a box then pushing a button on an apparatus inside the box). The button press initiated presentation of a picture on a computer monitor, which the patient attempted to name. Patients received 30 treatment sessions, each with 50 picture-naming trials. Two patients with bilateral frontal activity before treatment showed increased right-hemisphere lateralization of lateral frontal activity after treatment; both showed significant improvement in word finding during treatment. One patient with bilateral frontal activity before treatment failed to show increased right-hemisphere lateralization of frontal activity after treatment; this patient showed no improvement during treatment. Two patients showed complete lateralization of lateral frontal activity to the right hemisphere before and after treatment; both showed significant improvement during treatment. In summary, for patients with bilateral frontal activity before treatment, the treatment was successful when accompanied by the targeted shift in lateralization and not successful when this shift did not occur.

G138

LINGUISTIC AND NON-LINGUISTIC FOCUS EFFECTS IN COREFERENTIAL PROCESSING: AN ERP INVESTIGATION *Clinton Johns[1], Peter Gordon[2], Tamara Swaab[1]; [1]University of California, Davis, [2]University of North Carolina, Chapel Hill* – Referential and coreferential processes are essential to discourse comprehension; readers and listeners must be able to determine who is doing what to whom, or coherence would rapidly break down. Understanding the elements of these operations is therefore fundamental to our understanding of discourse processing, as it is clear that referential factors modulate how words are processed. Previous research has shown that some classic effects of repetition priming with repeated name coreference (when two instances of a name refer to the same person) are not found when the discourse model does not support repeated name coreference. Specifically, repetition priming effects on the N400 component of ERPs are not observed when the antecedent name is in linguistic focus, despite presentation of the same word only seconds earlier. This processing difficulty has been dubbed the Repeated Name Penalty (Gordon et al., 1993). The current study used ERPs to investigate whether the effects of linguistic focus could be dissociated from effects of non-linguistic attentional focus. Linguistic focus was manipulated by varying the syntactic structure in which the antecedent was embedded (e.g., "Chantel bought groceries…" vs. "Chantel and John bought groceries…"); non-linguistic focus was manipulated by reversing the initial letters of the antecedent (e.g. "Chantel" vs. "hCantel"). Results show that linguistic focus and stimulus-driven highlighting affected coreferential processing of the repeated names differently. It was found that enhancing focus on antecedents by non-linguistic means did not result in the repeated name penalty, suggesting that the different types of focus elicited different processing operations.

G139

N400 PRIMING EFFECTS FOR REGULAR AND IRREGULAR VERBS ARE INTACT IN LEFT FRONTAL PATIENTS *Jary Larsen[1], Timothy Justus[1], Jennifer Yang[1], Paul de Mornay Davies[2], Diane Swick[1,3]; [1]VA Northern California Health Care System, Martinez, CA, [2]Middlesex University, London, UK, [3]University of California, Davis* – The English past tense exemplifies a long-standing controversy between dual-system theorists, who argue for distinct neural systems for regular and irregular morphology, and single-system theorists, who argue that a single connectionist network that maps form and meaning can account for both. Previous studies in left anterior aphasic patients suggested dissociations between regular and irregular verbs, with impairments in the former but not the latter, implicating left inferior frontal gyrus (LIFG) processes (Tyler et al., 2002). We present behavioral and event-related potential data from 12 patients with LIFG lesions and 12 age- and education-matched controls in a unimodal design employing four types of auditory priming relationships: two between past-tense forms and present-tense forms (regular and irregular) and two between words with only formal (phonological and orthographic) overlap. Patient behavioral data revealed overall accuracy was only modestly compromised, with no difference between the two verb types. RT data revealed that the patients demonstrated less priming than controls for both verb conditions. Although behavioral priming differences were evident for verbs, the patients did not demonstrate a significant reduction in the N400 priming effect. Preliminary ERP analyses suggest that at both early (350-550 ms) and late (550-750 ms) windows, there were no group differences in the N400 priming effect. Importantly, the magnitude of priming for regular and irregular verbs did not differ between the groups. Our ERP data suggest that the LIFG does not make differential contributions to the processing of regular verbs and irregular verbs, at least as indicated by the N400 component.

G140

LANGUAGE IN WONDERLAND: LINGUISTIC PROCESSING DURING NATURAL STORY LISTENING *Jonathan Brennan[1], Yuval Nir[2], Uri Hasson[1], Rafael Malach[2], David Heeger[1], Liina Pylkkanen[1]; [1]New York University, [2]Weizmann Institute of Science* – The neural correlates of language processing were studied in a naturalistic setting by having 9 subjects listen to 5 minutes of the story 'Alice in Wonderland' during fMRI. To identify areas associated with linguistic processing, the corresponding text was tagged for lexical, semantic and syntactic factors. Data were aligned to the Talairach coordinate system and averaged across subjects. Low-level auditory factors were excluded from analysis by convolving the absolute value of the sound-wave with a hemodynamic impulse response function (HRF), and removing this component from the data. Each linguistic factor was convolved with the HRF and used to fit (via regression) the fMRI data at each voxel. The linguistic predictors we highly correlated with activity in known language areas. Word frequency and imageability correlated positively with activity in the Middle Temporal Gyrus, consistent with previous findings (cf., Prabhakaran et al., 2006; Frost et al., 2005). Syntactic complexity, measured by Gibson's (1998) memory cost, best explained activity in language-related regions. It was positively correlated with a left-hemisphere network including Wernicke's area, the Superior Temporal Gyrus, areas in the pre-motor cortex, and Inferior Frontal Gyrus. We also investigated what brain regions were sensitive to the function/content word contrast, which has been difficult to study due to length and frequency confounds. Our method successfully separates the effect of word class from other correlated stimulus factors. Function word density, but not content word density, correlated positively with the same network as syntactic memory cost, further supporting the role of these areas in syntactic processing.

G141

DRAWING INFERENCES DURING DISCOURSE COMPREHENSION: AN ERP STUDY *Martin Paczynski[1], Tali Ditman[1], Kana Okana[2], Gina Kuperberg[1,4]; [1]Tufts University, Medford MA, [2]New York University, [4]Massachusetts General Hospital, Boston, MA* – The current study utilized event related potentials (ERPs) to examine the time course of brain activation during the generation of causal bridging in simple discourse. ERPs were measured as twenty-three right-handed participants read 159 three-sentence scenarios and judged the causal relatedness between each final sentence and its preceding context on a three-point scale. Scenarios were either highly causally related, intermediately related (where the final sentence only followed logically if participants drew a causal inference from information provided in the context) or unrelated (where the final sentence did not follow logically from the context). To control for the effects of lexico-semantic association, all three conditions were matched for semantic similarity values using Latent Semantic Analysis. A significantly larger negativity between 325-400msec was evoked by critical words (independently pre-determined) in both the intermediately related and unrelated scenarios, relative to the highly related scenarios. This negativity was distributed more anteriorly than the classic N400 and may have reflected participants' engagement of working memory in attempting to generate bridging causal inferences to achieve discourse coherence. There was a trend towards a greater negativity to critical words in the unrelated relative to the intermediately related scenarios, suggesting that a failure to generate such bridging inferences may have led to some increased difficulty in integrating critical words into their discourse context.

G142

SEX DIFFERENCES IN THE EFFECTS OF DELAYED AUDITORY FEEDBACK: TIMING AND COGNITIVE EFFECTS *David Corey, Vishnu Cuddapa; Tulane University* – Persistent Developmental Stuttering (PDS) is characterized by dysfluencies in language. Delayed auditory feedback (DAF; amplified and delayed presentation of a speaking person's voice) induces dysfluency in normally-fluent people. Sex differences exist in both the incidence of PDS (M:F ratio 4:1 to 5:1) and in the effects of DAF (men are more susceptible than women). Sex differences in DAF effects also show developmental shifts similar to developmental shifts in the male:female ratio among people with PDS. Planum temporale (PT; auditory association cortex) anatomy is also associated both PDS and with sex, and PT anatomy is associated with DAF effects among people who stutter. These relationships suggests a possible etiological factor in PDS: sex differences in PDS incidence may be caused by underlying sex differences in auditory processing. As part of a research program designed to evaluate this proposition, sex differences were evaluated in fluent subjects speaking with no amplified feedback, and feedback conditions with the following delays: 0ms, 180ms, 230ms, 280ms, 330ms, and 380ms. For each DAF condition, fluency was measured when reading and during conversational speech. Fluency was significantly affected by a Delay-x-Condition-x- Sex interaction ($p<0.005$) indicating that (1) males were more susceptible to DAF effects than females, (2) DAF effects were stronger during conversation than reading, and (3) sex differences in the relationship between delay length and fluency varied significantly with speech task. Results suggest that in addition to timing of auditory processing, cognitive processes (as evidenced by reading task demands) may also be a factor in DAF effects.

G143

INVESTIGATING RECEPTIVE COMPENSATON OF PLACE ASSIMILATION: DO´S AND DONT´S IN AN ODDBALL PARADIGM. *Ludger Elling, Pienie Zwitserlood, Kambiz Tavabi, Christian Dobel, Markus Junghöfer; University of Münster* – The regressive place assimilation is a phonotactically natural misarticulation. Such adaptions of the place of articulation towards the anterograde context may yield phonemic category changes in the speech signal. To explain the compensation of according mismatches on the recipients' side, the regressive inference model (RI) and the featurally underspecified lexicon (FUL) have been suggested, among others. To find evidence in favour of either, we varied two requirements of phonotactical naturalness, legality and viability. Effects in terms of competing models were excluded by both using pseudoword stimuli and neutralising acoustic cues with a cross-splicing procedure. To investigate neural correlates of place assimilation we evaluated the magnetic mismatch negativity (MMNm) which provides a passive measure of discriminability on all levels of speech processing. A clear MMNm was visible for the factor legality with higher mismatch amplitudes upon changes from illegal to legal conditions. This effect was, however, opposed to the predictions of the FUL model. There was also no significant interaction of viability and legality, despite the prediction according to RI. Further investigations of the stimuli in a gating paradigm revealed differences of the recognition points between assimilated and nonassimilated stimuli. Given their strength and direction, they did not provide an alternative explanation for latency differences of the MMNm in terms of an artefact. The gating data instead indicated influences on the MMNm due to coarticulatory cues. These results shed new light on a preceding study of place assimilation and may guide future attempts.

G144

NON-INVASIVE MAPPING OF LANGUAGE AND MEMORY CORTEX WITH FMRI AND MEG *Thomas Thesen[1,2], Carrie R. McDonald[2], Chad E. Carlson[1], Ruben I. Kuzniecky[1], Ming-Xiong Huang[2], Mazyar Ahmadi[2], Don J. Hagler[2], Jeff D. Stout[1], Kate I. Nearing[1], Anders M. Dale[2], William B. Barr[1], Orrin Devinsky[1], Eric Halgren[2]; [1]New York University, [2]University of California, San Diego* – Mapping of language and memory is an important procedure performed before resection of tumors and epileptic tissue in order to avoid the removal of eloquent cortex. Wada testing and direct cortical stimulation are the most widely used clinical methods; however, they pose significant risks and discomfort to the patient. Non-invasive functional brain imaging methods such as functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG) have the potential to identify cortical language and memory areas with minimal risk to the patient. For this purpose, we devised a language protocol involving a semantic decision task for use with MEG and fMRI. Novel and repeated word stimuli were presented visually at an ISI of 600-1500ms while participants were instructed to either respond to repeating words or to infrequent target words (i.e., animals). Experimental paradigms were designed to be analogous between MEG and fMRI modalities with the exception that a block design was used for fMRI and an event-related design for MEG. Consonant strings and false font sequences were used as non-language control stimuli and contrasted to the novel and repeated word activations to reveal language and memory-specific cortex, respectively. Of particular interest were Wernicke's area in the posterior superior temporal gyrus and Broca's area in the inferior frontal gyrus. In a subset of patients, validation of language localization was achieved with direct cortical stimulation and Wada testing. Results from both imaging methods are compared and their suitability discussed with respect to replacing invasive mapping techniques.

G145

EXAMINING IMPLICIT PHONOLOGICAL PROCESSING USING A PICTURE-WORD MATCHING TASK AND FMRI *Randy Lynn Newman[1], Marc Joanisse[2], Amy Desroches[2]; [1]Acadia University, [2]The University of Western Ontario* – Studies of phonological processing have typically employed metalinguistic tasks such as rhyme judgment and phoneme monitoring. However, such tasks tend to be contaminated by working memory and attention. The current study proposes a different approach to assessing the brain mechanisms of everyday phonological processing. Neurologically healthy adults performed a picture-sound matching task requiring them to match a picture to a spoken word. The degree of phonological overlap between pictures and words was manipulated across 4 conditions: match trials in which the correct word was presented (picture: CONE, word: "cone"); cohort mismatch trials in which the initial segment of the word matched that of the picture (CONE; "comb"); rhyme mismatch trials in which the word and picture shared the same rime (CONE; "bone"); and unrelated mismatch trials where there was no overlap (CONE; "fox"). To perform this task, participants had to generate and maintain the phonological representation of the picture in anticipation of the spoken word probe. Statistical maps constructed to identify overall task activation implicated both STG and IFG in the formation and maintenance of phonological word forms. We next identified regions showing increased activity in response to mismatch stimuli. Key differences emerged in IFG, STG and inferior occipitotemporal regions as a function of the phonological overlap between the expected and probe words. Further analyses examined how activity in these regions is modulated by the phonological relationship between the target and distractor. Results are discussed with regard to models of auditory word recognition.

G146

ELECTROPHYSIOLOGICAL MEASURES AND SELECTIVE ATTENTION TO ACOUSTIC AND PHONEMIC CUES *Priya Patel[1,2], Martin Duff[1,3], Hilary Gomes[1,4], Brett Martin[3]; [1]The City College of New York, CUNY, [2]Graduate Center, CUNY, [3]The Graduate Center, CUNY, [4]The Graduate Center,CUNY* – Classic research in attention has shown that people can selectively attend to one speaker while ignoring another. This ability has been explored electrophysiologically with an event-related potential associated with selective attention, the Nd. Most of these studies, however, have employed simple auditory cues to differentiate information streams; only a few have used phonemic cues. This study compared Nds elicited when channels were defined by simple and by phonemic cues. Four conditions were presented that differed in the type of cue separating the streams and the characteristics of the target: place (ba/da, target-phoneme); place (ba/da, target-stimulus of longer duration); voice (ba/pa, target- phoneme); frequency (1000Hz/2000Hz, target-duration). Participants (7 adults) were instructed to attend to one of the two streams in order to detect a target embedded within the attended channel while ignoring stimuli in the unattended channel. Preliminary behavioral data suggests that participants perform better when attending to CVs then tones as demonstrated by higher accuracy and shorter reaction times. The ERP data showed that Nds (defined as ERP difference between the unattended and attended standard stimulus) were elicited in all conditions, but were larger when the target was defined by a phonemic cue than when it was defined by an acoustic cue.

G147

DISCOURSE CONGRUITY OVERRIDES SEMANTIC PRIMING DURING SPOKEN LANGUAGE COMPREHENSION: AN ERP STUDY *Lara Polse[1], Tamara Swaab[1], Peter Gordon[2], Christine Camblin[2]; [1]UC Davis, [2]University of North Carolina at Chapel Hill* – In a previous study we used eyetracking and ERPs to examine the interplay of lexical association and discourse congruence during reading (Camblin et al., in press). With both methodologies main effects of discourse congruence and association were found. However, under natural reading conditions with eyetracking, manipulations of discourse congruence eliminated associative priming in the target region. This indicates that the speed and/or the naturalness of the input may modulate the influence of discourse context on lexical priming. This was tested in the present study, where we manipulated associative priming and discourse congruity to examine the extent to which discourse level representations can affect associative priming in naturally produced connected speech. Short passages were aurally presented and 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., "The movie was applauded by adults and CHILDREN/TODDLERS," preceded either by a context referring to a Disney film or to a holocaust documentary). Within a stimulus set the last sentence was identical up until the critical word, and this sentence was congruent when read in isolation. The preceding context, however, made the critical final word congruous or incongruous at the discourse level. ERP results showed early main effects of discourse congruence, but no effects of association. The results are consistent with the idea that discourse context can override effects of lexical association in spoken language comprehension.

G148

LEXICAL AND SUB-LEXICAL READING PROCESSES: BEHAVIOURAL AND NEUROBIOLOGICAL EVIDENCE FOR MATHEMATICAL INDEPENDENCE *Jacqueline Cummine, Gordon Sarty, Ron Borowsky; University of Saskatchewan* – The present study evaluated both behavioral (i.e., naming accuracy) and neuroanatomical (functional Magnetic Resonance Imaging, fMRI) evidence for the relationship between sub-lexical and lexical systems in basic reading processes. Dual-route models of reading (e.g., Coltheart and colleagues) assume mathematical independence between lexical and sub-lexical systems whereby regular words can be read correctly by both lexical and sub-lexical systems, whereas irregular words are read by the lexical system, and nonwords are read by the sub-lexical system. Following Castles, Bates and Coltheart (in press), an equation was derived for predicting regular word reading accuracy that assumes mathematical independence between lexical and sub-lexical systems. During a blocked and gapped MRI experiment participants (N=10) named letter-strings aloud and accuracy scores were recorded. Regression analyses were run to examine the extent to which actual regular word (e.g., hint) naming accuracy could be predicted given irregular word (e.g, pint) and nonword (e.g., bint) or pseudohomophone (e.g., pynt) naming accuracy, and confirmed the mathematical assumption of independence between lexical and sub-lexical systems. The independence of functional neural systems was confirmed by examining fMRI activation maps that separate unique versus shared regions of activation, whereby there was significant unique activation for each stimulus type as well as significant shared activation between stimulus types. The present study provides strong support for a mathematically independent dual-route model (i.e., both behaviorally and functionally) of basic reading processes.

Poster Session H

Higher level cognition: Executive functions

H1

AN FMRI INVESTIGATION OF DENIAL AND DECEPTION *Christopher P. Said[1], Christopher D. Moore[1], Jonathan D. Cohen[1], Alexander Todorov[1]; [1]Princeton University* – Previous imaging studies of deception may have confounded cognitive arousal with deception. Because lie conditions may be perceived by participants to be more salient than truth conditions, classifiers trained on simple comparisons between truth and lie may in part be relying on different levels of arousal and associated cognitive processes between conditions, and thus may carry a high risk of false positives in applied settings. In this fMRI experiment, 13 subjects participated in a mock crime in which they "stole" a high-value money pouch and a low-value money pouch, while not stealing another high-value pouch and another low-value pouch. While in the scanner, subjects denied taking both the stolen pouches (lie condition) and the unstolen pouches (truth condition) to a naive experimenter who they believed was using an online classifier to detect lies. Critically, subjects believed that they could lose the money from any pouch the experimenter believed they were lying about, regardless of whether the experimenter was correct. Our results show brain regions significantly responsive to both the lie condition and high-arousal condition, suggesting that some regions previously implicated in deception may be driven by arousal.

H2

NEURAL CORRELATES OF PERCEPTUAL DECISION-MAKING IN HUMANS AND MONKEYS *Jack Grinband, Joy Hirsch, Vince Ferrera; Columbia University* – Although homology between monkey and human brain has been demonstrated in early sensory regions, it remains unknown whether functional homology extends to higher cognitive centers of the brain. The goal of our study was to identify the neural networks involved in making perceptual decisions and to determine the extent of homology present between humans and monkeys by studying both species under identical conditions. We trained two rhesus macaques to perform a speed categorization task. The stimulus consisted of randomly generated, coherently moving dots. The speed of the motion was randomized on each trial. Subjects indicated whether they perceived motion as "fast" or "slow" by making a saccade to one of two targets. The position of the targets was randomized from trial to trial to dissociate the categorical "fast/slow" decision from the motor response. Correct trials were reinforced with a juice reward. Five human subjects performed the identical task, also using saccadic responses and receiving juice rewards. Event-related fMRI was performed to identify task related neural activity. Humans showed significant activation related to the difficulty of the decision in anterior insula, medial frontal gyrus, ventral striatum, and dorsomedial thalamus, consistent with our previous results (Grinband, Hirsch, Ferrera. 2006. Neuron 49, 757-763). A comparison of the human and monkey data indicates that monkeys may use different brain regions from humans during perceptual decision making.

H3

ANTERIOR CINGULATE AND PREFRONTAL ACTIVITY AS CORRELATES OF ATTENTION SWITCHING AND CONSIDERATION OF MULTIPLE RELATIONS DURING TRUTHFUL AND DECEPTIVE RESPONSES: A BOLD IMAGING STUDY *Carmen Sanchez, Scott Meek, Michelle Phillips, Veena Nair, Adam Craig, Laura Jelsone, Laura Smarandescu, Deepa Vijayakumar, Jennifer Vendemia; University of South Carolina* – In a study with college-aged students (N=20) using directed deceptions during a sentence verification task with two stimuli, BOLD activations in the anterior cingulate and prefrontal cortex were measured. Although general comparisons were made between truthful and deceptive responses as well as switch vs. no-switch trials two further comparisons were made to address specific hypotheses. It has been debated whether or not the anterior cingulate activity observed during fMRI studies of deception is related to attention-switching alone or to both attention-switching and conflict resolution. In the current study, deceptive switch trials were compared to no-switch trials to answer this question. Some fMRI researchers argue that the anterior prefrontal cortex, specifically Brodmann's Area 10, is involved in the act of deception. ECD models of HD-ERP data have supported this supposition (Vendemia, 2003). Ramnani and Owen (2004) argue that this area is activated when an individual must make simultaneous considerations of multiple relations. When an individual deceives, these multiple relations may occur between situational context, goal-driven behavior, divergence of the deceptive information from truthful information, and a variety of internal states. Given the generalist nature of these "simultaneous considerations", it is no surprise that several researchers have identified activation in this region during the act of deception. Prefrontal activity during deceptive responding was contrasted with prefrontal activity during truthful responses in switch and no-switch conditions. The findings are discussed as they relate to early attentional mechanisms and decision making during deceptive responses.

H4

THE INFLUENCE OF CULTURE ON EXECUTIVE FUNCTION: AN ERP STUDY *Xiaoqin Mai[1], Chao Liu[1], Roma Sharma[1], Twila Tardif[1], Yuejia Luo[3]; [1]University of Michigan, [2]Beijing Normal University, Beijing, China* – Executive functioning plays a crucial role in early stages of mastering new skills. Recent studies have found that Chinese preschoolers outperform their U.S. counterparts on measures of executive function. However, we still do not know the behavioral and neural mechanisms of this cross-cultural difference and whether it applies to Chinese and US adults as well. To explore this phenomenon, 19 Beijing and 19 Ann Arbor college students were asked to perform a Stroop-like task in which they pressed a key in the direction a certain color [e.g., green] of fish was pointing (Congruent condition), and pressed a key in the opposite direction for fish of another color [e.g., red] (Incongruent condition). EEGs were recorded from 128 scalp sites using identical equipment and procedures across laboratories. In both groups, the reaction time was longer, and accuracy was lower in Incongruent than in Congruent conditions. Interestingly, US students responded faster than Chinese students for both conditions. ERP results showed that P300 amplitudes were also higher for US students than for Chinese students, which might suggest that US students devoted more resources to the task. We also observed two negative components, N240 and N430. The amplitude of these components is greater for Incongruent than for Congruent condition in both groups. This Stroop task requires subjects not only to inhibit a response, but also to execute a rule-guided action. Thus, N240 might reflect the processes of inhibitory control, and N430 may be related to executing the non-habitual behavior.

H5

DIFFERENCES IN THE NEURAL CORRELATES OF RESPONSE TIME VARIABILITY IN CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER *Stewart Mostofsky[1,2], Daniel Simmonds[1], Stacy Suskauer[1,2], Sunaina Fotedar[1], James Pekar[1,2], Martha Denckla[1,2]; [1]Kennedy Krieger Institute, [2]Johns Hopkins University School of Medicine* – Increased intra-individual response time (RT) variability is consistently found in attention-deficit/hyperactivity disorder (ADHD). It correlates with measures of response inhibition, another implicated deficit in ADHD. This study used fMRI to examine whether the neural correlates of efficient Go/Nogo task performance differ between children with ADHD and typically-developing (TD) controls. Twenty-four each of ADHD (15M) and TD (14M) children, ages 8-12 years, completed a Go/Nogo task with minimal cognitive demands. Stimuli were presented rapidly with a Go(green):Nogo(red) ratio of 3:1. The groups were matched on commission errors and RT variability, measured as: (standard deviation of RT)/(mean RT). Variability correlated with commission errors (r=.43,p=.001) and was more pronounced in ADHD (r=.54,p=.003). Correlational analyses revealed that lower variability in both groups was primarily associated with Go-activation in anterior cerebellum (culmen), with Nogo-activation in superior medial premotor areas (BA6/8) and with Go- and Nogo- activation in bilateral parietal regions (BA7/40). Higher variability in controls was associated with Go-activation in left postcentral gyrus (BA3) and with No-go activation in right middle frontal gyrus (BA46) and caudate, while in ADHD was associated with Go- and Nogo-activation in bilateral temporal regions, bilateral sensorimotor regions (BA3/4), anterior cingulate, bilateral inferior/orbitofrontal gyri (BA47/11) and insula. These findings suggest that the functional correlates of RT variability differ between TD and ADHD children, such that children with ADHD with less efficient performance do not sufficiently recruit parietal and medial premotor regions important for guiding and selecting/inhibiting responses; they instead rely on regions important for sensory-association processing, error-monitoring and higher-order cognitive control.

H6

THE DEVELOPMENT OF COGNITIVE CONTROL: AN ERP INVESTIGATION IN CHILDREN, YOUNG AND OLDER ADULTS *David Friedman, Yael M. Cycowicz, Cort Horton, Doreen Nessler, Marianne de Chastelaine; New York State Psychiatric Institute - CEPL* – Cognitive control becomes increasingly efficient throughout childhood into early adulthood and begins to lose its efficacy in old age. One such control process, response conflict detection, is critical for inhibiting inappropriate, competing responses. The amount of response conflict was assessed by measuring medial frontal negativity (MFN) amplitude in a flanker task in children (mean age = 9.5), young (23.3) and older (71.0) adults. A central arrow pointed to the right or left and flankers were congruent (C) or incongruent (I) with its direction. In the Same (S) and Opposite (O) conditions, subjects pressed a button corresponding, respectively, to the same or opposite direction of the central arrow. Children were less accurate than young and older adults. For all, RT showed I>C and O>S; this latter difference was greater in older than young adults and children. MFN showed I>C for older adults and children, but not young adults, whereas O>S for young and older adults but not children. Hence, when response conflict was moderate (incongruent flankers), children and older adults detected that conflict appropriately. However, when response conflict was heightened (O condition), children did not detect that conflict adequately, whereas older adults did but with large RT costs. These data suggest that conflict detection is relatively mature for moderate levels of conflict by the mean age of 9.5 and does not show age-related change. By contrast, the ability to deal with heightened levels of response conflict to inhibit inappropriate responses appears to undergo protracted development and is altered with aging.

H7

NEURAL DYNAMICS OF COGNITIVE CONTROL: EFFECTS OF ALCOHOL *Ksenija Marinkovic, Sheeva Azma; Harvard Medical School, Boston* – Moderate alcohol intoxication impairs executive functions by interfering with cognitive control: the ability to evaluate competing demands of a task and inhibit maladaptive responses. Healthy subjects took part in both alcohol (0.6 g/kg ethanol for men, 0.55 g/kg women) and placebo conditions as they participated in a modified 4-color Stroop task that combined reading and color naming. MEG signals were recorded from the whole head (Elekta Neuromag). Noise-normalized distributed minimum norm inverse solutions were constrained to each person's cortical surface reconstructed from high-resolution anatomical MRI scans and averaged across subjects.Alcohol lowered response accuracy overall. It attenuated early visual sensory processing and increased difficulty of semantic and contextual integration. In contrast to low-conflict conditions, incongruous stimuli elicited activity in distributed prefrontal regions indicating optimization of motor planning and execution. Alcohol reduced the prefrontal activity particularly on high-conflict trials, and increased contributions of the supplementary motor and anterior cingulate regions overall. This suggests compensatory engagement of this circuitry, reflecting increased effort in response selection, preparation and execution. The dorsal anterior cingulate area was engaged under alcohol conditions during the later stages of processing encompassing response execution and performance monitoring. Its activity was increased on error trials, particularly under alcohol. The observed impairment of cognitive control may provide insight into deleterious effects of alcohol on the strategic decision-making process in situations evoking inhibitory control, and could help elucidate the neural basis of the inability to refrain from drinking and the subsequent development of alcohol abuse and dependence. Supported by AA13402, ABMRF. P41RR14075, MIND.

H8

DELAY DISCOUNTING DEPENDS ON GENERAL INTELLIGENCE: EVIDENCE FOR SEPARABLE COMPONENTS AND DISSOCIABLE NEURAL MECHANISMS *Noah A. Shamosh, Colin G. DeYoung, Deidre L. Reis, Jeremy R. Gray; Yale University* – Delay discounting (DD), which reflects preference for smaller, sooner rewards over larger, delayed ones, may depend on differences in working memory capacity (WMC; Hinson, Jameson, & Whitney, 2003). Because WMC is strongly associated with general intelligence (g), the relative influences of WMC and g on DD remain unclear. To tease apart these influences, we analyzed data from 101 participants who completed measures of intelligence and WMC, and were then scanned with fMRI during a demanding working memory task (3-back). Although both g and WMC were associated with DD (r(99)=-.42, p<.001 and r(99)=-.24, p=.017, respectively), g showed a unique association with DD (beta=-.45, t(98)=3.84, p<.001) whereas WMC did not (beta=.043, t(98)<1). In the scanner, neural activity during the 3-back task was correlated with performance (p<.05, FWE) in three regions of interest within bilateral anterior prefrontal cortex (BA 10) and right superior parietal cortex (BA 7). Higher g was associated with greater activity during the 3-back in all three regions. Critically, activity only in the left BA 10 region of interest was associated with DD, and this activity partially mediated the g-DD relation (standardized indirect effect =-.061, p=.038). The results suggest that DD depends on g, not WM capacity specifically, and that dissociable neural mechanisms mediate this relation. The specificity of these mediating mechanisms suggests that integration of complex, goal-relevant information may play a more important role in DD than does executive control of attention.

H9

IMPAIRED RESPONSE SWITCHING ON SACCADE TASKS IN SCHIZOPHRENIA *Cosima Franke, Benedikt Reuter, Lisa Schulz, Norbert Kathmann; Humboldt-Universität Berlin* – To specify deficits of action control in schizophrenia we studied the effects of switching between rightward and leftward prosaccades and antisaccades. Previous research with healthy subjects suggested that task switch effects (between pro- and antisaccades) reflect the persistence of a task-specific production rule and refer to the level of task selection, whereas response switch effects (between leftward and rightward saccades) point to the persistence of a specific motor program, referring to the level of response selection. The present study investigated task switching and response switching in 20 schizophrenia patients and 20 control subjects. Groups did not differ concerning task switch effects. In contrast, response switching entailed a stronger enhancement of error rates in patients, suggesting a specific deficit on the level of response selection in schizophrenia. In addition, response switch effects for healthy subjects were smaller than in previous studies, presumably due to a longer inter-response interval in the present study. A second study is being conducted to investigate the effects of different inter-response intervals on response switching both in schizophrenia patients and healthy subjects.

H10

MODULATION OF THE FEEDBACK RELATED NEGATIVITY BY EXPECTATION AND LEARNING IN A CATEGORIZATION TASK. *Dan Lopez-Paniagua, Marc Richard, Mark Towne, Carol Seger; Colorado State University* – The feedback related negativity (FRN) is an event related potential (ERP) component that follows the receipt of negative feedback during learning, and is believed to signal activity in the medial prefrontal brain regions involved in performance monitoring. Moreover, medial prefrontal regions are modulated by ascending dopaminergic projections that signal violations of reward expectancy. We examined how the FRN was modulated by feedback expectancy and learning using a simple categorization task. On each trial, subjects viewed individual pictures of college students, decided for each which of two sections of a course he or she typically attended, and then received feedback as to whether the decision was right or wrong. Pictures of eight different college students were studied; two had a deterministic relationship with the course sections (always attended section 1 or always section 2), four had a probabilistic relationship (In section 1 80% of trials and in section 2 20% of trials, or vice versa) and two were random (50% of trials in each section). We examined the feedback related negativity (FRN) which was time-locked to the receipt of feedback, and found that the FRN was modulated by feedback expectancy rather than the mere presence of negatively valenced feedback.

H11

COGNITIVE BENEFITS AND NEURAL PROCESSING FOLLOWING EARLY AND CONTINUED ARTS TRAINING IN DANCE *Melody Berens[1], Ioulia Kovelman[1,2], Katherine White[1], Mark Shalinsky[1,3], Ryan Gramacy[1], Laura-Ann Petitto[1]; [1]Dartmouth College, [2]MIT, [3]Harvard MGH* – A hotly debated topic is whether early extensive Arts training (e.g., dance) affords advantages to other higher cognitive abilities. Studies have supported this hypothesis (e.g., Schellenberg, 2004), but the existence and duration of such cognitive benefits remains unclear. Experiment 1 asked whether early, extensive, and maintained dance training yields long-term cognitive benefits. Experiment 2 used Near-Infrared Spectroscopy (Hitachi ETG-4000), which, like fMRI, measures hemodynamic change, to investigate neural processing in Dancers and Non-Dancers. "Dancers" had (i) >8 years dance training, (ii) begun before age 7, (iii) training into adulthood, (iv) professional performances, and (v) reported dance pleasurable. Experiment 1- 30 participants (15/group), tasks: (a) Language, (b) Attention (SRC & Flanker), (c) Dance/Walk Perception, (d) Verbal/Nonverbal measures. Significant results: Dancers performed more accurately than Non-Dancers on the SRC task ($p < .03$) and faster on the Dance/Walk Perception task ($p < .015$). Experiment 2-17 participants (8 Dancers, 9 Non-Dancers), task: Dance/Walk Perception. Significant results: Group x hemisphere interaction revealed that Dancers had greater Right than Left hemisphere Parietal activation; Non-Dancers showed the reverse pattern ($p < .02$). Notably, both groups exhibited similar activation patterns on Walk, with lateralization differences emerging only on Dance. Significance: While predicted that Dancers would exhibit superior perception of dance movements, surprisingly, Dancers were faster than Non-Dancers when processing walking, revealing facilitation in processing of biological motion that extended to everyday walking. Extensive training in the Arts may afford long-term advantages to other higher cognitive abilities; such training may also alter neural processing.

H12

NEUROPHYSIOLOGICAL CORRELATES OF ERROR DETECTION IN PERFORMING MUSICIANS *Clemens Maidhof, Martina Rieger, Wolfgang Prinz, Stefan Koelsch; Max Planck Institute for Human Cognitive and Brain Sciences* – Playing a musical instrument at a professional level is a highly demanding task requiring the constant monitoring of ones own actions in order to achieve correct performance. By using auditory, visual and somatosensory feedback, it is possible to detect and subsequently correct errors. Because of the precision required for music performance, monitoring and detecting errors should be highly developed processes in musicians. Therefore, the aim of this study was to investigate the neurophysiological correlates of error detection in performing musicians. Twelve pianists participated in an experiment comprising an active performing condition and a passive perception condition. In the action condition, they were asked to play fast tone sequences bimanually on an E-Piano. Event-related potentials (ERPs) for random auditory feedback manipulations (shifts of one semitone) and ERPs for self-made errors were computed. In the perception-condition, the task was to listen to those sequences, also containing random pitch manipulations of one semitone. Analogously, ERPs for these pitch manipulations were computed. The results of the action-condition showed that feedback manipulations elicited an early feedback error-related negativity (feedback ERN), while pitch manipulations in the perception-condition also elicited a potential similar to the feedback ERN, but which was considerably smaller than in the action-condition. This implies that error detection mechanisms appear to be enhanced by action-related expectations. The ERPs in response to the self-made errors showed a positive deflection beginning already prior to the onset of the tone, suggesting that not all error-related mechanisms during piano performance do rely on auditory feedback.

H13

IS MENTAL EFFORT AVERSIVE? SOME BEHAVIORAL AND PSYCHOPHYSIOLOGIC EVIDENCE *Zev Rosen[1], Matthew Botvinick[2,1]; [1]University of Pennsylvania, [2]Princeton University* – Behavioral and economic theories have long maintained that actions are chosen so as to minimize demands for exertion or work, an idea formalized in Hull's well-known law of least effort. The data supporting this idea pertain almost entirely to physical effort. However, the same principle is also often assumed to apply to mental effort. We set out to evaluate the validity of this assumption. In two behavioral experiments, participants chose freely between courses of action associated with different levels of cognitive demand. Both experiments revealed a marked bias in favor of the less demanding course of action, even among participants who were unable to report the basis of their decisions. Two further experiments leveraged the finding that a skin conductance response (SCR) occurs prior to actions linked with aversive outcomes. During performance of our choice task, participants displayed an elevated SCR just prior to opting for the high-effort course of action. Based on these findings, as well as convergent neuroimaging evidence, we propound a law of least mental effort.

H14

TESTING IMPULSIVE DECISION MAKING WITH THE NOVEL TIME CONFLICT TASK *Ahmed Moustafa[1], Mike Cohen[2], Michael Frank[1]; [1]University of Arizona, [2]University of California Davis* – We present a novel "time conflict" (TT) task for assessing the neural mechanisms of impulsive decision making. Subjects are presented with a clock face whose arm makes a full turn over the course of 5s. They are instructed to press a key at some point before the arm makes a full turn. They score points after each response. Reward magnitude increases while the reward probability decreases over time within each trial. Depending on the task block, the integrated expected value either decreases (DEV), increases (IEV), or stays constant (CEV). This manipulation results in conflict between reward frequency and magnitude as time elapses: In the IEV condition, the longer the subject waits, the less likely s/he will receive a reward, but the larger the potential gain. In contrast, in the DEV condition faster responses will yield more points on average. In pilot testing, subjects adaptively modulated reaction times, responding faster for DEV and slower for IEV, relative to CEV. Post-experiment debriefing showed that subjects were unaware of differential change of reward frequency and magnitude. Our neurocomputational model suggests that the ability to slow RT's for high conflict decisions depends on the subthalamic nucleus. We will present data from Parkison's patients on and off deep brain stimulators (DBS). Our computational model predicts that

DBS should cause impulsive responding by preventing patients from slowing RTs in IEV relative to CEV, together with intact abilities to speed responses in DEV.

H15

NO-GO N2 AND RESPONSE INHIBITION IN GERIATRIC DEPRESSION. *Richard Katz[1], Filip DeSanctis[2], Christopher Murphy[1], Glenn Wylie[3], George Alexopoulos[1], John Foxe[2]; [1]Weill Medical College of Cornell University, [2]The Nathan Kline Institute for Psychiatric Research, [3]Kessler Medical Rehabilitation Research and Education* – Depression is associated with executive dysfunction. Frontostriatal dysfunction leads to development of depression and executive dysfunction in the elderly. The anterior cingulate cortex (ACC) is believed to play a central role. Here we use event-related potentials (ERPs) to measure prefrontal dysfunction using the no-go N2 ERP component, in depressed and non-depressed older adults. The no-go N2 is believed to be generated by the ACC and may vary in amplitude based on the degree of neuronal activity required for response inhibition. We recruited 8 older adults with major depression (mean age=73 yrs) and compared them with 8 age-matched controls. ERPs were acquired from 64 scalp electrodes during a go/no-go task. The N2 amplitude was smaller for depressed subjects (1.04mv) compared to controls (2.37mv), p=0.012. The depressed group had a 100ms lag in RT compared to controls. Accuracy between the two groups were relatively the same. To our knowledge, this is the first report of low N2 amplitude during performance of a go/no-go task in geriatric depression. This finding is consistent with clinical and neuroimaging evidence of frontostriatal dysfunction in geriatric depression.

H16

MOTIVATIONAL INFLUENCES ON RESPONSE INHIBITION MEASURES *Lauren Kaplan, Tor Wager; Columbia University* – Psychological research has placed great emphasis on understanding inhibitory control, largely because of its integral role in normal cognition and behavior, as well as its apparent deficit in ADHD and other clinical disorders. The stop-signal paradigm is a promising task for assessing the ability to inhibit responses. However, the models typically employed to analyze performance on this task do not effectively disentangle the ability to inhibit responses from strategic biases related to speed-accuracy tradeoffs. In the present study, we conceptualize stop-signal performance as a decision-making task involving strategic allocation of resources. In a series of experiments, monetary rewards and losses were varied systematically to manipulate strategy in several variants of the stop-signal task. To separate the influence of strategic bias from measures of inhibitory control ability, we develop a model analogous to the receiver operating characteristic (ROC) for stop-signal performance. Varying reward contingencies and modeling both reaction time (RT) and stop-signal distributions using ex-gaussian functions, we calculate response curves for varying strategic go-speed / stop-accuracy tradeoffs. Participants slowed responses and made fewer false alarms as payoffs favored accuracy over speed. SSRT estimates also varied as a function of strategic control, overestimating stop latency when speed was favored and underestimating stop latency when accuracy was favored. We present an improved measure of inhibitory control that may provide more accurate and reliable measures of individual differences in inhibitory capabilities.

H17

THE ROLE OF THE BODY IMAGE IN THE MONITORING OF ACTION IN SCHIZOPHRENIA. A CONTROLLED STUDY USING VIRTUAL REALITY AND INTERACTIVE MULTIMEDIA TECHNIQUES. *Elise Lallart[1], Roland Jouvent[1], Xavier Lallart[2]; [1]La Salpetriere Hospital, [2]Ville Evrard* – Patients with delusions of control are not normally aware of the consequences of their actions and encounter difficulties correcting their movements. As a result, they think that they are a passive instrument in the hands of an external will and therefore attribute their actions to others. The delusion of influence is another example of a lack of congruence between the intended actions and their sensory consequences. In a more general view, several authors consider the disruptive mechanism of attribution of actions as one of the essential etiopathogenic mechanisms of schizophrenia. In this study we evaluate the efficacy of the monitoring of action in a group of schizophrenic subjects (PANSS) compared with controls. We use new interactive technologies, which offer the opportunity to involve the user's body in a virtual environment while seeing herself/himself performing the actions. Therefore the subject is not only an agent during the test, but also sees himself being the actor. We were interested to see if the visual perception of the body as a whole would reinforce the monitoring of the action. Consequently, we alternated two conditions: a control condition and a second one in which we hide the central part of the body. In this latter condition, the subject only sees his arms moving. The results show that the alteration of the body image modifies the performances in normal subjects. Nevertheless, schizophrenics are less perturbed when they don't see the totality of their body image, suggesting a defect in whole body integration.

H18

A LATERALIZED NON-VERBAL STROOP TEST *Nooshin Yashar[1], Michelle Fourney[1], Dena Elperin2, Herzberg Kristin[3], Nancy Sin[1], Leonardo Fernandino[1], Eran Zaidel[1]; [1]UCLA, [2]Department of Psychology, UC Berkeley, [3]Department of Psychology, SUNY Albany* – We constructed a non-verbal test, pairing colors (red, yellow) with emotional cartoons (angry face, happy face). The tasks were to identify the color or to identify the emotion. We studied the following properties of the test: (1) speed asymmetry between Color and Emotion identification, (2) asymmetry of the Stroop effect between the two tasks, and (3) adequacy of the speed and automaticity accounts of the Stroop effects. Happy and angry cartoon faces were surrounded by red or yellow backgrounds. One of the four combinations was presented tachistoscopically to the left or the right visual hemifield. Subjects were asked to indicate the color or the emotion by a two-choice button press. Experiment 1 showed an overall left visual hemifield advantage, a task asymmetry (Color faster than Emotion), an asymmetric Stroop effect (larger in the Emotion task), and no correlation between the task asymmetry and the Stroop effects. Experiment 2 replaced the cartoons with real emotional faces. There was no Stroop effect in either task. Experiment 3 repeated experiment 1 and asked participants to rate their degree of familiarity with the association between the colors and cartoons. The results replicated experiment 1 and showed no correlation between degree of familiarity of the color/cartoon association and the Stroop effects. The Stroop effect is diluted by the spatial separation of the color and the cartoon face, as well as by non-verbal responses. Nonetheless, there was a significant Stroop effect, which was not due to either speed or automaticity differences between the two tasks.

H19

AGE DIFFERENCES IN DEMAND-RELATED ACTIVATION AND DEACTIVATION: EVIDENCE FROM TASK-SWITCHING IN YOUNG, MIDDLE-AGED, AND OLD ADULTS *Cindy Lustig[1], Denise Head[2], William E. Janes[2], Randy L. Buckner[3,4]; [1]University of Michigan, [2]Washington University in St. Louis, [3]Howard Hughes Medical Institute, [4]Harvard University, Harvard Medical School, and Massachusetts General Hospital* – Tasks with high demands for controlled, effortful processing typically activate frontal-parietal networks, and can be especially difficult for older adults. We report data from a study contrasting behavioral reaction times (RT) and fMRI activations during conditions that vary the demand for control in young (24 yrs, n= 44), middle-aged (49 yrs, n = 41), and old adults (74 yrs, n=90). In the low-control condition, participants perform the same task throughout the run. In the high-control condition, participants switch tasks at unpredictable intervals in response to a cue. Age and control demand were associated with increased RT and frontal-parietal response. Aging was associated with greater load-sensitive responses in dorsal prefrontal cortex (left BA 6/44). More ventral regions (bilateral BA 45/47) were not significantly activated by young adults. By contrast, middle-aged participants activated these regions in the high-demand condition, and older adults showed even greater demand-related increases in activation. Medial prefrontal and posterior cingulate regions showed little response in any group in the low-demand condition. Young and middle-aged adults deactivated these regions in the high-demand condition, but older adults did not. Correspondence between regions showing increased activation as a function of old age and those showing increased activation as a function of control demand suggests that older adults may recruit controlled processing at nominally lower levels of demand, but like young adults, can increase activation in response to increased demand. Age differences in deactivations may reflect either compensatory strategies or a failure to inhibit task-unrelated processing. Support Contributed By: NIH and HHMI

H20

PREPARATORY ATTENTION AND READINESS FOR COGNITIVE CONFLICTS *And Turken[1], Diane Swick[1,2]; [1]VA Northern California Health Care System, Martinez, CA, [2]UC Davis Neurology Department* – We investigated the relation between preparatory activity, as reflected in the contingent negative variation (CNV), an event-related potential (ERP) component that occurs in anticipation of oncoming stimuli, and performance in a cognitive conflict task. Electroencephalographic signals were recorded from 20 subjects while they performed a variant of the Stroop task with congruent and incongruent trials and low and high conflict conditions. An instruction cue preceding the stimulus by 1400 ms indicated which of two stimulus dimensions should be attended to on each trial. Mean amplitude of the late CNV (1000-1400 ms), at fronto-central electrodes was used as an electrophysiological marker of task set preparation. Faster reaction times on both congruent and incongruent trials were associated with larger CNV amplitudes, consistent with higher levels of cognitive and motor readiness. In the high conflict condition only, the CNV difference between fast and slow response trials was significantly larger when stimuli were incongruent. In order to control for the contribution of motoric aspects of preparation, congruent and incongruent trials matched for reaction time and trial history were compared. CNV amplitude was larger on incongruent trials than congruent trials only in the high conflict condition, indicating that a higher level of preparation is required to maintain the same performance level when conflicts occur. These results are consistent with the idea that higher levels of preparatory brain activity reflected by the CNV is associated with better performance, particularly when conflict monitoring and resolution are required.

H21

HOLD YOUR HORSES! TESTING THE RACE MODEL OF RESPONSE INHIBITION *Fenna Krienen, David Badre, Mark D'Esposito; University of California, Berkeley; Helen Wills Neuroscience Institute* – The ability to inhibit unwanted or irrelevant thoughts and actions is central to cognition. Response inhibition has been conceptualized as a general, central capacity and as independent of the pathway that leads to the emission of a response. Deriving from this perspective, recent neuroimaging and neuropsychological evidence implicating the right inferior prefrontal cortex in the inhibition of an already initiated manual response (the stop-signal task) has led to the proposal that the right inferior prefrontal cortex is the site of a general capacity inhibitory system. Critically, however, the assumption that the stop-signal task or other inhibition-based tasks are reflective of a central inhibition faculty remains to be tested in a within-subjects design. Additionally, a broad range of actions has not yet been systematically tested using the same paradigm. Here, we investigate the hypothesis of cross-modal differences in response inhibition. Subjects responded to Go signals and attempted to inhibit the initiated response to occasional Stop signals. Stimuli required either spatial or semantic judgments (Content), and subjects responded with manual key presses or verbal utterances (Output). Initial results suggest that correlations in stop signal reaction time (SSRT) may differ between Content and Output. We consider the implications of these results for the independence assumption between going and stopping processes in the stop signal task, the central capacity formulation of response inhibition, and the validity of drawing inferences about inhibitory performance in one domain based on performance in another.

H22

DOES MULTI-TASKING AFFECT ACTION MONITORING? *Adrian Willoughby, Diane Swick; VA Northern California Health Care System, University of California, Davis* – Because multi-tasking is commonplace in today's hectic society, much research has focused on the effects of performing more than one task simultaneously. Typically, these studies investigate whether performance of one task affects performance on another. However, it is also important to know whether monitoring processes are impaired. That is, not only could multi-tasking lead to the commission of more errors, but a compromised error detection system could result in errors having more serious consequences. The Error-Related Negativity (ERN) has been proposed as an electrophysiological correlate of several monitoring processes, including error detection and conflict monitoring. Therefore, examining its behaviour under dual-task conditions may help elucidate both its underlying psychological processes and whether these processes can, in fact, be compromised by performing a concurrent task. Participants performed an arrow flanker task both in isolation and during the delay period of a Sternberg memory task. Dual-task difficulty was manipulated by using a memory load of either four or seven letters. Preliminary results with eight subjects do not show any significant difference in the amplitude of the ERN across either the single- or dual-task conditions or across the different memory loads in the dual-task condition. A tentative conclusion is drawn that the psychological processes underlying the ERN do not share the same resources as those required by the Sternberg memory task and are not affected by the reallocation of attention between the two tasks.

H23

DISSOCIATING LEVELS OF COGNITIVE CONTROL IN FRONTAL CORTEX HIERARCHY: EVIDENCE FROM PATIENTS WITH FOCAL LESIONS *Joshua Hoffman, David Badre, Taylor Berg-Kirkpatrick, Fenna Krienen, Jeffrey Cooney, Mark D'Esposito; University of California, Berkeley, Helen Wills Neuroscience Institute* – The prefrontal cortex (PFC) supports flexible, goal-directed behavior. However, the organization of the PFC remains unknown. One hypothesis is that the PFC is organized hierarchically, based on the level of abstraction at which multiple representations compete to guide selection of action. In a recent fMRI study consistent with this hypothesis, we demonstrated that increases in competition among alternative (a) responses, (b) response-relevant features of a cue, (c) response-relevant dimensions of a cue, and (d) overlapping context-to-dimension mappings were respectively associated with discreet regions of activation in progressively anterior regions of PFC. The present study sought to test the necessity of the PFC sub-regions, identified with fMRI, in selection at different levels of representation (a-d). Neurological patients with focal lesions of lateral PFC were tested on a behavioral version of the tasks used in the fMRI study. Behavioral data were analyzed using an observer independent method in which patient structural data are normalized to a canonical space and then group lesion overlap maps are generated. These maps are then weighted by each patient's behavioral performance relative to controls. Initial results suggest that the site of injury along the posterior to anterior axis of PFC may determine the pattern of impairment on tasks taxing sub- and superordinate levels of the hierarchy. These results provide important insights toward a general understanding of the organization of PFC and cognitive control processes that it supports.

H24

TEMPORAL DYNAMICS AND REPRESENTATIONAL SELECTION IN FRONTAL POLAR CORTEX *David Badre, Mark D'Esposito; Helen Wills Neuroscience Institute, UC Berkeley* – Neuroimaging evidence has associated activation in frontal polar cortex (FPC) with second-order control functions, like subgoaling, integration of internal representation, and the selection of abstract action representations. In parallel findings, activity in FPC is also distinguished from more posterior PFC subregions in that it commonly demonstrates a sustained, as opposed to transient, response that spans multiple trials. This has lead to the attribution of state-based functions to FPC. However, higher-order representations, by virtue of their abstractness, tend to be relevant over longer periods, and so it is unclear if FPC is distinguished from posterior PFC regions based on its temporal dynamics or the representations that it processes. In the present experiment, control demands were manipulated at two levels of representation by varying (1) the number of dimensions of a cue relevant to a response and (2) the relative overlap of contextual cue-to-dimension mappings. These manipulations were pitted in a factorial design against the latency over which these representations were relevant to the selection of a response. Preliminary analysis suggests that activity in FPC, as well as in lower-order PFC subregions, is determined by the level of representation to be selected rather than the frequency with which representations are updated. These initial results suggest that hierarchy in PFC may be ranked based on representational abstractness rather than temporal dynamics.

H25

ISOLATING INHIBITION IN THE STOPPING OF MOTOR RESPONSES *Chelan Weaver, Michael Anderson; University of Oregon* – Motor-stopping tasks such as the stop-signal paradigm have been developed to measure people's ability to stop prepotent motor responses, a capacity long assumed to involve inhibition. Although this paradigm clearly quantifies an aspect of stopping, it has never before been shown that the facility measured by this task is implemented by inhibitory control. In cognitive tasks, as discussed by Anderson and Spellman (1995), it is possible to isolate the contribution of inhibition by measuring the aftereffects on a supposedly inhibited representation to determine whether the ability to use that representation is degraded. Anderson & Spellman (1995) developed the independent probe method as a tool for dissociating the effects of inhibition from other sources of performance decrements, such as associative interference, that might contribute to impaired responding. Incorporation of the logic of the independent probe into an adapted stop-signal task confirmed the involvement of inhibitory control in the revocation of a motor response. These findings provide a novel measure of inhibition, measuring the aftereffects of inhibition rather than stopping speed. This paradigm also enables identification of the separate contributions of response-specific inhibition and generalized slowing due to alerting effects of the stop tone. By establishing that response inhibition is a component of motor stopping with an independent probe, this work provides a new measure of inhibition that is parallel to that developed in the study of cognitive inhibition, providing an important first step toward understanding response inhibition across domains.

Higher level cognition: Other

H26

NEURAL EVIDENCE THAT WORKING MEMORY LOAD BOOSTS LEARNING IN A BLOCKING PARADIGM *Christian Luhmann, Nicholas Turk-Browne, Marvin Chun; Yale University* – Blocking is a classic phenomenon in which learning is suppressed when events are completely predictable on the basis of prior learning. Associative learning theory, which is based on the notion of prediction error, has been employed as the traditional explanation of the blocking effect: blocking occurs because predictable events do not produce any error. However, critics of associative theory have demonstrated that performing a difficult secondary task during causal-associative learning attenuates blocking. These critics conclude that concurrent load disrupts the application of high-level rules, supporting a non-associative account of blocking. The current event-related fMRI experiment sought to distinguish between these alternative accounts of blocking and to understand the impact of load on learning. Subjects completed two runs of a causal-associative learning task, one with load and the other without load. Blocking was only observed in the behavioral judgments in the absence of load. Likewise, BOLD activation in right prefrontal cortex exhibited the traditional blocking effect without load. In contrast, under concurrent load, the neural blocking effect in this region was significantly reduced. Critically, activity in this region also conformed to a variety of additional predictions from associative learning theory, confirming that, as in previous studies, this region reflects prediction error. These results suggest that working memory load interferes with the suppression of learning typically observed when an outcome is fully expected, supporting a modified associative account in which working memory-dependent processes (e.g., attention) are critical for learning.

H27

MAPPING FUNCTIONAL CORRELATIONS IN THE BRAINS OF TWINS *Philippe Pinel[1], Fabien Fauchereau[2], Thomas Bourgeron[2], Denis LeBihan[3], Stanislas Dehaene[1]; [1]INSERM Unit 562, [2]Institut Pasteur, [3]CEA* – Exploring the genetic influence on cerebral activation patterns is a recent challenge of neuroimaging. Previous research has shown that targeted individual polymorphisms in certain genes of interest may modulate fMRI responses in task-related brain areas. On the other hand, other papers have demonstrated genetic influences on brain anatomy. However, there is still no study of the effect of overall genetic similarity on functional brain organization, especially for high-level human cognitive functions such as language or arithmetic, even if several studies stressed the importance of genetic factors in related disabilities. To address this issue, we studied fMRI data of three populations of healthy male subjects characterized by their degree of genetic similarity: monozygotic (MZ) twins who share 100% of their genes, dizygotic (DZ) twins who share, on average, half of their genes, and unrelated subjects who present different patterns of polymorphisms. Given that we are in the early stages of mapping genetic influences onto fMRI activations, we developed a functional paradigm that covers a broad variety of cortical territories, from sensory-motor processing to higher-level cognitive functions: parietal activations sustaining ocular saccades and number manipulation, superior temporal activations related to recognition of sounds, human voice or speech comprehension, and inferior temporal activations related to various categories (e.g., faces, houses, and words). We report here the correlation, both at the overall circuit level (overall correlation of functional substrates) and at the voxel level for each functional task, between MZ, DZ and unrelated pairs of subjects.

H28

PERSPECTIVE-TAKING IS DIFFERENT FROM EVALUATING SELF AND OTHERS: AN ERP STUDY *Elizabeth J. Simon[1,2], Heather Henkell[1,2], Sarit A. Golub[1,2], Elizabeth Diamond[1], Margo Kakoullis[1], Ray Johnson Jr.[1,2]; [1]Queens College/CUNY, [2]The Graduate Center of CUNY* – Theory of Mind (ToM), defined as the ability to make inferences about another person's mental state, may use one's own mental processes as a model. Imaging studies of ToM have found different patterns of brain activity when comparing self-evaluation to either perspective-taking or evaluating another person. It remains unclear whether perspective-taking is different from one's opinion/evaluation of the other person. An event-related potential (ERP) study was conducted in which participants viewed personality trait words and evaluated, in different conditions, whether the word described themselves (Self), a person close to them (Close Other), or a person not close to them, but they still knew (Non-Close Other). In the two perspective-taking conditions, participants made responses by putting themselves in the Close Other's and Non-Close Other's shoes. Reaction times were not significantly different across conditions. Recordings from 83 scalp sites revealed a differential pattern of activation in which medial frontal activity preceded that in the anterior prefrontal cortex in the 700 ms leading up to the response. These spatial and temporal patterns differed as a function of perspective (self, other evaluation, perspective-taking). The patterns were also different depending on whose perspective was being taken (Close Other, Non-Close Other). These data fit with previous findings that both these frontal areas are involved in self-referential and ToM tasks. The differences between the Close Other and Non-Close Other conditions will be discussed in terms of overlap with the Self. The results indicate that perspective-taking and evaluating others involve different cognitive processes arising from different brain areas.

H29

OBSERVING OTHERS' ACTIONS TOWARDS AND AWAY FROM HARMFUL OBJECTS: AN FMRI STUDY *India Morrison[1], Patric Bach[2], Steven Tipper[2]; [1]Sahlgrenska Hospital, Gothenburg University, [2]University of Wales, Bangor* — Recent neuroimaging and behavioral evidence indicates that the brain uses some of the same mechanisms during the observation of others' pain as it does during the direct experience of pain. These studies have explored observers' responses to painful events happening to other people, when the other person is a passive target of painful stimulation. So far, no study has investigated the effects of pain observation when the painful event is the consequence of the observed person's own action. In the present fMRI study, subjects viewed short clips of others' hands grasping or withdrawing from objects which were either noxious or innocuous. We found that the type of action and the noxiousness of the object affected reaction times and influenced the hemodynamic responses in dissociable pathways, reflecting affective motor, and sensory components of pain representation (such as anterior cingulate, insula, and secondary somatosensory cortices). These findings imply that when pain observation occurs in the context of goal-directed agent-object interactions, the underlying neural processing supports a multi-component, behavior-centered representation of the other person's action that incorporates not only its sensorimotor features, but also the action's motivational and affective aspects.

H30

EVENT-RELATED RESPONSES TO WORDS: THE EFFECTS OF CLASS, CONTEXT & TIMING. *Lea Pilgrim, Rhonda B. Friedman; Georgetown University* – Studies using event-related potentials (ERPs) have identified a negative component—the N400—thought to reflect semantic processing. Research has generally found a reduced N400 for closed class compared to open class words. Here we consider the effects of word class, context and timing on reading. All three variables have been shown to affect word reading; however their possible interaction has not yet been examined. ERPs were recorded from electrodes at 64 scalp locations while subjects silently read 340 open class and 174 closed class words, presented one-at-a-time, for 400ms each. Words were presented in two contexts: sentence and word-list, with two SOAs (stimulus onset asynchrony): 800ms and 1200ms. To ensure subjects were attending to the stimuli, they answered sentence- or word-related questions orally after presentation of each sentence or list. Our results showed a significant three-way interaction between word class, SOA and context. The mean amplitude of the N400 was smaller for closed compared to open class words in the sentence context (with no effect of short versus long SOAs for closed class words). However, closed class words showed a significantly larger N400 (comparable to open class words) in the word-list context compared to sentence context. This negativity was even larger at the longer SOA. We discuss these findings in relation to the processing of different word classes in normal readers. In addition, we consider how these findings impact on our model of reading deficits in phonological alexics.

H31

THE EFFECTS OF CONTENT ON DEDUCTION: A MULTI-VOXEL PATTERN ANALYSIS OF NEURAL SIMILARITY. *Martin Monti[1], Lawrence Parsons[2], Daniel Osherson[1]; [1]Princeton University, [2]University of Sheffield* – The ability to draw secure inferences from previously acquired information is a distinguishing feature of human intellect. We recently proposed (Parsons et al. 2006) that deductive reasoning engages a distributed network of regions that is (a) disjoint from regions traditionally associated with linguistic processing, and (b) organized into: (i) logic regions containing a deductive calculus and sensitive to the formal structure of argument (e.g. BA10, 8medial, BA6,7,40,47); and (ii) regions selectively engaged by the specific lexical content of an argument (possibly responsible for maintaining the identity of different phrasal constituents within an argument). In a single trial fMRI experiment healthy individuals assessed the validity of a set of 8 logic forms (half invalid). Each structure was presented twice with contents referring to features of an imaginary face and twice with contents referring to features of an imaginary house. Using a novel multi-voxel pattern analysis (MVPA) we compared patterns of activation within each region across trials with identical logic but different content versus trials with similar content but different logic. Observed patterns of neural similarity supported the classification (i) versus (ii) above. For the regions in (i), greater similarity of activation patterns was associated with arguments of the same formal structure. For the regions in (ii), with a sole exception, greater similarity of activation patterns was associated with arguments of the same lexical content.

H32

SELF-REFERENTIAL EVALUATIONS OF TRAITS AND VALUES DO NOT RELY ON EPISODIC MEMORY: AN ERP STUDY *Heather Henkell[1,2], Elizabeth J. Simon[1,2], Kristen Gillespie[1], Yael Diamond[1], Ray Johnson Jr.[1,2]; [1]Queens College/CUNY, [2]The Graduate Center of CUNY* – The role of memory in self-referential decisions (e.g., whether a trait adjective is self-descriptive) is not well understood. According to the “computational view,” these decisions rely on episodic retrieval whereas the “abstraction view” proposes dependence on retrieval of trait summaries abstracted from episodic memories (Klein et al., 2002). Because distinguishing between these theories is difficult using behavioral data, we assessed the role of episodic retrieval processes using event-related potentials (ERPs). We looked for the presence of the parietal episodic memory (EM) effect, an ERP component shown to reflect the use of recollective processes during episodic retrieval. Recordings were made from 83 electrodes while participants made evaluations about three types of stimuli: 1) whether traits (e.g., honest) described them, 2) whether they agreed or disagreed with value items (e.g., murder) and 3) whether personal facts (e.g., occupation) applied to them. Non-self-relevant semantic decisions (active/passive) were made as a control. Reaction times varied across conditions (personal facts < traits < values). ERPs elicited by evaluations of all three types of stimuli elicited activity in medial brain areas associated with processing of the self (e.g., anterior prefrontal cortex, ACC, precuneus) in the 600 ms preceding and 150 ms after the response. Personal facts elicited the typical parietal EM effect, indicating these decisions were based on recollective processes. In contrast, no parietal EM effect was found for evaluations about either traits or values, suggesting they are not based on specific episodic memories. Hence, these results do not support the computational view of self-referential decisions.

H33

NEURAL CORRELATES OF REWARD EXPECTANCY DURING INSTRUMENTAL LEARNING *Samantha Crowe, Charlene Wu, James Blair; National Institute of Mental Health, Mood and Anxiety Disorders Program, Bethesda, MD* – To investigate the brain regions involved in reward expectancy during instrumental learning, we used event-related fMRI (1.5 Tesla) to examine BOLD responses in healthy adults (N = 18) while they performed a conditional discrimination task. During the task, correct behavioral responses (button presses) to visual stimuli received point rewards. Each stimulus had a corresponding correct button such that there were 4 button choices for each set of 4 stimuli. Our goal was to examine cue- and reinforcement-dependent activity in the amygdala and medial orbitofrontal cortex as a function of learning. The ISI between cue and reinforcement was jittered (from 1.0 to 8.5 seconds) to allow the differentiation of cue- and reinforcement-dependent activity. Specific and distinct learning-related activity was seen in both the amygdala and medial orbital frontal cortex.

H34

ANTICIPATING SELF-REFERENTIAL PROCESSING ELICITS A UNIQUE PATTERN OF BRAIN ACTIVITY: AN ERP STUDY *Ray Johnson Jr.[1,2], Elizabeth J. Simon[3,2], Heather Henkell[3,2], Elizabeth Diamond[3], Robin E. Winkler[3]; [1]Queens College, [2]The Graduate Center of CUNY, [3]Queens College/CUNY* – Recent studies have shown that a network of midline brain areas (medial prefrontal, ACC, precuneus) appears to play a central role in self-referential processing. Because these areas have been found to be active during baseline scans when there is no task-related processing, Raichle and others have suggested that such self-referential processing occurs in a "default" state. Given this characterization, we wanted to identify the brain processes associated with transition into this state when anticipating self-referential processing. We recorded event-related potentials (ERPs) from 83 sites while participants made forced-choice judgments about personality trait adjectives (e.g., optimistic), which were presented at S2, in an S1-S2 paradigm with a 2 second inter-stimulus interval. Four equiprobable S1 cues indicated whether the subsequent trait judgment was to be about: Self, Close Other (person they are close with), Non-Close Other (person they know, but are not close with) or Semantic (active/inactive). The judgments about others required participants to answer from the perspective of their Close and Non-Close Other. We found that, within 200 ms after onset of the "Self" cue, brain activity diverged from that elicited by the other three cues, with the initial (200-600 ms) ERP difference located over central scalp (Cz). In the remaining 1400 ms before presentation of the trait adjective, the response to the "Self" cue was characterized by ERP differences over midline central-parietal (i.e., precuneus) and right prefrontal scalp. Thus, the data indicate that particular brain processes are invoked during the necessary transition into the "default" state.

H35

RAPID TRYPTOPHAN DEPLETION ALTERS VALUATION OF SOCIAL IMAGES IN THE MACAQUE MONKEY *Karli Watson, Michael Platt; Duke University* – Behavioral decisions reflect the expected value of available options. Recent studies suggest that manipulation of neuromodulatory systems can alter both mood and social behavior, thus raising the question of whether these systems alter valuation of social stimuli during decision-making. To address this question, we used a pay-per-view choice task to measure the value of orienting towards different classes of social images. On each trial a male rhesus macaque fixated a central yellow square. After a delay, two targets (T1, T2) were illuminated and, following the offset of the central stimulus, the monkey was free to shift gaze to either target. Juice delivery followed gaze shifts to T1 while both juice and display of a social image followed gaze shifts to T2. Social image pools were comprised of faces of familiar male macaques; sexual image pools were comprised of photos of female perinea. Varying the reward and image outcomes for orienting to T1 and T2 permitted us to estimate the value of different classes of images in common fluid units. In control conditions, male monkeys paid a fluid premium to view images of female perinea and the faces of dominant individuals, but were indifferent to images of subordinates. We found that rapid tryptophan depletion, which decreases serotonin concentration in the central nervous system, decreased valuation of faces, but not female perinea. These findings suggest that serotonin selectively contributes to the reward valuation of social stimuli but not sexual stimuli.

H36

THE STRUCTURE OF A NEUROPSYCHOLOGICAL BATTERY ACROSS HEALTHY ELDERS AND THOSE WITH QUESTIONABLE DEMENTIA AND ALZHEIMER'S DISEASE *Karen Siedlecki, Yaakov Stern; Columbia University* – An exploratory factor analysis was conducted on 16 variables designed to assess different cognitive abilities in a sample of healthy older adults. Four factors emerged corresponding to language, memory, processing speed, and visual-spatial/reasoning constructs. This four-factor solution was cross-validated in a second sample of healthy elders. The invariance of the four-factor model was subsequently examined across three groups- a group of healthy elderly, a group of patients diagnosed with questionable dementia (QD), and a group of patients diagnosed with probable Alzheimer's Disease (AD). Results of the invariance analysis suggest that the model is not invariant across the three groups, implying that the meaning of the constructs may be changing. Specifically, preliminary analyses suggest that the memory construct may represent something different in the QD and AD group as compared to the healthy elderly group, consistent with the underlying pathology in early AD.

H37

LACK OF SEX DIFFERENCES IN OBJECT RECOGNITION AND NAMING: AN FMRI STUDY. *Cheryl Garn, Mark D. Allen, Doug Richards, Kerry Jeffs, Lauren Ford; Brigham Young University* – We explore sex differences in picture naming focusing specifically on two categories of objects, hand-manipulated (HM) and plant-edible (PE), because recent studies suggest that these are the two categories of objects most likely to lead to the largest sex-based disparities in naming performance (Capitani, Laiacona, and Barbarotto, 1999). We ran two experiments: a behavioral task measuring vocabulary size and an fMRI task involving picture naming. It was hypothesized that females would show a greater vocabulary size for PE items and more areas of activation in fMRI compared to males. Twenty-eight males and 30 females participated in the vocabulary size study. Twenty-six participants (13 male and 13 female) participated in the fMRI study. All participants in both studies were right handed and had no previous neurological or psychological brain damage. There were no intellectual differences between groups for either study (as shown in standardized test scores). Sex differences were not significant in vocabulary size overall. However, a within group analysis of females showed significantly greater vocabulary size for PE objects compared to HM. Based on the fact that females show greater vocabulary size for PE items, we might have expected more activation in areas involved in language retrieval and selection for these items, but that wasn't the case. fMRI data showed no significant sex differences or category differences. These finding contribute to a body of evidence failing to find significant sex differences on language tasks.

H38

INDUCED AND TRAIT DIFFERENCES IN EEG PHASE SYNCHRONY AND POWER FOR EXPERIENCED MEDITATORS VERSUS NON-MEDITATORS *Barry Oken, Dan Zajdel, H. Jaskirat Wild; Oregon Health and Sciences University* – Objective. This study examined electroencephalogram (EEG) differences between experienced meditators and non-meditators. Our specific goal is to explore phase synchrony and power differences in the EEG for these two groups before, during, and after meditation (for the meditators) and relaxation (for non-meditators). We also seek to replicate Lutz et al's (2004) findings of meditation-induced increases in amplitude and phase synchrony in the gamma band. Methods. Participants included 12 Zen Buddhists (mean lifetime meditation experience = 12119 hours), and 12 matched control non-meditators. Participants listened to a 15-minute audio recording. Next, meditators were instructed to practice loving kindness meditation (Metta Bhavana), and controls were instructed to relax for 30 minutes. Finally, observers again listened to a 15-minute audio recording. In all conditions, participants' eyes were open half the time and closed the remainder of the time. EEG was recorded for the entire session. Results and conclusions. Analyses to be reported explore differences between the meditators versus controls, as well as meditation/relaxation-induced changes in both groups. Specifically, we are examining power and phase synchrony the alpha (8-13 Hz), beta (13-20 Hz), and theta (4-8 Hz) frequencies. The gamma band, defined by Lutz et al (2004) as 25-42 Hz, will also be examined. Analyses suggest differences in alpha power for meditators versus non-meditators, and that differences between the pre-, during, and post-meditation/relaxation conditions may be specific to the experienced meditators. To be reported are further analyses that explore specific effects including amplitude differences as well as gamma band synchrony.

H39

NEURAL RESPONSES OF SATED AND UNSATED SMOKERS ON A SEQUENTIAL INVESTMENT GAME *Pearl Chiu, Terry Lohrenz, Read Montague; Baylor College of Medicine* – The addictive properties of nicotine have been linked to anomalous dopamine release in striatal brain regions associated with reward response and prediction error signals. In the current study, neural responses to monetary gain and monetary loss, and to prediction error and counterfactual learning signals were examined in sated and unsated smokers during a sequential investment task. Specifically, smokers participated in an investment game that required viewing price histories from historical stock markets and choosing percentages of an initial $100 endowment to invest in market fluctuations. Upon concluding the task, participants were paid the actual amount held in their portfolio. Individuals played the game on two separate days: a "Sated" day (i.e., smoke as usual), and an "Unsated" day (i.e., abstain from midnight prior to the laboratory appointment). On both days, brain hemodynamic responses were acquired using fMRI. Preliminary analyses suggest differential striatal responses to gain and loss in the Sated and Unsated conditions. The data are discussed with regard to implications for understanding the neural substrates of addictive disorders and normative decision-making.

H40

WHO KNOWS BABY BEST? INVESTIGATING GENDER IDENTIFICATION IN BABIES *Rebecca L. Bevans, Eric S. Clapham, Aaron T. Karst, Saloni Sharma, C. Mark Wessinger; University of Nevada, Reno* – The current study used gender-specific cues to explore the relation between contextual information and gender choice when viewing neutral baby faces. In the absence of contextual information it is extremely difficult to correctly choose the gender of infants. In order to determine and better understand the influence of context on gender-choice we manipulated contextual cues in a modified priming paradigm. That is, gender-specific contextual cues were briefly presented with forward and backward masking in order to reduce explicit processing. Subsequently, a gender-nonspecific infant face was presented as the target stimulus and participants were required to indicate if the face was female or male. Contextual cues ranged from pink and blue color blobs, boy printed in blue and girl printed in pink and vice versa, to gender specific toys such as dolls and action figures. Despite assurances from participants that they would be able to accurately identify infant faces as male or female, this was not the case. That is, in the absence of contextual information, gender choice was at chance. The presence of gender-specific contextual cues (girl printed in pink) strongly influenced gender choice. Interestingly, contradictory information (i.e. girl printed in blue) disrupts these cueing effects. Taken together, these data support the notion that gender specific contextual cues are necessary when determining gender infants. Such data will help us better understand how individuals recognize and classify infants.

H41

EXPERTISE AND PERSPECTIVE EFFECTS ON VISUALIZATION IN ACCOMPLISHED ATHLETES *Jian Li[1], Kenneth Kishida[1], Dongni Yang[1], Read Montague[1], Arturo Hernandez[2]; [1]Baylor College of Medicine, [2]University of Houston* – In order to elucidate the neurobehavioral mechanisms underlying socially relevant mental imagery, we have studied the effects of expertise and perspective taking on the visualization of complex motor tasks using highly trained athletes and functional magnetic resonance imaging (fMRI). Specifically, we recruited professional and college-level athletes (46 subjects) from soccer, football, and baseball and had them perform mental imagery of various sports related motor tasks. The spectrum of motor-tasks was taken from each of the sports that the various subjects specialize in. Subjects watched video clips that showed athletes performing specific tasks from each of the three sports mentioned as well as video clips of intricate ballet dances. Prior to viewing the video clip, subjects were instructed to attend to the actions of a specific individual, which they would subsequently be instructed to visualize from either the first- or third-person perspective. Brain responses measured during the visualization phase of the task revealed distinct patterns between visualization from first-person perspective and visualization of the same actions from the third-person perspective. Furthermore, visualization evoked BOLD responses were different depending on the expertise of the subject regarding the specific sport of the action visualized.

H42

IS "WE" AS BIG AS "ME"?: THE P300 AND SELF CONSTRUAL ACROSS TWO CULTURES *Richard Lewis, Eric Tang, Yumi Ando, Carol Huang, Sharon Goto; Pomona College* – Perceptions of the self in relation to others have been identified as a crucial component of cultural variation (see Markus & Kitayama, 1991). For example, Asians are characterized as having an interdependent self-construal, viewing themselves as more interconnected with others, in contrast to more independent European Americans with autonomous, separate selves. Differences in self-construal result in interdependents giving more importance to ingroup members, seeing them as closer to, and even part of the self. Gray et al. (2004) have recently shown that the magnitude of the P300 can serve as an index of stimuli that are self-relevant. The goal of the present study was to use the P300 to test Markus and Kitayama's model of Asians viewing their ingroup as more self-relevant than European Americans. So far, 8 Asian Americans and 11 European Americans have been tested on an oddball P300 task where they were to detect a red stimulus among black distractor stimuli consisting of people's names. The names of ingroup members were among the distractors. No differences were found in the magnitude of the target items at Pz between the Asian and European Americans, $t(17) = 1.2$, ns. As expected, Asian Americans had significantly larger P300 amplitudes to ingroup members than did European Americans, $t(17) = 2.90$, $p = .01$. These data suggest that Interdependent Asians view ingroup members as more self-relevant than do Independent European Americans. Implications with respect to cultural theory and methodology will be discussed.

H43

IMPLICIT RACIAL PREJUDICE DIRECTS MOTIVATED ATTENTION TOWARDS OUT-GROUP CUES *Catherine Norris[1], Matthew Longo[2], Bennett Bertenthal[3], John Cacioppo[3]; [1]University of Wisconsin - Madison, [2]University College London, [3]University of Chicago* – Previous research on early neural responses to in-group and out-group cues has found that the P2 component of the ERP, which is associated with motivated attention, is larger to Black than to White faces, regardless of individual differences in implicit or explicit racial attitudes. In the current study, we examined the relationship between racial attitudes and both neural and behavioral responses on a task involving speeded responses to observed simple finger movements of a Black or a White hand, or to symbolic cues. ERP data revealed that only individuals high in implicit prejudice as measured by the IAT exhibited a larger P2 to the Black than the White hand. This finding extends previous research, as our hand stimuli have few distinguishing characteristics and less social impact than the faces that are commonly used to study racial bias. In other words, motivated attention to out-group cues occurs in response to weaker stimuli in individuals with high than low implicit prejudice, as the presence of a Black hand elicits a larger P2 than the presence of a White hand in individuals with high implicit race bias. In sum, our results indicate that implicit (but not explicit) racial attitudes guide attention towards even rudimentary out-group cues, resulting in larger attention-related ERP components.

H44

SEMANTIC INTEGRATION IN REAL-WORLD AND CARTOON-WORLD MOVIE CLIPS: ELECTROPHYSIOLOGICAL EVIDENCE *Courtney Brown[1], Tatiana Sitnikova[2,3], Gina Kuperberg[1,2], Phillip Holcomb[1]; [1]Tufts University, [2]Athinoula A. Martinos Center for Biomedical Imaging, [3]Harvard Medical School* – In three experiments, we used event-related potentials (ERPs) to examine neural correlates of comprehending real-world and cartoon-world events, depicted in short, silent movie-clips. The real-world events displayed people carrying out every-day activities; the cartoon events displayed characters carrying out activities portrayed in popular animation series (e.g., 'Tom and Jerry"). In Contrast 1, final movie scenes were preceded by congruous (versus incongruous) movie contexts (e.g., real-world: an actor rolled dough after shaving; cartoon-world: a character blew up a balloon after slipping on a banana peel). In Contrast 2, congruous final scenes were compared to impossible final events that violated the functional constraints of the conveyed central action (e.g., real world: an actor applied shaving cream and then stroked a rolling pin across his face – this object had no functional properties required for shaving; cartoon: a character fell off a cliff and was suspended in mid-air – this character had no means for levitation). Our findings were similar between real-world and cartoon-world stimuli, suggesting that participants engaged the same real-world comprehension mechanisms. In Contrast 1, incongruous final events evoked an anteriorly-distributed N400 effect. This might reflect participants' first-pass attempt to semantically integrate final scenes into preceding context. In Contrast 2, impossible final events evoked a reduced N400 effect but a large parietal Late Positivity effect. We interpret the Late Positivity as reflecting a second-pass reanalysis in which the semantic properties of people and objects are evaluated against the functional semantic constraints dictated by the central action (e.g., shaving or levitating).

H45

CONTEXT MOTIVATES COMPREHENDERS' ATTEMPTS TO MAKE SENSE OF NOVEL EVENTS: EVIDENCE FROM EVENT-RELATED POTENTIALS (ERPS) *Tatiana Sitnikova[1], Martin Paczynski[2], Gina R. Kuperberg[2,1]; [1]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, [2]Tufts University, Medford, MA* – We and others have recently reported that a Late Positivity with a parietal maximum is evoked by both verbal and video depictions of events violating functional constraints of real-world actions (e.g., in a sentence, "To make good documentaries the cameras must wash …", cameras are inanimate and lack the functional properties required for washing; in a movie-clip showing a man applying shaving cream and then stroking a rolling pin across his face, the rolling pin lacks the functional properties required for shaving). We have hypothesized that the Late Positivity might reflect a second-pass reanalysis in which functional semantic properties of the people and objects are evaluated against the central action. We have also suggested that this second-pass functionally-based semantic analysis may be critical for comprehenders to make sense of novel events and that it is neurocognitively distinct from a first-pass semantic integration reflected by the N400. The present study aimed to further characterize the process reflected by the Late Positivity by determining whether it is evoked by novel events taken out of context. ERPs were recorded while participants viewed 2-sec-long videos depicting either familiar or novel events without their preceding contexts. Novel, relative to familiar, events evoked an increased N400, but no Late Positivity. We suggest that this N400 reflected participants' first-pass attempt to grasp the meaning of movie-clips. The absence of the Late Positivity effect suggests that any second-pass functional semantic analysis only comes into play when comprehenders are given contextual cues that more exhaustive processing may be worthwhile.

H46

BLUFF AND DOUBLE BLUFF: AN ERP STUDY ON DECEPTION IN SOCIAL CONTEXT *Natalie Sebanz[1], Ricardo Carrion[2], Julian Keenan[3]; [1]Rutgers University Newark, [2]Rutgers University New Brunswick, [3]Montclair State University* – It is generally assumed that our ability to deceive others relies on theory of mind and requires the ability to keep actual and fictitious states of affairs apart. Yet, few studies have investigated the cognitive and neural processes of deception in a dyadic setting. In the present study, event-related potentials (ERPs) were measured while participants played a game together with another person. Their task was to deceive the other about the identity of a figure projected onto the other's forehead. Thus, both bluff (lying) or double-bluff (telling the truth to mislead the other) were possible. In a "choice" condition, participants could choose whether to lie or tell the truth. In a "forced" condition, a cue indicated whether participants should lie or tell the truth. ERPs were analyzed time-locked to the onset of a cue signaling participants to make a choice or telling them what to do. In the forced condition, lying was associated with a negative deflection 400-600ms after the cue (N450), while telling the truth was associated with a positive deflection (P450). In contrast, in the choice condition, telling the truth was also associated with a negative deflection (N450). This suggests that telling the truth with the intention to double-bluff involves similar processes as the intention to tell a straight lie.

H47

DECISION FIELD THEORY AS A BRIDGE BETWEEN NEURAL MODELS AND COMPLEX DECISION BEHAVIOR *Ryan K. Jessup, Jerome R. Busemeyer; Indiana University* – Diffusion processes, and their discrete time counterparts, random walk models, have demonstrated an ability to account for a wide range of findings from behavioral decision making research for which the purely algebraic and deterministic models often used in economics and psychology cannot account. Recent studies in which researchers record single cell neural activity from non-human primates during perceptual decision making tasks have revealed that neural firing rates closely mimic the accumulation of preference theorized by behaviorally-derived diffusion models of decision making (Gold & Shadlen, 2001, 2002; Hanes & Schall, 1996). Here we present decision field theory (Busemeyer & Townsend, 1993; Busemeyer, Jessup, Johnson, & Townsend, 2006), a connectionist model of decision making that implements diffusion processes, as a bridge linking lower-level neural recordings and more complex behavioral findings from psychology and economics (Roe, Busemeyer, & Townsend, 2001; Johnson & Busemeyer, 2005). Proposed neural correlates of this model include a basal ganglia network of lateral inhibition (Plenz, 2003) and orbitofrontal reward representations (Schultz, 1998; see Frank & Claus, 2006, for a similar proposal) connected via parallel circuits (Alexander, DeLong, & Strick, 1986).

H48

PARTIAL DIRECTED COHERENCE (PDC) AS A MEASURE OF CHANGES IN FLOW OF NEURAL INFORMATION DURING COMPLEX VISUAL PROCESSING – ELECTROCORTICOGRAPHIC DATA OF EPILEPTIC PATIENTS *Minna Silfverhuth, Adam O. Hebb, Heracles Panagiotides, Jeffrey G. Ojemann; University of Washington, Seattle, WA* – Goal. The flow of neural information in brain sites involved in higher visual processing, such as face and object processing is still the subject of debate. Our aim was to apply partial directed coherence (PDC) as a measure of flow of information or 'causality' or 'connectivity' in a sense of following directional frequency relationships between channels or areas [1,2]. Methods. Electrocorticographic (ECoG) recordings from four locations in the inferior temporal cortex, i.e., occipito-temporal (O), posterior temporal (PT), mid-temporal (MT), and anterior temporal (AT), from epilepsy patients (N=4) has been used to study the processing of faces in an event-related paradigm. Artifact-free data segments time-locked to the onset of face stimuli were entered into a PDC analysis (Matlab, Biosig, model order=5) that yielded directional relationships between ECoG time series recorded at the four regions of interest. Pre-stimulus (baseline) PDC values was compared to activation PDC in statistical analysis of pooled group data (threshold p=0.05 or 0.001). Results. Directional relationships from posterior to anterior regions were revealed as well as feedback loops in the opposite directions. The flow of information is based on different frequency bands between locations. Conclusions. PDC is a relatively new measure associated to flow of information in brain. Particular interest is on 'binding' mediated within certain frequency bands. In conclusion, PDC may reveal new views onto cognitive interrelations inside the brain areas during complex visual processing.

Higher level cognition: Problem solving

H49

FLUID REASONING IN DEVELOPMENT: CHANGES IN BRAIN FUNCTION *Samantha Wright[1], Bryan Matlen[1], Carol Baym[1], Silvia Bunge[2]; [1]University of California, Davis, [2]Helen Wills Neuroscience Institute, University of California, Berkeley* – Fluid reasoning, or the capacity to solve novel problems, is central to the development of human cognition. While this ability is known to develop gradually throughout childhood and adolescence, little is known about the underlying brain changes that facilitate this reasoning. The present study examines neurodevelopmental changes on a reasoning task devised for use in younger children: a visual analogy task in which participants must identify semantic relationships between drawings of common objects. In the current study, children aged 6-12 (current N=4) and young adults (current N=17) are tested on 80 visual analogy problems during event-related fMRI data acquisition. On REL-1 problems, participants must identify the object that is most closely semantically related to a cued object (e.g. a snowball is related to a snowman). REL-2 problems follow a A:B::C:? analogy format (e.g. shoe is to foot as glove is to…?). To probe the type of information that children use to solve the problems, we have included perceptual and semantic lures among the possible answers. We predict that adults will be faster and more accurate on all types of analogy problems than children, and that younger children will initially commit more errors corresponding to perceptual lure answer choices on REL-2 problems while older children will commit more errors related to semantic lure answer choices. Based on our prior research with the Raven's Progressive Matrices, we predict a positive correlation in children between performance on REL-2 problems and activation of lateral and anterior PFC and inferior parietal cortex.

H50

ELECTROPHYSIOLOGICAL MARKERS OF SKILL-RELATED NEUROPLASTICITY *Stephen Romero[1,2], Dennis McFarland[3], Robert Faust[2], Lori Farrell[1], Anthony Cacace[2]; [1]Union College, [2]Albany Medical College, [3]The Wadsworth Labs* – Neuroplasticity involved in acquiring a new cognitive skill was investigated with two approaches to the analysis of scalp-recorded electroencephalographic (EEG) activity: standard time domain event related potentials (ERPs) and frequency domain analysis of EEG oscillations. Electroencephalographic activity was recorded before and after practice, while participants performed alphabet addition (i.e., e + 3 = g, true or false?). Participant's performance became automated with practice due to a switch in cognitive strategy from mentally counting-up in the alphabet to retrieving the answer from memory. Time domain analysis of the ERPs revealed a prominent positive peak at ~300 ms that was not reactive to problem attributes but was reduced with practice. A second prominent positive peak observed at ~500 ms was found to be larger after practice, mainly for true problems. Frequency domain spectral analyses of event-related EEG oscillations yielded two distinct findings: 1) a frontal midline synchronization of Delta/theta activity that was greater after practice, and 2) a beta band desynchronization that increased with problem difficulty before, but not after practice. Because the EEG oscillations were not time locked to the stimulus, they were viewed as being independent of the time domain results. Consequently, use of time and frequency domain analyses provides a more comprehensive account of the underlying electrophysiological data than with either method alone. When used in combination with a well-defined cognitive/behavioral paradigm, this approach serves to constrain the interpretations of the electrophysiological data and sets a new standard for studying the neuroplasticity involved in skill acquisition.

H51

MEDIAL OFC AND AMYGDALA MEDIATE APPETITIVE AND AVERSIVE BASED OPERANT EXTINCTION LEARNING IN HUMANS *Elizabeth Finger[1], Derek Mitchell[2], Matthew Jones[1], James Blair[1]; [1]National Institute of Mental Health, [2]University of Western Ontario* – Extinction learning in humans has important applications to the development and treatment of anxiety and behavioral disorders. Previous studies of extinction learning have used fMRI to investigate the extinction of classically conditioned fear responses (Gottfried 2004; Phelps 2004; Knight 2004). However, aside from extinguishing classically conditioned responses, a crucial aspect of learning involves the extinction of instrumental responses when they are no longer adaptive. In the present study, we used event related fMRI to identify the neural regions recruited for extinction of instrumentally learned responses during a modified passive avoidance task. In passive avoidance learning, organisms learn to approach stimuli associated with reward, and avoid stimuli associated with punishment. In the current study, after a learning phase, the reinforcement value of select stimuli abruptly changed. Participants learned to extinguish instrumental responses to previously rewarding stimuli, and overcome avoidances to previously punished response. This novel task design enabled us to identify the neural regions active during extinction of instrumentally learned responses compared to instrumentally learned responses which did not require extinction. It also allowed us to compare extinction of responses to both appetitive and aversive cues. During failures to extinguish a previously advantageous response, differential activity was observed in frontopolar mOFC and the amygdala. Successful extinction learning (extinguishing a previous approach or avoidance) corresponded to increased BOLD responses in the same region of mOFC. These data suggest that the extinction of instrumental learning, like that of classical conditioning, recruits the regions of medial prefrontal cortex.

H52

USING COGNITIVE MODELING TO UNDERSTAND THE ROLES OF PREFRONTAL AND POSTERIOR PARIETAL CORTEX IN ALGEBRA PROBLEM SOLVING *Jared Danker, John Anderson; Carnegie Mellon University* – Based on the findings of an ongoing research project centered around a cognitive architecture (Anderson, 2005), we have associated prefrontal cortex with memory retrieval and posterior parietal cortex with mental representation. We explore the roles of these two regions in the context of an algebra task in which retrieval and representation are separated in time. The interaction between retrieval and representation is particularly apparent in the solution of algebra equations, in which retrieval is brought to bear via the retrieval of mathematical facts (e.g., 8 – 2 = 6) and representation is brought to bear via transformations of the problem state (e.g., from x / 3 +2 = 8 to x / 3 = 6). In naturalistic algebra problem solving, retrieval and representation are typically confounded. We attempt here to see if they can be manipulated independently. While our imaging results showed that prefrontal and parietal regions each responded to manipulations of both retrieval and representation, an information-processing model of the algebra task fit to the response time data concurred with our imaging results, predicting that each manipulation should increase both retrieval and representational demands. This simultaneously emphasizes the strong relationship between retrieval and representation in mathematical reasoning and demonstrates that cognitive modeling can serve as a useful tool for understanding task manipulations in neuroimaging experiments.

H53

POSITIVE AFFECT AND ANXIETY INDUCED STATES MODULATE PROBLEM SOLVING STRATEGIES *Karuna Subramaniam, Mark Jung-Beeman; Northwestern University* – We have found that positive affect and anxious preparatory brain states modulate problem-solving strategies. Initial findings were based on affect assessment in 79 subjects. Subjects saw 135 Compound Remote Associate problems, each of which can be solved with or without insight. Insights arise suddenly, with an "Aha!" They require cognitive restructuring - shifting attention from prepotent, incorrect associations to the non-prepotent, correct solution. On each trial, subjects saw 3 words (tooth, potato, heart) and tried to find a solution word (sweet) forming a compound word with each of the 3 words. If solved, subjects indicated whether or not they had an insight. Behavioral results were correlated with neural activity across 27 subjects scanned while solving problems. Positive affect altered preparatory brain states to increase dorsal ACC activity ($r(25) = 0.41$, $p < .05$), facilitating insights ($r(77) = -0.34$, $p<.005$). Anxiety decreased dorsal ACC preparatory activity ($r(25) = -0.34$, $p = .08$) to inhibit insights ($r(77) = -0.34$, $p<.005$). We now build upon these preliminary findings to draw strong causal inferences on how induced affect modulates problem-solving processes. We use film clips to induce positive, neutral, and anxious states to compare activation patterns between the 3 conditions, within and across subjects, at the preparation interval, at stimuli onset, and at solution time points. We predict positive mood inductions (MIs) will enhance preparatory ACC activation to increase solving and insights, while anxiety will decrease ACC activation inhibiting overall solving and insights, compared to neutral MIs.

H54

NEURAL CORRELATES OF THEORY OF MIND: AN EVENT-RELATED FMRI STUDY *Koji Jimura, Seiki Konishi, Tomoki Asari, Junichi Chikazoe, Yasushi Miyashita; University Tokyo School of Medicine* – Previous blocked-design fMRI, PET, and neuropsychological studies have suggested that multiple cortical regions including medial prefrontal cortex, superior temporal sulcus, bilateral temporal pole, and precuneus were involved during comprehension of other persons' mental states (theory of mind). However, the involvement of each of these regions is still controversial. The present fMRI study devised a theory of mind task derived from false belief paradigms that allowed event-related analysis to be applied, and explored brain activity associated with exact cognitive processes time-locked to the successful understanding of others' mental states. The task consisted of two phases, study and test. During the study phase, subjects studied a brief story in which protagonists have two false beliefs. The subjects were then asked questions about the story that had to be correctly answered before moving to the test phase to ensure that the subjects sufficiently learned the story. During the test phase, functional imaging was administered while the subjects were asked questions about one of the two false beliefs (false belief condition), and about facts related to the other false belief (control condition). In the event-related analysis, comprehension of others' mental state and its control were coded by transient events time-locked to subjects' responses in a general linear model. Transient activity was observed in multiple frontal and temporal regions in the false belief condition, compared to the control condition. The present results suggest that multiple cortical regions cooperatively contribute to theory of mind.

H55

BRAIN MECHANISM FOR INSIGHT PROBLEM-SOLVING: A NIRS STUDY *Kazuhiro Ueda[1], Machiko Konno[1,2], Haruaki Fukuda[1], Hiroaki Suzuki[3]; [1]The University of Tokyo, [2]Tohmatsu Consulting Co., Ltd, [3]Aoyama Gakuin University* – Some psychological theories on mental processes of insight problem-solving have been proposed. For example, dynamic constraint relaxation theory (Suzuki et al., 2001) claims that some constraints of a problem operate jointly to produce an impasse in an early stage while the constraints are gradually relaxed in the process, which results in more frequent constraint violation and insight. On the other hand, brain activity during insight problem-solving has not been well clarified. If the above theory is correct, the activation of some cortex areas should correlate with the gradual increase in number of constraint violation towards the moment of insight. This study aims to confirm this possibility. Sixteen subjects participated in our experiment and were asked to solve T-puzzle, a kind of geometric puzzle. We made, using NIRS, event measurements of oxygenated hemoglobin at prefrontal and left premotor/motor cortices (brain activity) and also counted the number of constraint violation (behavioral activity). Five subjects succeeded in this problem-solving by themselves while eleven failed. We compared brain and behavioral activities of successful group with those of unsuccessful group between the first and second halves of problem-solving. An ANOVA showed that the two groups were different both in brain activity around left premotor cortex and in behavioral activity and, in successful group, brain activity as well as behavioral one was gradually enhanced towards the moment of insight. As far as we know, this is the first report of brain activity during insight problem-solving, which is congruent with a psychological theory.

H56

COMPUTING SOLUTIONS TO ALGEBRAIC PROBLEMS USING A SYMBOLIC VERSUS A MODEL STRATEGY *Kerry Lee, Stephanie H. M. Yeong; National Institute of Education, Nanyang Technological University* – Using pictorial models to represent algebraic word problems has been shown to reduce errors in problem comprehension (Lewis, 1989). To improve access to such problems, children in Singapore are taught to utilise model representation from a young age. An issue that concerns some educators is whether teaching such heuristics assists children in acquiring symbolic algebra. Because of difficulties in using conventional programme evaluation techniques, we used fMRI to evaluate differences between the use of models versus symbolic algebra for solving such problems. In a previous study, we examined processes involved in building model versus symbolic representations. Participants were presented with word problems and were asked to transform them into symbolic or model representations. The former engaged the posterior superior parietal lobules, precuneus, and caudate more so than did the latter. What remained unknown was whether such differences persisted in the latter stages of problem solving. In this study, we examined processes involved in the computation of numeric solutions from either symbolic or model representations. Participants were matched on academic proficiency and competency in the two strategies. Preliminary analyses showed that symbolic representations activated the middle and medial frontal gyri, anterior cingulate, caudate, and precuneus. Differences involving greater activation in the model condition were few and were largely restricted to occipital areas. These findings are consistent with the view that generating symbolic representations and computing solutions from them require greater attentional resources and may be more reliant on proceduralised processing than do similar processes involving model representations.

H57

FRONTO-PARIETAL NETWORK FOR INITIAL SELECTION, ACC FOR VERIFICATION OF STRATEGIES IN AN ARITHMETIC SEARCH TASK *Masahiro Kawasaki[1], Masataka Watanabe[1], Takayuki Sato[1], Jiro Okuda[2], Masamichi Sakagami[2]; [1]University of Tokyo, [2]Tamagawa University Research Institute* – Human can flexibly cope with first time circumstances in complex and difficult environments. The key lies in the efficiency to "initially select", at first glance, few good strategies out of millions, and to verify them step by step, whether or not they are logically correct. Previous fMRI studies could not evaluate such thinking processes, because of limits in difficulty, e.g. Tower of Hanoi, and limits in subjective report, e.g. anagram task. Here, to dissociate the neural substrate of the "initial selection" process from the later process of "verification", we conducted a complex arithmetic search task, under functional magnetic resonance imaging (fMRI). In this task, a subject was given an initial number and asked to either multiply or subtract 4 other given numbers step by step, to achieve a goal number. Although the combination of possible strategies summed over 100, behavioral results revealed that, after training, most subjects solved nearly half of the given problems in 40 seconds. This data suggested that they indeed initially selected strategies to logically verify. Furthermore, we found additional reaction time in the first three calculation steps, besides a single mental calculation. fMRI results indicated that the anterior and dorsolateral prefrontal cortex and parietal cortex were sensitive to this overhead reaction time, a candidate neural substrate of the initial selection process. Meanwhile, the anterior cingulate cortex changed activity depending on the residual difference between the goal and the mentally calculated number, indicating its role in evaluation at the final stage of the verification process.

H58

AN FMRI STUDY OF THE NEURAL CORRELATES OF PERFORMANCE AND LEARNING IN AN ALGEBRAIC ISOMORPH TASK *Jon Fincham, John Anderson; Carnegie Mellon University* – The current work explores changes that occur in neural activity as students interacted with a tutoring system that taught an algebra isomorph. 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). Using a data-flow isomorph to algebra, 12 undergraduate students were taught to solve problems equivalent to the full range of linear equations that appear in a classic Algebra 1 textbook. The interface involved using a mouse to select appropriate parts of a diagram, appropriate operations, and keying symbolic and numeric values. 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 the curriculum. The second imaging session occurred after the full curriculum had been completed and consisted of problems structurally identical but unique from those presented in the first imaging session. Control, retrieval, representational, visual and manual areas all showed significantly increased activity with increased problem complexity, reflecting greater demands for each of those resources when solving more difficult problems. Over the course of training, decreases in activation were shown in all these same areas with the exception of anterior cingulate which showed no change. These results are consistent with prior imaging work suggesting control demands remain the same, while demands of other component processes decrease after practice.

H59

ENDOGENOUS CONTROL IN ALGEBRAIC PROBLEM SOLVING: AN FMRI STUDY *Andrea Stocco, John Anderson; Carnegie Mellon University* – We present an experiment exploring cognitive control in algebraic problem solving. Participants solved 128 four-term equations and followed the same three-step strategy to solve each problem. Problems varied along two dimensions: (a) Whether the intermediate state of each problem was displayed on the screen ("updated") or the equation remained the same ("non updated"); (b) Whether they contained only parametric or only numeric terms. Therefore, the demands for retrieval and maintenance of arithmetic and visual information were manipulated independently, while the demand for endogenous control increased as more representations had to be maintained. Participants performed the task within a 3T fMRI scanner (Field of view 200mm, Repetition time 1,500ms, Flip angle 73°). The paradigm was slow event-related, with each trial lasting 22.5s. An exploratory analysis showed that right and left dorsolateral prefrontal regions and the left insula were insensitive to the equations being updated or not, but were selectively activated by arithmetic retrievals. A medial frontal region encompassing the dorsal cingulate was sensitive to control demands. Activity in parietal regions (BA7/39) was compatible with both control and mental imagery demands. A confirmatory analysis using eight predefined ROIs confirmed that the head of the caudate nucleus was also sensitive to control demands. An ACT-R computational model for the task succeeded in reproducing both the behavioral and the hemodynamic data. These results support our hypothesis that cognitive control is mainly achieved by medial and subcortical (and, possibly, parietal) regions, with other areas biasing response selection by holding task-relevant representations.

H60

THE EFFECTS OF SECONDARY RULES ON THE PROCESS OF CONSOLIDATION OF A ABSTRACT RULES *Clarisse Longo dos Santos, Virginia Penhune; Concordia University* – The present experiment is part of a set of studies looking at stages learning of abstract rules in a Biconditional Grammar (BG), a modified version of AGL (Johnstone & Shanks, 2001). It has been proposed that acquisition of explicit knowledge about abstract rules could be facilitated by sleep (Wagner et al., 2004), since consolidation might restructure the representation of recent memories. In the present study, we examined learning of a BG over two consecutive days. Consolidation and gain of explicit knowledge were investigated. Participants (N=90) were randomly assigned to one of six groups. In Group1 and G1b, participants were tested at night, and, twelve hours later, in the morning. In Group 2 and G2b, participants were tested during the day with twelve hours between sessions. In Group 3 and G3b, participants completed both sessions continuously, with a short break after the first session. Session one included training and testing; session two included test, training and test. Participants were either exposed to strings with SR (Groups1, 2 and 3) or without SR (G1b, G2b, and G3b). Preliminary analyses show that more participants from Group1 and G1b gained explicit knowledge about the BG rules after one night of sleep. Simple passage of time did not allow gain of explicit knowledge: participants in Group2/G2b and Group3/G3b did not show a significant improvement from session one to session two. Also, participants not exposed to SR perform better and show more knowledge of the BG rules.

H61

FMRI EVIDENCE ON THE NEURAL BASES OF PHYSICAL AND SOCIAL CAUSATION *Aron K. Barbey[1], Phillip Wolff[1], W. Kyle Simmons[2], Lawrence W. Barsalou[1]; [1]Emory University, [2]National Institute of Mental Health* – Causal knowledge provides the basis for higher-level thought, supporting explanatory and predictive inferences that are essential for learning and controlling the environment to achieve goals. Despite the importance of causality and its central role in the psychological literature on human thought, little is currently known about the neural bases of causal reasoning (for exceptions, see Fonlupt, 2003; Fugelsang & Dunbar, 2004; Fugelsang et al., 2005). The present fMRI study provides new evidence on the neural bases of causal reasoning and evaluates two unexplored issues. First, we assess the neural systems that underlie physical and social causation, exploring whether reasoning about physical versus social events recruits common and/or distinctive neural systems. Second, we explore, for the first time, the neural representation of CAUSE versus PREVENT. The experiment consisted of 12 separate blocks of physical versus social events representing one of three conditions: cause, prevent, and control. Each block consisted of 3 realistically rendered animations of the same 6 sec event presented from different viewpoints. The animations were balanced across the physical and social conditions, having a comparable number and configuration of entities and a similar dynamic time course. At the beginning of each block, a sentence appeared that described the animations to follow. Subjects viewed each animation and then judged whether the event represented a good, average, or bad example of the causal relation. Our results elucidate the neural representation of causal reasoning and suggest that physical and social reasoning engage different brain systems.

Emotion

H62

THE NEURAL CORRELATES OF PROCESSING FACES AND BODIES IN DEVELOPMENTAL PROSOPAGNOSIA *Jan Van den Stock[1], Wim van de Riet[1], Julie Grèzes[2], Beatrice de Gelder[1,4]; [1]Cognitive and Affective Neuroscience Laboratory, Tilburg University, The Netherlands, [2]Laboratoire de Physiologie de la Perception et de l'Action (LPPA), CNRS-*

Collège de France, France, [4]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA – Prosopagnosia is a deficit in the ability to recognize a person by the face. When it occurs in normal adults as a consequence of brain damage it is often associated with lesions in the occipito-temporal brain regions. But another kind of profound face recognition is not associated with acquired brain damage but results presumably from anomalous postnatal development. These developmental prosopagnosics show no evidence of brain damage and the exact etiology of their face recognition deficits is unknown. Both kinds are characterized by face recognition deficits in combination with relatively normal object recognition skills. Brain imaging studies investigating the neural correlates of face perception in prosopagnosia have not reached a clear consensus. The few available brainimaging studies of developmental prosopagnosics show little consistency as concerns the deviation from the normal pattern of activation of the brain areas that play a role in normal face perception (eg. fusiform gyrus and inferior occipital gyrus). So far the relative specificity of face recognition problems in prosopagnosics has been established by comparing performance on faces vs. objects. But in view of the recent findings of similarities in the neural basis of face and body perception it now becomes imperative to include human bodies in the comparison upon which conclusions of face deficits are based. We measured BOLD responses in four developmental prosopagnosics while they were presented with images of faces, houses and bodies. The observed activation is discussed against the background of the neural correlates of normal face and body processing.

H63

THE IMPACT OF ANXIETY AND UNCERTAINTY ON DECISION-MAKING IN YOUTH. *Kristin F. Gotimer[1], Amy L. Krain[1], Monique Ernst[2], Daniel Pine[2], F. Xavier Castellanos[1]; [1]New York University School of Medicine, [2]NIMH* – Background: Anxiety has been defined as a response to uncertainty regarding potential threats. This suggests that anxiety disorders may involve dysfunction in cognitive processes related to uncertainty. Research has demonstrated that individuals with excessive worry, like those with anxiety disorders, endorse greater intolerance of uncertainty (IU) than non-worriers. Further, IU has been associated with decision-making deficits in adults. The present study aims to extend these findings and examine how IU and anxiety impact decision-making in a pediatric population. Methods: Children and adolescents (ages 8-17) with and without anxiety disorders are being examined. Subjects complete a diagnostic interview (ADIS-IV-C), questionnaires measuring anxiety and IU, and three computerized decision-making tasks. Task #1, the HiLo-Game, has been used previously in fMRI studies (Krain et al., 2006). In Task #2, subjects are asked to choose between a known probability of winning (choosing a red marble from a bag) and an unknown probability. Task #3 is a computerized version of the Ambiguous/Unambiguous Diary Task (Davey et al., 1992). Results: Data collection is ongoing. Within-subjects analyses of the decision-making tasks show that subjects are responding as expected. Reaction times (RT) during uncertain conditions of the HiLo-Game are significantly longer than during more certain conditions ($p = .001$). Diary Task RTs for rating ambiguous situations are significantly longer than ratings of unambiguous situations ($p = .019$). Preliminary analyses show a significant correlation between IU and RT during the Marble Task ($r = -0.54$, $p < .05$). Additional results and implications will be presented.

H64

PHYSIOLOGICAL AND SUBJECTIVE MEASURES OF NEGATIVE EMOTION REGULATION USING A STARTLE MODULATION PARADIGM *Christina Gojmerac[1,2], Adam Anderson[1], Darlene Floden[3], Donald Stuss[2,1]; [1]University of Toronto, [2]The Rotman Research Institute, Baycrest, [3]Toronto Western Hospital* – Goals: There were two goals focused on understanding emotion regulation: the relationship between objective (physiological) and subjective measures; the determination of the efficacy of different regulation strategies in the down- and up-regulation of negative emotions. Methods: We used a startle modulation paradigm where negative and neutral pictures were paired with the following regulation instructions: “look”, “increase”, or “decrease” (Jackson et al., 2000). Electromyography (EMG) was used to record eye blink responses to the acoustic startle probe. The original paradigm was modified in order to 1) include subjective ratings of emotional reactivity under the three different regulation instructions, and 2) compare the effects of two specific strategies, cognitive re-appraisal and attentional focus. Results: Participants were able to increase their reactions to negative pictures as measured by the magnitude of the startle eye blink response, but the decrease instruction showed no significant effects. In contrast, participants were able to decrease their negative reactions as measured by subjective ratings of valence and arousal, but no significant effects were observed for the increase instruction. For decrease instructions, participants tended to use attentional focus significantly more than cognitive reappraisal, but this reversed for increase instructions. Conclusions: The startle modulation paradigm is a useful way to objectively measure the ability to regulate negative emotions. However, physiological and subjective measurements do not always indicate the same information with respect to emotions. We further demonstrate that different regulation strategies are drawn upon depending on whether the goal is to up- or down-regulate negative emotions.

H65

EVIDENCE FOR THE WARNING SIGNAL HYPOTHESIS IN VERBAL MEMORY PERFORMANCE *Ryan Smith, David Beversdorf; The Ohio State University* – An oddball stimulus of negative valence produces an “attentional blink” resulting in decreased memory performance for adjacent stimuli, while increased memory for the oddball is observed. We examined memory performance while varying the valence and semantic relationship of the word preceding the oddball. The valence of the oddball stimulus was also varied; either emotionally neutral or negative. Significantly greater recall was associated with both increased semantic relatedness and increased emotionality for both the oddball stimuli and immediately preceding words. As with previous findings, anterograde amnesia was observed for words following the oddball. These findings lend support for the warning signal hypothesis and may help explain the process by which memory performance is enhanced for emotional events.

H66

DISTRIBUTED N300 COMPONENT FOLLOWS N100 COMPONENT CONFINED TO THE FRONTAL ELECTRODES TO SUGGEST IMMEDIATE AFFECTIVE PERCEPTION OF SOCIAL ACTORS. *Lasana Harris[1], Susan Fiske[1], Jack Gelfand[2]; [1]Princeton University, [2]State University of New York, Oswego* – Recent social neuroscience research has used functional magnetic imaging (fMRI) reduced activity in medial prefrontal cortex (mpfc; part of the brain necessary for social cognition, Amodio & Frith, 2006) to social group-members perceived as less human (Harris & Fiske, 2006); participants view pictures of group members previously rated as low in perceived trait competence. Pictures of group members (e.g. American heroes, business people, disabled people) perceived as high on either warmth, competence, or both elicit more exclusively social emotions: pride, envy, and pity respectively (Fiske et al., 2002). These group-members also activate an area of ventral mpfc above the fixation baseline. However, pictures of social group-members that are perceived as high on neither warmth nor competence elicit a non-exclusively social emotion, disgust, and do not activate this, or any other area of the mpfc above baseline. The present study replicates this task using electroencephalography (EEG). A 128-electrode cap recorded neural activity as participants view pictures of the two types of social actors separated by a jittered interval. We predicted very early frontal electrode differentiation. Our results confirmed the hypothesis; in the alpha frequency, a quick differentiation of an N100 component, and a second subsequent N300 component that also differentiated the two group-members, but reversed the order of magnitude now favoring the less human group-members. In addition, this latter component was distributed across almost the entire scalp. These findings taken with the imaging result suggests a critical role for mpfc in the generation of this schema-triggered affect.

H67

PHYSIOLOGICAL AND NEURAL CORRELATES OF AVOIDANCE LEARNING DURING FEAR CONDITIONING *Rita L. Jou[1], Elizabeth A. Phelps[1], Joe LeDoux[1], Mauricio R. Delgado[2]; [1]New York University, [2]Rutgers University, Newark, NJ* – Avoiding negative outcomes is an important motivation in every day behaviors. The goal of this study was to investigate the physiological and neural correlates underlying avoidance learning. Specifically, we used a classical conditioning paradigm where three different conditioned stimuli (CS) were presented. One stimulus (e.g., a blue square) predicted the delivery of a shock upon stimulus offset (CS+), while another (e.g., a yellow square) predicted no negative consequences (CS-). A third conditioned cue (e.g., a purple square) also predicted delivery of a shock, but participants were instructed they could avoid the shock if they entered the correct sequence of numbers from a keypad (AV_CS+). After successful learning of the sequence, participants could then terminate shock easily during subsequent stimulus presentations (AV_CS-). A conditioned response (as measured by increases in skin conductance responses) was observed when comparing CS+ and CS- trials, but also when comparing AV_CS+ and CS- trials. Further, such responses were diminished after avoidance learning (AV_CS-). Preliminary investigations revealed increases in blood oxygenation level dependent (BOLD) responses in the amygdala when contrasting CS+ and CS- trials, in accordance with previous studies of fear conditioning. During avoidance learning trials, however, BOLD responses in the striatum were increased when the motivation to avoid a potential shock was high (AV_CS+); that is, when participants had an opportunity to influence the outcome of the trial. Further analysis will investigate the interactions between the amygdala and striatum during the acquisition and implementation of avoidance learning.

H68

REAPPRAISING LOSS AVERSION: A PHYSIOLOGICAL CORRELATE OF THE RELATIVE OVERVALUATION OF LOSSES *Nina Curley[1], Peter Sokol-Hessner[1], Ming Hsu[2,3], Mauricio Delgado[4], Colin Camerer[5], Elizabeth Phelps[1]; [1]New York University, [2]University of Illinois at Urbana-Champaign, [3]The Beckman Institute for Advanced Science and Technology, [4]Rutgers University, [5]California Institute of Technology* – Loss aversion, formalized with the parameter ?, describes the multiplicative overvaluation of losses relative to gains. While many studies have confirmed the existence of loss aversion on a group level, few, if any, have quantifiably demonstrated or manipulated loss aversion on an individual level. We developed a set of 140 monetary choices to robustly recover behavioral choice parameters for individuals. After an initial endowment of $30, participants made choices between risky binary gambles and guaranteed outcomes. From these choices we were able to reliably recover accurate value parameters and demonstrate individuals' loss aversion. We used this paradigm to investigate the effect of intentional cognitive regulation strategies on choice behavior. In the first of two sessions, participants completed two identical sets of choices. One set's strategy encouraged the bracketing of choices ("portfolio" approach), while the other set was made considering each choice in isolation ("one-choice" approach). The "portfolio" strategy reliably decreased estimates of ? within-subjects. During the second session, participants made choices while galvanic skin response (GSR) was recorded. When using the "one-choice" strategy, participants showed higher arousal per dollar to losses than gains. No such difference existed when using the "portfolio" strategy. Furthermore, decreases in ? when using the "portfolio" strategy correlated with decreases in the difference in arousal to losses relative to gains. The present study demonstrates the robust effect of an intentional cognitive regulation strategy in decreasing both behavioral and correlating physiological measures of sensitivity to losses relative to gains.

H69

NEURAL CORRELATES OF COMPASSION AND COGNITIVE REAPPRAISAL EMOTION REGULATION STRATEGIES *Helen Weng, Gregory Rogers, Richard Davidson; University of Wisconsin-Madison* – Little is known about the neural processes of compassion and its regulatory effect on emotion. Compassion is compared to cognitive reappraisal as a method of emotion regulation to negative social stimuli using functional magnetic resonance imaging (fMRI). We hypothesize to see similarities between groups in areas of the prefrontal cortex representing goal maintenance, but differences in areas involved in down-regulating amygdala activity. We predict increased amygdala activity in the compassion group because compassion involves more engagement and attention to the negative stimuli, but expect to see regulatory processes occur after this increased attention. We predict increased insula and basal ganglia activation, which may represent the increased interoceptive monitoring, motor planning, and reward state involved in compassion. Participants were trained for 2 weeks in either compassion meditation (N=9) or cognitive reappraisal (N=8) and scanned with an emotion regulation paradigm. Preliminary analyses show that both compassion and reappraisal involved increased activations in prefrontal cortex, but compassion showed decreased activation in VMPFC. Compassion also showed increases in amygdala activity. Compassion compared to reappraisal showed higher activations in bilateral insula, caudate, left putamen, and left precentral gyrus. Reappraisal compared to compassion showed higher activation in the right inferior frontal gyrus. Compassion may be regulating negative emotion using differing neural circuits compared to reappraisal that support interoceptive awareness, motor planning, and reward states.

H70

IMAGING CAUDATE RESPONSES TO REWARD AND PUNISHMENT IN HEALTHY OLDER ADULTS *Karin Cox, Howard Aizenstein, Kate Fissell, Julie Fiez; University of Pittsburgh* – Previous fMRI studies in our laboratory have used a 'card-guessing' task to examine reward-related processing. On each trial, subjects guess the value of a playing card. Values are predetermined such that exactly 50% of subjects' guesses are correct. Correct guesses are rewarded with monetary gain while incorrect guesses are punished with monetary loss. The caudate exhibits a differential BOLD response to the two outcome types: 'Reward' trials result in a sustained response, while 'punishment' trials elicit an early positive peak followed by a drop to sub-baseline levels. In the present study, we investigate the degree to which this activation pattern might be preserved in older populations. Twenty older adults (51-68y) and 13 young adults (18-28y) completed the card-guessing task. BOLD signal timecourses were extracted from an anatomically-defined caudate region of interest and submitted to a 3-way ANOVA, with age group (young vs. old), valence (reward vs. punishment), and time (scan epoch within each trial, T1-T14) as factors. A significant valence x time interaction was found in both the younger and the older adults, and the older adults' response pattern shared the key features that have typically been reported for young adults. We also found a 2-way interaction of group x time, as reflected in timecourses that appear generally blunted in the older adults. These results indicate that this task can be used to probe reward-related processing in older adults, though the number of subjects should be increased to compensate for a reduction in statistical power.

H71

REPEATED EXPOSURE TO MEDIA VIOLENCE DISRUPTS A NEURAL CIRCUIT THAT REGULATES IMPULSIVE AGGRESSION *Christopher Kelly, Jack Grinband, Joy Hirsch; Columbia University* – Although numerous studies have indicated that prolonged exposure to media violence can contribute to individual aggressive behavior, the nature and mechanism of this influence remains unknown. Using functional magnetic resonance imaging (fMRI), we show that repeated exposure to violent stimuli selectively diminishes responsiveness within the right orbitofrontal cortex (rOFC). The size of these responses was inversely correlated with individual scores of trait aggression. The relationship between rOFC and aggression is consistent with recent models of impulsive aggression, which propose that this frontal region sends context-specific information to the amygdala to suppress the intiation of reactive behaviors in motor planning regions such as supplementary motor regions. In accordance with this model, we found that (1) the rOFC response attenuation was accompanied by increased responses in supplementary motor cortex and (2) as responses in rOFC diminished, the functional connectivity between rOFC and amygdala decreased. These are the first findings to suggest a neural mechanism that relates the emergence of impulsive aggression to repeated contact with violent media.

H72

MODULATION OF THE GAZE CUEING EFFECT BY FACIAL EXPRESSION *Teresa Farroni[1,2], Sara Benetti[2], Enrica Menon[2], Silvia Rigato[1], Katiuschia Pastrello[2], Nathalie George[3]; [1]Birkbeck College, London WC1E 7HX, [2]University of Padova, ITALY, [3]CNRS UPR 640 – LENA / Université Pierre et Marie Curie and Centre MEG-EEG, Paris, France* – Three studies were carried out in which we examined whether fearful and happy expressions enhance the effect of another's gaze in directing the attention of an observer using a spatial orienting task with different techniques. Participants were presented with neutral, happy, and fearful faces with varying gaze directions and were required to detect the appearance of a peripheral target as quickly as possible, either by making a keypress response (experiment 1 and 2) or by making an eye movement (experiment 3). In all the experiments there was a gaze congruency effect: response times (RT) were faster when the eyes gazed toward (congruent condition) rather than away (incongruent condition) from the target location. In the first experiment there was no validity effect for the fearful faces, while this validity effect was there for happy and neutral faces. Fearful faces seem to induce slower valid trials and faster invalid trials as compared to happy and neutral faces. By contrast, in the second experiment, where the expression was established simultaneously with the gaze turning to the right or left, we find a gaze cueing effect for fearful faces. The data of the third experiment support the hypothesis that both emotional expressions facilitate gaze-induced attention shifting toward a peripheral target when a more sensitive measure than RT can be used. In sum, the results provide novel evidence for the rapid integration of facial expression and gaze direction information and will be discussed in terms of perception (detection) request versus acting (overt gaze orienting) response.

H73

EFFECT OF ANTICIPATION ON MEMORY OF EMOTIONALLY SALIENT STIMULI IN A CLINICAL POPULATION OF SNAKE PHOBICS *Allison Schaus, Deborah Kerr, Issidoros Sarinopoulos, Mai Lor, Danielle Green, Jack Nitschke; [1]University of Wisconsin, Madison, WI* – Anticipatory and memory processes have been implicated in the pathophysiology of anxiety disorders. A recent study in our laboratory found that activation in the amygdala and hippocampus during the anticipation of aversive pictures was associated with better immediate recognition memory (Mackiewicz et al., 2006). The present event-related fMRI study examined whether such anticipatory activation predicted memory of anxiogenic stimuli in a clinical population. In the scanner, snake phobics and healthy controls viewed snake, fish, and disgust videos that were preceded by cues that were the first letter of each stimulus type: S, F, and D. Participants then completed a recognition memory task either immediately following the scan (time 1) or one week later (time 2). Memory data for Pr indicated that participants correctly remembered videos of aversive stimuli more than videos of neutral stimuli. In addition, participants correctly remembered more videos at time 1 than time 2 with the exception of phobics remembering more snake videos at time 2 than time 1. Recognition memory (Pr) of the videos was then regressed on whole-brain contrasts comparing anticipatory activation to each cue. For phobics, increased activation in the amygdala and hippocampus during anticipation of S-F contrast predicted better recognition at time 2. For controls, increased activation in these regions during anticipation of D-F contrast predicted greater performance at time 1 only. These results highlight the role of the amygdala and hippocampus in anticipation and memory in a clinical population.

H74

NEURAL CORRELATES OF COGNITIVE BIASES IN PROCESSING OF EMOTIONAL PICTURES IN MAJOR DEPRESSION *Amy M. Jimenez[1], Avgusta Y. Shestyuk[1,2], Brooks R. King-Casas[3,2], Robert T. Knight[1], Patricia J. Deldin[4,2]; [1]University of California, Berkeley, [2]Harvard University, [3]Baylor College of Medicine, [4]University of Michigan, Ann Arbor* – Cognitive biases in processing of emotional information have long been identified as one of the core features of major depressive disorder (MDD). However, empirical findings of preferential processing of negative information have not been consistent. Specifically, level of processing may influence the emergence of negative biases in MDD. The current study examined event related potentials (ERPs) during processing of never-before-seen positive, negative, and neutral IAPS pictures during directed encoding (high effort) and in a yes/no recognition task (low effort) in individuals with and without MDD. During directed encoding, thirty-eight pictures of each valence were presented for 1.5 seconds in 6 blocks. Participants were asked to carefully examine and memorize each picture for verbal recall following each block. At the end of the experiment, participants performed a yes/no recognition task with old and new pictures presented for 1.5 seconds. Individuals with MDD recalled more negative than positive or neutral images ($p<.01$), whereas control participants recalled more positive than negative or neutral images ($p<.01$). During directed encoding, control individuals displayed larger P3b amplitudes to positive than negative ($p<.05$, Cz) or neutral ($p<.01$) pictures. In contrast, MDD participants exhibited greater sustained late positive component amplitudes to negative than positive ($p<.01$, parietal sites) or neutral ($p<.01$) images. At the recognition phase, there were no group differences in ERP amplitudes during identification of new pictures. These results suggest that level of processing of novel information is instrumental in eliciting a bias towards positive stimuli in healthy controls and towards negative stimuli in MDD individuals.

H75

ANIMAL, VEGETABLE, MINERAL: IMPLICIT ACTIVATION OF BRAIN REGIONS INVOLVED IN MENTALIZING ABOUT OTHERS. *Dylan David Wagner, Kathryn E. Demos, William M. Kelley, Todd F. Heatherton; Dartmouth College* – Recent research has characterized a network of brain regions involved in our uniquely human ability to perceive the mental states of others. This capacity for Theory of Mind (TOM), or mentalizing, involves a range of brain structures including medial prefrontal cortex, temporal parietal junction, superior temporal sulcus, and posterior cingulate. A topic of recent debate has been the degree to which mentalizing is an automatic response. The vast majority of tasks used to assess TOM in fMRI research have relied upon explicit instructions to engage in mentalizing behavior, or employing material that strongly encourages TOM processing. In the present study we examined brain activity associated with the categorization of photographs as either animal, vegetable, or mineral. Critically, the animal category was comprised of both images of humans and images of animals and thus allowed an implicit assessment of mentalizing in a task condition for which explicit judgments about the two subcategories were identical. Several brain regions showed greater activity to the categorization of humans relative to non-human animals, vegetables and minerals including brain regions previously implicated in mentalizing ability (MPFC, TPJ, STS, and posterior cingulate cortex). These findings suggest that people can spontaneously engage in mentalizing in the absence of explicit task instructions.

H76

NEUROPHYSIOLOGICAL MECHANISMS OF EMOTION REGULATION FOR SUBTYPES AGGRESSIVE CHILDREN *Connie Lamm, Marc Lewis; University of Toronto* – Children referred for aggressive behaviour problems may not represent a homogeneous population. Our objective was to assess neural mechanisms of emotion regulation that might distinguish subtypes of aggressive children from each other and from their age matched controls. Specifically, we were interested in subdividing children based on their underlying feelings. Aggressive children who have comorbid anxiety or depression often feel sad or fearful, and aggress due to these underlying negative emotions. We used a go/nogo task with a negative emotion induction, and we examined dense-array EEG data together with behavioral measures of performance. We investigated the nogo N2, a negative deflection observed about 200-400 ms poststimulus at medial frontal sites. This event-related potential (ERP) is generally interpreted in terms of inhibitory control or cognitive control ─ both vital aspects of emotion regulation. The results revealed that aggressive internalizing children showed larger N2s and activated more anterior regions of the cortex than both control children and aggressive children not comorbid for aggression and internalizing behaviour problems. These findings highlight different mechanisms of emotion-regulation underlying subtypes of aggressive children and point toward distinct developmental pathways and treatment strategies.

H77

HAPPINESS IS NOT IN THE EYES: EFFECTS OF EYE-GAZE AND EMOTION ON VISUAL ATTENTION *Sarah Bayless[1], Roxane Itier[2], Margot Taylor[1]; [1]Hospital for Sick Children, Toronto, Canada, [2]Rotman Research Institute, Toronto, Canada* – We investigated the effect of facial emotion on the magnitude of attentional cueing elicited by eye-gaze. In the first experiment we used dynamic facial displays which transformed from neutral to emotional facial expression and in which eye gaze shifted from straight to right or left averted. This transformation took place over 120ms, and the final frame was held for 80ms. The facial expressions were Anger, Fear, Happiness and Surprise. In the second experiment the same stimuli were masked to reveal only the eyes (no eyebrows). Using a Posner paradigm, we measured participant's reaction times to detect a small target to the left or right of the face/eyes. Emotional expression and gaze – target correspondence were evenly distributed across trials. With full faces congruency effects (RT difference between incongruent and congruent trials) were modulated by emotional expression, with happy expression eliciting significantly smaller effects than all other emotions. For eyes alone the modulation by emotion disappeared. The findings suggest that threat related emotions but also surprise resulted in a larger congruency effect compared to happy facial affect in non-anxious participants. Surprised expression shares many features with fearful expression: wide-open eyes as well as communicating an increased state of vigilance. The results of the eyes-only experiment suggest that to perceive facial affect of happiness, the eyes alone are not sufficient, while this is not the case for the other emotions. The neural underpinnings of these effects will be investigated in an fMRI paradigm.

H78

EARLY INFLUENCE OF EMOTIONAL INFORMATION ON VENTRAL VISUAL STREAM RELIES ON A TWO-PATHWAY NEURAL ARCHITECTURE WHICH INCLUDES THE INFERIOR LONGITUDINAL FASCICULUS: EVIDENCE FROM MEG/DCM *David Rudrauf[1,2], Antonio Damasio[3], Jean-Philippe Lachaux[4], Christopher Kovach[1], Jacques Martinerie[2], Bernard Renault[2,5], Thomas Grabowski[1], Olivier David[6]; [1]University of Iowa College of Medicine, [2]Pierre & Marie Curie University, Hôpital de la Pitié-Salpêtrière, Paris, France, [3]University of Southern California, [4]INSERM U280, Lyon, France, [5]MEG Center Paris, Hôpital de la Pitié-Salpêtrière, Paris, France, [6]INSERM U594 France* – Visual attention can be modulated by the emotional effects of stimuli prior to full visual processing. Two classes of models have been proposed to account for such modulation: 1. "two-stage models", which include serial processing along the ventral visual stream (VVS), followed by secondary feedbacks to the VVS from structures involved in emotion processing (such as the amygdala and the orbitofrontal cortex (OFC)); 2. "two-pathway models", which also include parallel short-cut pathways (SCPs) reaching directly the emotion processing structures. The retino-tectal pathway is one possible SCP candidate. Anatomical evidence suggests however that the inferior longitudinal fasciculus (ILF), and perhaps the inferior occipital-frontal fasciculus, might constitute alternative or complementary SCPs. We investigated which type of neural architecture is the most likely to operate in the human brain, using dynamic causal modeling (DCM) applied to MEG evoked responses. 15 subjects were recorded in MEG while presented with arousing visual stimuli. All DCM models shared hierarchical connections between early visual areas (V1-V2), the fusiform gyrus, lateral IT, a cluster representing the amygdala and temporal pole, and the OFC. Models were compared using Bayesian procedures. The two-pathway models which included the ILF explained the data significantly better (log evidence) than all alternative models. In contrast, the model with only a retino-tectal SCP was not associated with significantly higher log evidence than two-stage models. The results support the hypothesis of an involvement of a two-pathway neural architecture relying on the inferior longitudinal fasciculus in the early modulation of ventral visual stream by emotionally competent stimuli.

H79

THE ROLE OF MEDIAL PREFRONTAL CORTEX IN REGULATING THE EXPERIENTIAL AND AUTONOMIC CORRELATES OF SOCIAL EVALUATIVE THREAT *Kevin Ochsner, Matthew Davidson, Brent Hughes, Tor Wager; Columbia University* – Public speaking is consistently rated as among the most aversive of all human experiences. The Trier Social Stressor Task (TSST) provides a well-studied laboratory model of a similar type of social evaluative threat. Here we used a modified, fMRI-compatible variant to determine whether similar or different regions of medial prefrontal cortex (MPFC) might play a key role in mediating negative affective experience, heart rate (HR), and skin conductance levels (SCL), all of which increase substantially during the task. We expected overlapping regions of MPFC to correlate with the timecourse of responses for each measure, given the MPFC's projections to hypothalamic and brainstem regions mediating autonomic outflow. We also expected unique correlates of each measure, as physiological and experiential data are themselves typically weakly correlated. To address these issues, whole-brain fMRI data, continuous HR and SCL, and periodic affect ratings were collected while participants mentally prepared speeches they believed would subsequently be delivered to an audience. Brain timeseries data were regressed on the timecourse of each measure for individual subjects, and a 'random-effects' model was used for group analysis of regression parameters. Results indicated that all 3 behavioral correlates of anxiety were inversely related to activity in overlapping regions of ventral MPFC. This region has been previously implicated in autonomic control, affective experience and individual differences in responses to stress. Taken together, past and present finding suggest that ventral MPFC may play a central role in down-regulating multiple channels of affective responding.

H80

EMOTION MINING: THE PREDICTIVE VALUE OF CONSCIOUS AND UNCONSCIOUS EMOTION IN DETERMINING POLITICAL PREFERENCE *George Trksak[1], Michael Milburn[2], Thomas Snyder[3]; [1]McLean Hospital, Harvard Medical School, MA, [2]University of Massachusetts/Boston, MA, [3]Emotion Mining Company, Wellesley, MA* – Studies examining voting decisions have often used voters' stands on political issues to predict political party and candidate preferences. While little is understood regarding the neurobehavioral substrates involved it is also well known that emotion processes play an important role. Two studies investigated the influence of voters' stands compared to emotional responses in predicting voters' candidate preferences in the context of a political campaign debate (either the 2000 Presidential Debates or the 2006 Massachusetts Gubernatorial Debates). Voters' stands were assessed by survey with questions related to topics such as taxes, gun violence, and abortion. Emotional responses were determined with a novel web-based methodology referred to as the EM toolset developed by Emotion Mining Company. The EM toolset characterizes conscious and unconscious emotional responses to a topic question with analysis of both categorized emotion words and written emotional responses in an aggregate database. First, correlation analysis calculated the contribution of voters' stands compared to emotional responses in predicting voter preference as measured with standard thermometer ratings. Second, conscious and unconscious emotional responses were analyzed pre- and post-debate to assess the influence of the debate in changing emotional responses to candidates. The results indicate that emotion measurements were significantly more predictive of participants' thermometer ratings than voters' political stands. Additionally, debates drove changes in conscious emotions towards candidates, while unconscious emotions remained stable. This study further demonstrates the strong influence of emotion in political preference and highlights the unique and informative potential of the EM toolset in elucidating emotional responses.

H81

THE NEURAL BASES OF PREPARATORY EMOTION REGULATION: HOW DOES PRE-APPRAISAL CUSHION THE BLOW OF AN IMPENDING NEGATIVE EVENT? *Brent Hughes, Kevin Ochsner, Matthew Davidson, Tor Wager; Columbia University* – Anticipating an unpleasant event may enhance suffering when the event actually transpires. Although behavioral studies have shown that cognitively preparing to regulate one's emotional responses can short-circuit aversive anticipation, the brain bases of this ability are not known. Building on prior work on reappraisal and anticipation (e.g. Ochsner et al, 2002, 2004; Wager et al, 2004), we hypothesized that preparing for, or 'pre-appraising,' upcoming aversive images could 1) diminish behavioral and neural correlates of aversive expectancy, and 2) might rely on prefrontal control systems whose anticipatory activation could predict subsequent drops in amygdala responses to aversive stimuli when they actually appear. To address these hypotheses whole-brain fMRI data was collected while participants completed both Pre-appraisal or Look (baseline) trials for aversive images and Look trials for neutral images. Trials consisted of an initial cue indicating trial type, a 4-sec anticipatory interval, an aversive or neutral image presented for 8-sec, a jittered 3-sec negative affect rating, and jittered ITI. Cue-only and anticipation-only catch trials permitted estimation of fMRI responses to each phase of the trial. Contrasts and connectivity analyses were used to identify regions activated on Pre-appraisal and Look trials during the anticipatory and stimulus presentation periods and to identify regions whose activity during anticipation predicted drops in amygdala activity during stimulus presentation. Results largely confirmed initial hypotheses providing the first evidence that PFC-amygdala interactions previously implicated in other forms of cognitive emotional control (e.g. reappraisal and placebo) may be similar to those when one cognitively prepares for anticipated aversive events.

H82

NEURAL CORRELATES OF EMOTIONAL EXPECTANCY DURING SENTENCE COMPREHENSION *Daphne Holt[1], W. Caroline West[1], Balaji Lakshmanan[1], Scott Rauch[2], Gina Kuperberg[3]; [1]Massachusetts General Hospital, [2]McLean Hospital, [3]Tufts University* – Sentence processing is known to engage inferior prefrontal and temporal cortices and the modulation of these regions is influenced by semantic context. Little, however, is known about whether these networks are modulated by the emotional meaning of words within sentences and/or whether paralimbic regions that are known to mediate emotional appraisal are also engaged. We used event-related fMRI to identify neural correlates of comprehending emotional words following an affectively neutral context. Fifteen healthy individuals read two-sentence scenarios describing social scenarios containing a pleasant, unpleasant or neutral word in the second sentence (e.g.: Sandra's old boyfriend stopped by her apartment. This time he brought a rose/gun/letter with him.) We found three overall patterns of response: 1) increased activation to the unpleasant scenarios relative to the neutral scenarios in the anterior and posterior cingulate gyrus, superior frontal gyrus, insula, and fusiform gyrus, 2) attenuated deactivation to the pleasant relative to the neutral scenarios in the anterior cingulate gyrus, and 3) increased activation to the neutral relative to the unpleasant and pleasant scenarios in the middle and inferior frontal gyri. Moreover, measures of negative affect were inversely correlated with the modulation of the left posterior cingulate gyrus to unpleasant relative to neutral scenarios. In conclusion, understanding the emotional meanings of words following a neutral context engages both networks known to mediate semantic integration as well as those involved in emotional appraisal. The posterior cingulate gyrus may serve to integrate emotional meaning with existing contextual information such as the individual's affective state.

H83

THERE'S MORE TO EMOTION THAN MEETS THE EYE: PROCESSING OF EMOTIONAL PROSODY IN THE AUDITORY DOMAIN *Lauren Cornew[1], Tracy Love[1,2], Georgina Batten[1], Leslie Carver[1]; [1]University of California, San Diego, [2]San Diego State University* – Much of the research in the emotion literature focuses on the processing of emotions in the visual modality, and data suggests a processing advantage for emotionally salient (especially negative) stimuli even at early sensory stages. This advantage is often interpreted to reflect an evolutionarily adaptive mechanism for rapid identification of potentially threatening stimuli which is thought to depend, at least in part, on the integrity of the amygdala. While emotion's influence on perception has significant implications for theories of cognitive and neural processing, the auditory correlates remain under-explored. In order to investigate a potential processing advantage for emotionally valenced stimuli in the auditory modality, this study employed a gating paradigm. Participants heard successive 250ms segments of Jabberwocky 'sentences' spoken with angry, happy, or neutral intonation. After each segment, participants indicated the emotion conveyed and rated their confidence in that decision. Contrary to predictions based on studies of visual emotion perception, participants identified neutral prosody more rapidly and accurately than either happy or angry prosody. Thus, perceptual modulation by emotional content appears to differ between visual and auditory modalities, with no processing advantage for emotionally valenced stimuli in the latter. We are currently collecting data from five and six year old participants using a modified gating paradigm in order to examine the developmental progression of this phenomenon.

H84

COMPARING SELECTION UNDER CONDITIONS OF EMOTIONAL DISTRACTION IN BORDERLINE PERSONALITY DISORDER PATIENTS AND CONTROLS *Charles A. Sanislow, Carol L. Raye, Karen J. Mitchell, Erich J. Greene, Alessandra Rellini, Shannon M. Tubridy, Marcia K. Johnson; Yale University* – Patients with borderline personality (n=12), a disorder characterized by dysregulated emotion, were compared with healthy controls (n=10) during fMRI on a working memory task requiring them to selectively refresh a just-activated word. On each trial, participants viewed a screen with 3 words (1 emotional, 2 neutral). A half-second later, either one of the words appeared again (repeat), or a black dot appeared which, by its location, signaled the participant to think back to (refresh) one of the previous 3 words. Across trials, half of the refreshed/repeated items were neutral and half were emotional; thus, when refreshing a neutral word, participants had to ignore the active representation of a salient emotional distracter. Different areas of left prefrontal cortex were recruited by controls and patients when participants had to ignore the emotional item to refresh the neutral item: For controls, activity was greater in more ventral areas (left lateral orbital/inferior frontal), whereas for patients, activity was greater in a more dorsal area (including left precentral, inferior frontal, and middle frontal gyrus). Further, relative to controls, patients showed less selection-related activation during refreshing in anterior cingulate and right inferior frontal gyrus independent of emotion. Such a pattern is consistent with the idea that patients and controls differ in the executive processes engaged for selection in the presence of emotion.

H85

ENHANCED CONDITIONING OF NEUTRAL FACES IN YOUNG ADOLESCENTS RELATIVE TO ADULTS *Nim Tottenham, Tara Gilhooly, Todd A. Hare, B. J. Casey; Weill Medical College of Cornell University* – If facial expressions are conditioned stimuli, interpretations of others' faces should be influenced by experience (Adolphs et al., 1995; Davis & Whalen, 2001). New associations should be more easily learned at younger ages than at older ages, when well-learned associations may be more difficult to alter. Neutral facial expressions were used as conditioned stimuli (CS) that were either paired or unpaired with aversive sounds (e.g., nails down a chalkboard; unconditioned stimuli (US)). The dependent measure was decreased response time to the CS during a timed task (Critchley et al., 2002). The training procedure was administered to adults (ages 19-25) and young adolescents (ages 12-15) in order to test the hypothesis that adolescents, relative to adults, should be facilitated in forming the associations between the CS and the US, as demonstrated by needing fewer trials to acquisition. Adults showed evidence of learning the association (decreased response time to the CS+) but not until the late trials of the experiment; however, adolescents showed evidence of learning earlier, by the middle trials of the experiment. While these behavioral data may be explained by heightened amygdala reactivity during adolescence (and hence better emotional learning), these data are consistent with the hypothesis that 1) facial expressions are conditioned stimuli and 2) that adolescents are faster to learn emotional associations with faces relative to adults because adults have better-established associations for facial expressions making them more difficult to alter.

H86

A HIGH-DENSITY ERP STUDY OF THE EMOTIONAL STROOP IN PARTICIPANTS WITH SUB-CLINICAL SEASONAL AFFECTIVE DISORDER *Fern Jaspers-Fayer, Isabel Taake, Lisa Buchy, Mario Liotti; Simon Fraser University* – Seasonal Affective Disorder (SAD) or winter depression is a form of affective disorder in which patients are predictably symptomatic in the winter, and remit in the summer. Most likely its neurobiology differs from typical depression, but so far little research has been carried out to identify cognitive and neurophysiological markers of SAD. Previously, we found that healthy individuals with subsyndromal SAD symptoms (as measured by the Seasonal Pattern Affective Questionnaire or SPAQ) tested in the winter had a selective slowing in color naming time for winter-related words in a modified emotional Stroop task. In the present study, we recorded high-density ERPs to winter-related and neutral words in healthy undergraduate students with (n=15) or without subsyndromal SAD (n=14). Critically, some participants were tested twice, first in the winter and then again in the summer (SAD: n=9; Non-SAD: n=11). No statistical RT differences were found. In the winter session, grandaverage ERPs for winter words were more positive over anterior frontal regions in the 200-400 ms range compared to the neutral words, for SAD participants only (p<.05). In the summer session, the effect disappeared, resulting in a significant interaction of season by emotion (p<.02) in the SAD group. No changes in the 200-400ms positivity occurred in either season for the NonSAD group. This frontal positivity modulation should be explored further as a possible neurophysiological marker of cognitive bias in winter depression.

H87

ERP EVIDENCE OF EARLY COVERT PROCESSING OF PHYSICAL THREAT WORDS IN SUBJECTS WITH HIGH AND LOW ANXIETY SENSITIVITY *Isabel Taake, Fern Jaspers-Fayer, Lisa Buchy, Mario Liotti; Simon Fraser University* – Anxiety Sensitivity is a measure of the extent people fear anxiety-related body sensations in future situations. It is a risk factor for the development of clinical anxiety, and can be measured with the Anxiety Sensitivity Index (ASI; McNally, 2002). Individuals with various anxiety disorders display content-specific cognitive biases, particularly in the domain of covert attention. One paradigm often used is the visual dot probe task. In clinical and non-clinical anxiety, responses to a dot presented in the same location of a previous threat stimulus are quicker than responses to probes in the opposite location (Sinha, Taake & Liotti, in press). In the present study, we recorded ERPs while healthy students with high (n=15) and low ASI (n=9) performed a dot probe task with lateralized physical threat, positive and neutral words. No statistical RT differences were found in either group. ERPs to probes in the location of threat words elicited significantly greater P1 activity over left parietal-occipital scalp than probes in the opposite location (p<.001). This was followed by enhanced positive activity over left frontal-central scalp (250-400 ms). Lateralized attention results in an enhanced positivity (P1 effect, 80-160 ms) for stimuli over contralateral occipital scalp (Mangun & Hillyard, 1991). This is to our knowledge the first electrophysiological demonstration that covert attentional shifts towards threat words modulate early activity in visual cortex as indexed by the P1 attention effect. High ASI resulted in a non-significant increase of the P1 modulation to threat words.

H88

DOES EMPATHY CHANGE WITH ADVANCING AGE? *Janelle Beadle, Sergio Paradiso, Natalie Denburg, Daniel Tranel; University of Iowa* – The ability to empathize with others is the basis for healthy personal relationships and well-being. Some studies have pointed to a decrease in empathy with advancing age. However, sampling and measurement issues limit the interpretation of this finding in the general elderly population. In addition, these studies have failed to acknowledge the multidimensional nature of the empathy construct. The aim of the current study is to obtain a representative sample of older adults and measure empathy through a self-report questionnaire, the Interpersonal Reactivity Index (IRI; Davis, 1980). The IRI measures empathy broadly through multiple subscales that represent its different facets: Perspective Taking (PT), Fantasy (FS), and Empathic Concern (EC). The Perspective Taking and Fantasy scales measure the degree to which one cognitively places oneself in the role of another person (PT) or a fictional character from a book or movie (FS). Differently, the Empathic Concern scale measures the degree to which one experiences emotional concern for the welfare of others. The current study compared 20 healthy older adults (aged 59-89) to a large normative sample of undergraduates (Davis, 1980). Older adults scored significantly lower on the Fantasy subscale, but did not differ on the Perspective Taking and Empathic Concern subscales. Rather than a global empathy decline, increased age suggests a decrease in a specific domain of empathy. As additional older adults are obtained, the reliability of these findings will continue to be examined in order to further elucidate the type of empathic change occurring in older adults.

H89

NEURAL DYNAMICS OF REJECTION SENSITIVITY *Ethan Kross[1], Tobias Egner[2], Kevin Ochsner[1], Joy Hirsch[2], Geraldine Downey[1]; [1]Columbia University, [2]Functional MRI Research Center, Columbia University* – Rejection Sensitivity (RS) is the tendency to anxiously expect, readily perceive, and intensely react to rejection. This study used fMRI to explore whether individual differences in RS are mediated by differential recruitment of brain regions involved in emotional appraisal and/or cognitive control. High and low RS participants were scanned while viewing either representational paintings depicting themes of rejection and acceptance or nonrepresentational control paintings matched for positive or negative valence, arousal and interest level. Across all participants, rejection vs. acceptance images activated regions of the brain involved in processing affective stimuli (posterior cingulate, insula), and cognitive control (dorsal anterior cingulate cortex; medial frontal cortex). Low and high RS individuals' responses to rejection vs. acceptance images were not, however, identical. Low RS individuals displayed significantly more activity in left inferior and right dorsal frontal regions, and activity in these areas correlated negatively with participants' self-report distress ratings. In addition, control analyses revealed no effect of viewing negative vs. positive images in any of the areas described above, suggesting that the aforementioned activations were involved in rejection-relevant processing rather than processing negatively valenced stimuli per se. Taken together, these findings suggest that responses in regions traditionally implicated in emotional processing and cognitive control are sensitive to rejection stimuli irrespective of RS, but that low RS individuals may activate prefrontal structures to regulate distress associated with viewing such images.

H90

CAN NEGATIVE FACIAL EXPRESSION BE PROCESSED UNCONSCIOUSLY? BEHAVIORAL AND NEURAL EVIDENCES *Renlai Zhou[1,2], Junhong Huang[1], Senqi Hu[3], Zoujun Ye[1], Xiaoyi Wang[1], Yufeng Zang[1], Qiyong Gong[4]; [1]Beijing Normal University, Beijing, China, [2]Southeast China University, Nanjing, China, [3]Humboldt State University, [4]Sichuan University, Chengdu, China* – The aim of the study was to explore if negative facial expression could be processed under different unattended conditions. Sixty-four healthy right-handed university students with normal or correct-normal vision aged from 18 to 25 years old participated in this study. A behavioral experiment (36 subjects), an ERP experiment (20 subjects) and an fMRI experiment (18 subjects) with the same procedure was performed respectively. Forty-two Chinese characters were used as attention targets. A total of 21 emotional human face photographs which consisted of negative, neutral, and happy faces were presented as the background of targets. The experiment was a 2 (tasks: low versus high perceptual load) * 3 (background: negative, neutral, and happy facial expressions) within subjects repeated design. The participants were asked to judge each Chinese character's structure (low perceptual load task) or tune (high perceptual load task). Behavioral results indicated that the interference effects of negative facial expressions occurred in the low perceptual load task (word structure judgment), but not in the high perceptual load task (word tone judgment). The results with ERP recording showed that the amplitude of P2 at CZ elicited by negative faces in the time-window ranged from 155 to 175 msec was significantly larger than that elicited by happy or neutral faces in the low perceptual load task ($F(df=2.32) = 7.73$, $P = 0.002$). However, there were no significant differences among the amplitude of P2 at CZ elicited by negative, neutral, and happy faces in the high perceptual load task ($F(df=2.32) = 0.12$, $P= 0.89$). The results with fMRI scan revealed that more brain regions were activated in the background of fear facial expression than that in the background of happy facial expression when word structure judgment task was performed, and that fewer brain regions were activated in the background of happy facial expression than that in the background of fear facial expression when word tune judgment task was performed. Furthermore, although the brain regions were more activated in the word structure judgment task than that in the word tune judgment task in the background of both fear and happy facial expressions, the activated brain regions were significantly different between these tasks. The above results were discussed in the context of the relationship between bottom-to-top and top-to-down processes.

H91

THE ROLE OF THE NEURAL CIRCUITRY UNDERLYING EMPATHY AND MENTAL ATTRIBUTION IN OBSERVATIONAL FEAR LEARNING *Andreas Olsson[1], Elizabeth Phelps[2]; [1]Columbia University, [2]New York University* – Observing another individual's fear expression in reaction to a stimulus provides a powerful means of learning the affective value of that stimulus. Previous research has suggested that observational fear learning (OFL) involves learning mechanisms similar to classical fear conditioning, specifically the amygdala. However, it is possible that the neural circuitry underlying empathy and mental state attribution may also play an important role in OFL. In this fMRI study, subjects (n=14) were asked to watch a movie of another individual (the model) receiving shocks paired with a conditioned stimulus (CS+), but not with a control stimulus (CS-) (observation stage), and were told that they were going to take part in an identical experiment at a later time (test stage). After watching the movie, subjects entered the test stage and were presented with the same stimuli as the model in the movie, however, no shocks were administered to the subjects. All subjects showed learning as measured by the skin conductance response (SCR) during the test stage. During observation, watching the model being presented with the CS+ versus the CS- resulted in activation in regions of the rostral anterior ACC and the right insula cortex, previously implicated in empathic responses, and the anterior rostral MPFC, previously implicated in mental attribution. Moreover, the magnitude of activation in these regions during the observation stage predicted the magnitude of learning expressed in the subsequent test stage. These results suggest that regions underlying empathy and mental attribution may play a role in fear learning through social observation.

H92

EMOTION PROCESSING BY STIMULUS TYPE AND GENDER IN MAJOR DEPRESSIVE DISORDER *Scott Langenecker[1], Allie Kade[1], Sara Wright[1], Patricia Deldin[1], Kristy Nielson[2], Elizabeth Young[1], Huda Akil[1], Lawrence Own[2], Jon-Kar Zubieta; [1]University of Michigan, [2]Marquette University* – Faulty classification of posed facial emotions has been explored in depression, although no study to date has included comparisons based upon gender, a variable potentially modulating the relationship between depressed status and correct classification of posed facial emotions. Differences in classifications of posed emotional expressions between participants with and without Major Depressive Disorder (MDD) and between females and males were hypothesized, as emotion classification disparities between males and females may underlie the greater prevalence in females. Participants included 53 healthy controls (32 males, 21 females) and 51 patients (17 males, 34 females) diagnosed with MDD with/without comorbid dysthymia or anxiety. For accuracy, there was an interaction between gender and diagnosis ($p<.04$). The MDD male group and the control female group performed significantly better than the MDD female group ($p<.04$), while the female control group was nominally better than the control male group ($p=.14$). For response time, the interaction between gender, diagnosis, and emotion type was significant ($p<.02$). The interaction included slower response time for MDD females for fearful stimuli compared to the control males ($p=.06$) and for sad stimuli compared to control males and females ($p<.014$). The MDD males were slower than control males for happy stimuli ($p=.03$). The results suggest that gender modulates the relationship between depression and emotion processing, with better performance in MDD males and worse performance in MDD females compared to their same-gender cohorts and potential MDD subtype by gender interactions that can be explored in future research.

H93

FEAR LEARNING TO SOCIAL AND NON-SOCIAL STIMULI AND ITS RELATIONSHIP TO INDIVIDUAL DIFFERENCES IN ANXIETY *Susanna Carmona[1], Andreas Olsson[2], Geraldine Downey[2], Kevin Ochsner[2]; [1]Universidad Autonoma de Barcelona, [2]Columbia University* – Previous research has showed that individuals high in anxiety and cortisol release in stressful situations display an attentional bias for threatening social stimuli, such as angry faces. Work in animals and humans suggest that cortisol may play an important role in fear conditioning. However, little is known about how individual differences in anxiety are related to learning that social stimuli have a threat value. In this experiment, subjects were presented with pairs of angry and neutral faces, and non-social stimuli (geometric shapes) in a differential fear conditioning paradigm. One conditioned stimulus from each category served as the CS+ and was paired with a mild shock, whereas the other served as a control stimulus (CS-) and was never paired with a shock. The skin conductance response (SCR) difference between CS+ and CS- was used as a measure of the conditioned response (CR). Our results indicated that the CR was stronger to angry faces than to neutral faces and non-social shape stimuli. In addition, the magnitude of the CR and the resistance to extinction to angry faces, but not to neutral faces or non-social stimuli, was positively related to individual differences in anxiety. These results support the notion that certain categories of social threat stimuli are more easily associated with an aversive outcome, and that individuals high in anxiety may be more vulnerable to developing a fear towards these stimuli.

H94

MEMORY MODULATION BY POST-TRAINING AROUSAL: RETRIEVAL ENHANCEMENT FOR POSITIVELY AND NEGATIVELY AROUSING WORDS INTERACTS WITH EMOTION REGULATION STRATEGY *William Lorber[1], Lauren McGurn[2], Kristy A. Nielson[2,4]; [1]Zablocki VA Medical Center, [2]Marquette University, [3]Medical College of Wisconsin, Foley Center for Aging* – Emotionally arousing stimuli are more memorable than neutral ones and arousal induced after learning enhances later retrieval, but there is little experimental evidence regarding how stimulus arousal and valence qualities differentially affect memory or memory modulation. The present study examined the effect of arousal induced after learning on memory for words varying in both arousal and valence quality. Eighty-four adults (64 female) viewed and rated 60 emotionally provocative words from the Affective Norms for English Words database for valence (unpleasant—pleasant) and arousal (low—high), chosen to fit four categories fully crossing the arousal/valence dimensions. Participants then completed questionnaires for 10-minutes, including the Emotion Regulation Questionnaire, which measures one's use of reappraisal to regulate emotion. A 3-min comedic or neutral video clip was then presented. Arousal and mood ratings were also collected. An unannounced word recognition test was given one week later. Word ratings demonstrated the expected normative pattern and did not differ by group. Mood and arousal state showed group equivalence prior to manipulation and increases after comedy. Recognition demonstrated that low-arousal/negative-valence words were less well retained than words from the other categories; comedy enhanced word retrieval across categories; and individuals who endorsed reappraisal, an emotion avoidance strategy, still showed significant enhancement of memory by comedy, but to a lesser degree than low reappraisers. Thus, emotional arousal induced after learning enhanced delayed retrieval qualities of the stimuli. Furthermore, emotion regulation strategies that can reduce the experience of emotion may also reduce the effects of emotion on memory consolidation.

H95

COMMON NEURAL SUBSTRATES FOR PERCEIVING FACES, EXPRESSING PREFERENCES AND MAKING 'GUT' DECISIONS: IMPLICATIONS FOR MODELS OF PERSON PERCEPTION *Teal S. Eich[1], Joshua I. Davis[2], Kevin N. Ochsner[2]; [1]University of California, Los Angeles, [2]Columbia University* – A network of regions centered around medial prefrontal cortex (MPFC) has been implicated in various aspects of person perception, including mental state attribution, impression formation, and trait attribution. The meaning of these activations is still a subject of debate, however, for at least two reasons. First, most studies have failed to differentiate between judgments made deliberatively as opposed to intuitively. Second, many of these regions have also been implicated the expression of and judgments about affective preferences. To disentangle neural bases of these factors, the present study collected whole brain functional images from 18 healthy individuals while they made affective (liking) or non-affective (visual complexity) judgments of social (faces) and non-social (food and art) targets that were made deliberatively or by 'going with your gut.' Findings revealed cortical regions commonly and distinctly associated with each type of these three factors. Intriguingly, an area of MPFC was commonly activated in three different contrasts: for judgments of liking vs. visual complexity, people vs. food or art, and 'gut' as opposed to deliberative modes of decision. These findings suggest that some MPFC regions previously thought to play a role specifically in social cognition may have a more general role in unreflective, affective-based categorizations.

H96

WHEN DO PEOPLE DISAGREE WITH AN OPINION STATEMENT? AN ERP STUDY ON SURVEY QUESTION ANSWERING *Jos Van Berkum[1,2], Bregje Holleman[3], Jaap Murre[1], Mante Nieuwland[1,4]; [1]University of Amsterdam, [2]FC Donders Centre for Cognitive Neuroimaging, Nijmegen, [3]University of Utrecht, [4]Tufts University* – In cognitive survey research, it is often assumed that respondents in opinion polls do a linguistic analysis of the entire question or statement before they bring their attitudes to bear on the issue. According to a leading model of question answering (Tourangeau, Rips & Rasinski, 2000), for example, respondents (1) interpret the question, (2) search for a relevant attitude in memory, (3) retrieve the attitude or construct one on the spot, and (4) translate the attitude into one of the precoded response options. Psycholinguistic research on sentence processing, however, has shown that people immediately bring the wider intepretive context to bear on comprehension, as the sentence unfolds. ERP studies with the N400, for instance, have shown that the meaning of a word is related to the story context or to the identity of the speaker within some 200 milliseconds after reading or hearing that word. Although the contextual factors examined sofar only involve 'cold cognition', we reasoned that sufficiently salient attitudes ('hot cognition') might also affect sentence interpretation this rapidly. To examine this possibility, we recorded EEG as people from two very different types of political parties read and answered a survey on societal matters (such as abortion, immigration, drugs, euthanesia, religion, premarital sex, adoption, or gay marriage). Relative to attitude-consistent control words, attitude-inconsistent words immediately elicited a widespread positivity between 400-700 ms in ERPs, as people were reading the survey statement. Our finding reveals that attitudes are brought to bear on language comprehension incrementally, with each word coming in.

H97

THE PAIN OF A MODEL IN THE PERSONALITY OF AN ONLOOKER: A TRANSCRANIAL MAGNETIC STIMULATION (TMS) STUDY *Alessio Avenanti[1,2], Ilaria Minio Paluello[3,4], Salvatore M. Aglioti[3,4]; [1]University of Bologna, [2]Centro Studi e Ricerche in Neuroscienze Cognitive, Cesena, Italy, [3]University of Rome "La Sapienza", [4]IRCCS Fondazione Santa Lucia, Roma, Italy* – The study of inter-individual differences represents a new avenue for Social Cognitive Neuroscience. Behavioral response to emotional and social stimuli varies greatly across individuals. A movie, for example, can bring a viewer to completely identify with the character and to "feel" his/her emotion while leaving other viewers unaffected. These individual differences may reflect both the on-line effect (state) of the observed stimuli and more stable (trait) individual characteristics. Here we show that the somatomotor mirror responses to the observation of others' pain are modulated by both state- and trait-individual differences in empathy. We used Transcranial Magnetic Stimulation (TMS) to record changes in corticospinal motor representations of hand muscles of individuals observing needles penetrating hands. We found a reduction of amplitude of motor-evoked potentials that was specific to the muscle that subjects observed being penetrated. This inhibition was linked to the empathic inferences of sensory qualities of the pain attributed to the model (state-empathy). Moreover, the effect was greater in those participants who scored high in cognitive empathy (trait-empathy) and lower in those subjects who felt strong aversion for the observed movies (state-personal distress). Results indicate that mirror somatomotor responses to others' pain are favored by specific traits of the personality of the onlooker and reduced by self-oriented emotional reactions.

Linguistic processes: Other

H98

DIMENSIONS OF DISCOURSE: BRAIN ACTIVATION DURING THE PROCESSING OF TEMPORAL, SPATIAL, AND ACTIONAL INFORMATION *Emily A. Cooper, Uri Hasson, Steven L. Small; University of Chicago* – The temporal dimension pervades human cognitive processing, and the ability to access and construct temporal representations is important not only for basic perception, but also for tracing the passage of time over months and years. Human temporal experience is often thought to rely on the ability to represent space and movement through space (action), with a particular emphasis on how these relationships are expressed in language. We examined the neural mechanisms by which temporal information is processed in language, and compared this to the processing of two other dimensions in language, space and action, which have been posited to involve related neural mechanisms. In an fMRI study, participants passively listened to stories after having been asked to focus on a single property of the discourse: time, space, or action. Participants heard each story once, attending to one of the three dimensions, but across participants, attention to each story was directed to all three dimensions. This enabled us to isolate directly the effect of cueing to time, space, and action. We defined five anatomical regions of interest and examined regional activity during story comprehension as a function of cueing condition. Our analysis demonstrated that cueing to different discourse dimensions affects activity differentially in these regions during language comprehension. We discuss how monitoring temporal, spatial, and actional properties affects regional neural activity and the implications of these findings for theories of discourse and embodied cognition.

H99

LANGUAGE FUNCTIONING IN THE BASAL GANGLIA *Shiaohui Chan, Lee Ryan, Thomas G. Bever; University of Arizona* – Due to the common belief that language is unique to humans, great emphasis has been placed on the neocortex in the past decades, especially Broca's and Wernicke's areas, while the role of the subcortical areas has been minimized. This project intended to use event-related functional Magnetic Resonance Imaging (fMRI) to study the involvement of the basal ganglia (BG) in language. Previous research has demonstrated that the BG are implicated in building up sequences of behavior into meaningful, goal-directed repertoires (Graybiel, 1995). Based on this, we hypothesized that if subjects were asked to produce a meaningful sentence or conceptual sequence, the BG should be involved. Twenty-four right-handed, neurologically healthy English speakers were recruited. They were asked to silently manipulate word stimuli vertically presented through goggles while being imaged by a 3T MRI scanner. The subjects' tasks included 1) putting words into a linguistic (syntactic or conceptual) sequence, 2) moving words using a non-linguistic rule and 3) repeating words. The results showed that the BG were significantly activated after subtracting the repeat condition from the linguistic sequencing condition, suggesting that these brain structures were recruited when subjects were doing linguistic computation with their knowledge of language. When subtracting the non-linguistic sequencing condition from the linguistic sequencing one, part of the BG were still activated, showing that their involvement may be language-specific, not simply a general/non-linguistic sequencing implication. In sum, our study suggests that the BG, which are usually ignored in language research, may take a central part in language functioning.

H100

COMPARISON OF CORTICAL NETWORK ACTIVATION DURING OBSERVATION AND IMITATION OF AUDIOVISUAL SPEECH *Zhi Li, Ana Solodkin, Steven Small; University of Chicago* – Significant recent interest has been directed to the neural systems involved in the observation and execution of movement, and we have had a particular interest in how this relates to language comprehension. In this study, we used functional MRI (fMRI) and structural equation modeling (SEM) to compare neural network activation during observation and imitation of single syllables. Eleven right-handed healthy adult native English speakers participated. Two conditions included (1) Observe, in which they watched a video of an actor pronouncing the syllables 'pa', 'fa;, 'tha', and 'ta.'; and (2) Imitate, in which they first observed and then overtly produced (imitated) the phonemes. For the analysis, we identified eight regions of interest that have been shown to be important in both language production and comprehension, including ventral and dorsal premotor (PMv and PMd), where PMv also includes the pars opercularis of the inferior frontal gyrus (IFG), primary motor, inferior parietal lobule, posterior superior temporal (gyrus and sulcus) (STp), anterior superior temporal (STa), pars triangularis of IFG, and cerebellum (CRB). We used SEM to fit and compare group models of the signal change across the two conditions. Models were constrained by known anatomical connectivity. Models for both conditions revealed strong effective connectivity among STp, IPL, and PMv. The models for observation and execution had interesting differences, particularly related to the balance between sensory (visual, auditory, and proprioceptive) and motor processing. The results are discussed in terms of recent theories of observation and execution matching.

H101

PROCESSING OF VERB-PHRASE ELLIPSIS: EVIDENCE FOR PRESERVED PROCESSING REFLEXES IN APHASIA *Josee Poirier[1,2], Lewis Shapiro[1], Tracy Love[1,2], David Swinney[2]; [1]San Diego State University, [2]University of California, San Diego* – Recent work in neurolinguistics has revealed impairment in real-time language processing routines following brain damage. More specifically, anterior lesions to the left hemisphere have been associated with delayed automatic syntactic reflexes. We investigated the processing of Verb-Phrase Ellipsis (VPE), which has been argued to be semantic-based, discourse-based, or of various syntactic sub-types that have not been investigated in aphasia thus far. Consider: 'The policeman carried the skier, and the clown did too'. Interpreting 'what the clown did' (upon encountering /did too/) requires rapid reference to the verb and its object in the first part of the sentence. We used Cross-Modal Picture Priming to determine whether the object /skier/ was immediately accessed as soon as its linking with /did too/ is licensed. To date, seven anterior-lesioned patients have completed testing. Preliminary results indicate immediate priming for the object / skier/, suggesting rapid referring to the first-clause verb phrase. This pattern is unlike what is observed with other complex constructions such as object relatives and cleft-objects, which are not processed normally by individuals with anterior lesions. We interpret our data in terms of the underlying nature of VPE and the role of anterior cortex. Specifically, VPE does not rely on the same sort of fast-acting automatic routine that underlies syntactic processing (and which is disrupted following anterior brain damage), and instead is likely to rely on more temporally forgiving routines more aligned with semantic and/or discourse operations. Preliminary data from posterior-lesioned and right-hemisphere patients will also be discussed in terms of our hypothesis.

H102

PHONOLOGICAL PROCESSING AND WHITE MATTER: SEPARABLE STRUCTURE-FUNCTION RELATIONSHIPS FOR THREE COMPONENT PROCESSES *Marc Dubin, Sumit Niogi, Jamie Ferri, Bruce McCandliss; Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University* – Phonological processing ability is a critical precursor and predictor of reading development in children. Three phonological processes have been distinguished that may have differential effects on reading development: 1) analysis/synthesis of phonemic information, 2) rapid automatized naming, and 3) a phonological component of short term memory (Torgesen and Davis, 1996). These components are assessed by the Complete Test of Phonological Awareness (CTOPP), and potentially engage distinct brain mechanisms (Turkeltaub, et al, 2003; Katzir, et al, 2005 and Rudner, et al, 2005). We used diffusion tensor imaging (DTI) to assess how individual differences in white matter tract microstructure may relate to performance in distinct components of phonological processing. Fractional anisotropy (FA) was assessed in several a priori regions of interest (ROIs), each localized in a subject-by-subject fashion on non-spatially transformed data. A left-lateralized parietal ROI, dominated by superior-inferior fibers, (Left Superior Corona Radiata) showed a positive correlation with a measure of phonological analysis/synthesis (CTOPP Elison). FA in a bilateral frontal ROI (Anterior Corona Radiata) was positively correlated with performance on an oral digit recall task (CTOPP Memory for Digits). Finally, the FA of the genu of the corpus callosum was correlated with performance on a fluency measure of phonological processing (CTOPP Rapid Letting Naming). Critically, these sets of correlations were unique to these particular pairings of ROIs and test components, suggesting a separability of the networks underlying different aspects of phonological processing.

H103

ASSESSING GRAY MATTER CHANGES DURING LANGUAGE LEARNING: A VOXEL- BASED MORPHOMETRY STUDY *Lee Osterhout, Andrew Poliakov, Judith McLaughlin, Kayo Inoue, Ilona Pitkanen, Geoffrey Valentine; University of Washington* – Recent studies utilizing Voxel Based Morphometry (VBM) have shown that i) exposure to a second language is associated with changes in gray matter (GM) density and ii) learning a new skill even over a short period of time can produce detectable changes in GM density. We hypothesized that students taking a nine-week intensive Spanish class may exhibit such changes. In our longitudinal VBM design, each learner participated in two MRI sessions of six scans (3D SPGR, Signa GE 1.5T scanner). One session came early in the instructional period, and the other came at its completion. The data were analyzed using SPM5 (http://www.fil.ion.ucl.ac.uk/spm/) and the VBM5 toolkit (http://dbm.neuro.uni-jena.de/vbm/). No significant changes in GM density were found using an anatomically open hypothesis (i.e. statistical analyses not constrained to any anatomical region), probably due to the small sample size. However, previous VBM studies of second language learners (Mechelli et al. 2004) provide specific predictions about possible effect locations that can be tested in an anatomically constrained hypothesis. The Small Volume Correction with a spherical 10 mm region of search centered at the predicted location detected a significant ($P < 0.05$) GM density increase. This pilot study is consistent with previous reports of language learning-related GM density effects, but shows that such effects can be observed after a very short instructional period. A larger study is needed to conclusively describe GM density changes. We will discuss lessons learned as well as methodological considerations for future longitudinal VBM studies of second language learning.

H104

THE CONSIDERATION OF THE N400 AND THE P600 ASSOCIATED WITH THEMATIC AND SEMANTIC VIOLATIONS *Hiroko Nakano[1], Bruno Rossion[2,3], Fabrizio Pizzioli[2]; [1]Saint Mary's College of California, [2]Université Catholique de Louvain, [3]Louvain-la-Neuve* – This study investigated auditory thematic integration processes in French using syntactically unambiguous sentence. Participants listened to sentences, which contained critical verbs that created thematic or semantic anomalies. The N400 and the P600 at the verbs were compared in the following conditions: Control, (e.g., the old man read the newspaper); Semantic, (e.g., The tree read the old man); Thematic, (e.g., The newspaper read the old man). In the Semantic condition, the subject noun did not fit either the “agent” or the “theme” role. In the Thematic condition, subject and object nouns were placed so that the sentence created a thematic violation, (i.e., the subject noun fits to the “theme” role, rather than the “agent” role). The plausibility of the subject noun as a theme was also manipulated. We observed that the Semantic condition elicited both P600 and N400 effects while the Thematic condition elicited P600 effects, but not N400 effects. Additionally, the P600 effect in the Thematic condition was modulated by the degree of plausibility of the subject noun as “theme.” The P600 without N400 in syntactically unambiguous sentences with meaning anomalies is consistent with recent results from sentence integration studies in other languages (e.g., Hoeks et al., 2004; 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 (Kuperberg, 2006).

H105

DIFFERENTIAL LEXICAL-SEMANTIC CONTRIBUTION FROM TWO LANGUAGES IN BILINGUAL VERBAL SHORT-TERM MEMORY *Priscilla L. P. Tu[1], Denise H. Wu[2], Daisy L. Hung[3], Ovid J. L. Tzeng[4]; [1]Institute of Cognitive Neuroscience, National Central University, Taiwan, [2]National Central University, Taiwan, [3]Institute of Neuroscience, National Yang-Ming University, Taiwan, [4]Institute of Linguistics, Academia Sinica, Taiwan* – Previous research has shown that bilinguals have separate lexicons of L1 and L2 in long-term memory (LTM). We hypothesized that there is a close relationship between verbal shot-term memory (VSTM) and LTM, therefore there are also correspondent buffers for L1 and L2 in VSTM. Specifically, we employed homophonic Chinese characters and English words (e.g., 貝/be/ vs. Bay) to examine the differential lexical-semantic contribution from the LTM of L1 and L2 to VSTM performance when the phonology of the to-be-remembered items were identical. Chinese-English bilinguals who have relatively high fluency in L2 were instructed to perform serial probed recall when the stimuli were presented in either L1 or L2. Consistent with our hypothesis, these bilinguals demonstrated a higher VSTM accuracy in L1 than in L2. The same advantage of L1 retention was also observed when articulatory suppression was applied, though the effect was restricted to earlier serial positions. These results highlight the contribution from lexical-semantic representation to VSTM. These data are also compatible with the proposal of linguistic specificity between bilingual LTM and VSTM, which has received support from previous neuropsychological and neuroimaging research. Semantic retention has been associated with left inferior/ middle frontal gyrus (LIFG & LMFG), and speech production in L1 and L2 also activates adjacent but not identical regions within LIFG. The current finding of differential contribution from the lexical-semantics of L1 and L2 to VSTM is likely subserved by anatomically adjacent but distinct areas of the language network in the LIFG and LMFG.

H106

P600 EFFECTS AND ORTHOGRAPHIC PROCESSING DIFFICULTY *Albert Kim[1], Ilona Pitkanen[2]; [1]University of Colorado at Boulder, [2]University of Washington* – Late positive ERP shifts are widely reported for grammatical anomalies during language processing, and have been interpreted as reflecting difficulty processing grammatical structure. Recently, however, similar positive shifts have been reported for stimuli such as mis-spellings, which do not involve grammatical violations. Several proposals argue that the P600 is elicited by a wide range of unexpected linguistic events, and that the underlying neural processes are highly domain general. Such accounts, though not implausible, fail to explain what distinguishes the P600 from enhanced N400, which is also elicited by unexpected linguistic events, such as semantic anomalies and pseudo-words. We tested the hypothesis that structural processing difficulty, whether orthographic or grammatical, unifies the language-related P600 effects and distinguishes P600 from N400-eliciting situations. We recorded ERPs as participants read sentence-embedded pseudo-words. In one study, pseudo-words elicited P600-like positive shifts when they appeared to be structurally ill-formed (“The baseball player caught the baul…). When the same pseudo-words did not appear structurally ill-formed (“The experienced chef sliced the baul…”), they elicited much smaller P600s and large N400 enhancement. In a second study, we parametrically manipulated the frequency of consonant clusters at the beginnings of the pseudo-words (‘thorp’, ‘phorp’, ‘ghorp’, ‘dforp’). Such pseudo-words elicited N400 and P600 effects. P600 amplitude was inversely proportional to cluster frequency, while N400 effects were not affected by the differences among the pseudo-words. We suggest that in both studies, structural processing difficulty (in this case orthographic) is manifested in P600 effects, while difficulty accessing meaning is manifested in N400 effects.

Linguistic processes: Semantics

H107

ERP MEASURES OF AUTOMATIC PRIMING IN A SEMANTIC CATEGORIZATION TASK *Barry Haimson, David Bertman, Andrea Shafer, Joy Occhiuto, Sarah Baker, Nishad Jabeen; University of Massachusetts Dartmouth* – The purpose of the present study was to extend previous research by this laboratory on the effects of relatedness proportion on ERP correlates of semantic categorization. These findings indicated no differences in the extent of the N400 effect when participants viewed stimuli consisting of a high proportion (.75) or a low proportion (.50) of related primes and targets. Both relatedness proportions may have produced a controlled priming effect. This raises the question whether the N400 effect will differ when a lower relatedness proportion is actually used. In the present study we tested subjects on the same semantic categorization task with a list containing a low proportion (.25) of related pairs of words. During testing participants viewed successively presented pairs of related (semantic and associative) and unrelated words and were asked to evaluate the relational status of the two words by depressing an appropriate button on a key pad. Related and unrelated waves were converted to differences waves. Peak amplitude values were obtained for the 320 to 450 ms (N400) and the 470 to 900 ms (positive slow wave) time windows. The results indicated that the N400 effect for the current low proportion (.25) related condition was greater than the comparable effect for the high proportion (.75) condition. However, no differences were found in slow wave activity for the three conditions. These results suggest that the N400 effect may be a stronger indicator of automatic priming than controlled priming in a semantic categorization task.

H108

OSCILLATORY CORRELATES OF VERBAL AND VISUAL SEMANTIC PROCESSING DURING SENTENCE COMPREHENSION *Roel Willems[1], Robert Oostenveld[1], Asli Özyürek[1,2], Peter Hagoort[1,2]; [1]F. C. Donders Centre for Cognitive Neuroimaging, Radboud University Nijmegen, The Netherlands, [2]Max Planck Institute for Psycholinguistics, Nijmegen* – Traditionally, electrophysiological studies of language have explored the evoked activity time locked to an event measuring Event-Related Potentials. It is however also possible to look at induced changes in the EEG by studying local neural synchrony as measured by changes in amplitude power in specific frequency bands. This approach has recently proved to be useful in the neurocognition of language (e.g. Bastiaansen et al., 2002, 2005; Hald et al., 2006). We explored the induced activity as contained in single trial oscillations of the EEG. We were interested in exploring oscillatory correlates of semantic integration during sentence comprehension. Specifically we were interested whether oscillatory activity in different frequency bands would distinguish between semantic processing of visual and non-visual semantic information. EEG was measured while subjects listened to sentences in which a critical word could either fit the preceding sentence context or not. Time locked to the critical word, a picture was presented that could also either fit the sentence context or not. In this way we were able to investigate neural changes to semantic processing of a word or of a picture into a sentence context. Increased semantic load is accompanied by an increase in power in the theta frequency range (4-6 Hz) irrespective whether the semantic information was conveyed through a word or through a picture. Picture specific effects were observed in the lower gamma frequency range (35 Hz). Results will be discussed in the context of what is known from frequency band in other domains of cognition.

H109

THE INFLUENCE OF TASK ON SEMANTIC PRIMING IN SCHIZOPHRENIA: EVIDENCE FROM EVENT-RELATED POTENTIALS *Donna Kreher[1], Phillip Holcomb[1], Sarah Choi[1], Donald Goff[2], Gina Kuperberg[1,2]; [1]Tufts University, [2]Massachusetts General Hospital* – Previous work has provided evidence for increased semantic priming under automatic processing conditions, and reduced semantic priming under more controlled processing conditions in schizophrenia patients relative to healthy controls. These two patterns of findings have led to the dual hypotheses of increased automatic spreading activation and decreased use of context in schizophrenia. Studies designed to elicit automatic or controlled semantic processing often differ in multiple experimental variables including stimulus onset asynchrony (SOA) relatedness proportion or behavioral task. The present studies examined direct and indirect semantic priming in schizophrenia with Event-Related Potentials (ERPs). The same patients and healthy controls completed two experiments in which word stimuli were identical, and SOA remained constant at 350 ms: in the first, participants monitored for words within a particular semantic category that appeared only in filler items, in the second, participants explicitly rated the relatedness of word pairs. In the implicit monitoring task, schizophrenia patients, particularly those with positive thought disorder, showed increased indirect N400 priming effects relative to healthy controls; no significant differences in direct N400 priming effects between patients and controls were observed. In the explicit relatedness ratings task, schizophrenia patients showed reduced direct N400 priming, and no indirect N400 priming, while healthy controls showed a stepwise reduction in N400 amplitude to unrelated, indirectly related, and directly related words. These results support prior reports of increased indirect semantic priming in thought-disordered schizophrenia patients under automatic conditions; in addition, they suggest that explicit decision-making reduces semantic priming in schizophrenia, even when a short SOA and indirectly related word pairs are utilized.

H110

EFFECT OF DELUSION PRONENESS OF HEALTHY SUBJECTS ON EVENT-RELATED POTENTIALS IN A SEMANTIC TASK *J. Bruno Debruille[1], Marie Prévost[1], Louis Renoult[1], Mathieu Brodeur[2], Claire Lionnet[3], Suzanne King[1]; [1]McGill University, [2]Université de Montréal, [3]Douglas Hospital* – In a previous study, more delusional schizophrenia patients were found to have smaller N400 potentials than less delusional patients, suggesting a deficit in semantic processes. In the present study, we examined whether delusion proneness could predict N400 amplitude reduction in healthy subjects performing the same task as in the previous study. The schizotypal personality questionnaire (Raine, 1991) was used to sort our participants into a subgroup of 24 subjects more prone to delusions (MPD) and a subgroup of 22 subjects less prone to delusions (LPD). They had to perform the categorization task, which was made of two serially presented words, a category word, ANIMAL?, and a target word that either belonged to that category (match condition) or did not belong to it (mismatch condition). To make sure the target word was fully processed and to avoid habituation, the category word was sometimes replaced by the word INACTION. In this condition, subjects had no decision to make. ERPs were less negative in the N400 time window in the MPD than in the LPD subgroup in the match conditions suggesting a disturbance in semantic integration processes. In the P600 time window ERPs were found to be more positive for the MPD than for the LPD subgroup indicating that MPD subjects could have extracted more information from a stimulus presentation. However the information may be of poorer quality due to MPD's deficient semantic information integration.

H111

ELECTROCORTCOGRAPHIC EVIDENCE THAT HIGH GAMMA ACTIVITY DIFFERENTIATES PROCESSING OF WORDS AND PSEUDOWORDS *Ryan Canolty[1], Maryam Soltani[2,3], Erik Edwards[2,3], Sarang Dalal[4], Sri Nagarajan[4], Heidi Kirsch[4], Nicholas Barbaro[4], Robert Knight[1,4]; [1]Helen Wills Neuroscience Institute, University of California, Berkeley, [2]University of California, Berkeley, [3]Helen Wills Neuroscience Institute, [4]University of California, San Francisco* – Six patients undergoing surgical treatment for intractable epilepsy had a 64-channel 8x8 electrode grid (2.3 mm electrode diameter, 10 mm center to center spacing) implanted under the dura followed by approximately one week of continuous monitoring of the electrocorticogram (ECoG). This monitoring was done in order to localize the seizure focus for later resection and identify critical language and motor areas to be avoided during resective surgery. Grid placement was determined entirely by clinical necessity and was over the left frontotemporal region in all patients. Auditory presentation of hand- and mouth-related action verbs produced changes in the amplitude of oscillatory activity in several frequency bands across the electrode grid. Language-related auditory stimuli produced a spatially and temporally broad drop in beta (12-30 Hz) amplitude combined with a distributed network of focal, temporally precise increases in high gamma (80-150 Hz) amplitude in the frontal and temporal lobes. Unintelligible pseudowords which matched the real verbs in duration, intensity, power spectrum, and temporal modulation both generated high gamma responses in early auditory areas. However, real words generated increased high gamma power with longer duration in these same electrodes relative to pseudowords. Real words also generated additional activity in electrodes over temporal and frontal areas not activated by pseudowords. These results suggest that high gamma activity, which has already been shown to track basic sensory and motor processing in humans, may also prove useful in mapping critical brain areas responsible for lexical processing in the human neocortex.

H112

WORKING MEMORY CAPACITY INTERACTIONS WITH PLAUSIBILITY TASK DEMANDS *Louise Stanczak[1], David Caplan[2], Gloria Waters[1], Laura Babbitt[3], Jung Min Lee[2], Gina Kuperberg[3], Neal J. Pearlmutter[4]; [1]Boston University, [2]Massachusetts General Hospital, [3]Tufts University, [4]Northeastern University* – This study investigates BOLD signal across three levels of sentence plausibility (e.g., "Venessa threw the javelin/feather/situation but did not win the competition."), in high and low working memory subjects, as a function of task demands. In Experiment 1, subjects read the sentences and answered Yes/No comprehension questions (e.g., "Was the throw good enough to win?") which did not involve the critical plausibility variation; i.e., plausibility computation was incidental relative to the comprehension task. Experiment 2 used the same stimulus sentences with an explicit plausibility judgment task, in which subjects categorized each sentence into one of three levels of plausibility. In both experiments, plausibility effects were found in both high and low working memory groups, particularly in the left inferior frontal region and right parietal region. Across experiments, an interaction between working memory capacity and task demands was found: Working memory did not interact with plausibility effects in Experiment 1, but it did in Experiment 2. These results suggest that high and low working memory subjects do not differ in their ability to compute plausibility, but they do differ in their use of plausibility information. Furthermore, these results are compatible with theories of working memory that distinguish between automatic versus controlled linguistic processing (e.g., Caplan and Waters, 1999).

H113

ATTENTION AND EMOTION IN VISUAL WORD PROCESSING – EVIDENCE FROM EVENT-RELATED POTENTIALS *Johanna Kissler[1], Cornelia Herbert[1], Markus Junghöfer[2]; [1]University of Konstanz, [2]University of Münster* – Emotional words, just like other perceptual stimuli, have recently been shown to be preferentially processed during uninstructed free viewing. In the cortical event-related potential (ERP) this preferential processing is reflected in an enhanced early occipito-temporal negativity, arising around 200 ms after stimulus onset. Theoretically, this enhanced negativity has been interpreted as an index of natural 'motivated' attention to emotional stimuli. Here we investigate to what extent an instructed non-emotional word processing task interferes with uninstructed 'motivated' attention to emotion. In a rapid serial visual presentation (RSVP, 680 ms per stimulus) subjects viewed continuous sequences of adjectives and nouns varying in emotional content (unpleasant, neutral, pleasant) and were instructed to attend to and count the occurrences of either adjectives or nouns. ERP results showed that the previously described early negativity in response to emotional words was unaffected by the explicit counting task and still occurred in response to emotional adjectives and nouns, regardless of whether they were attended to or not. At later processing stages, however, ERPs clearly differentiated between attended and unattended words as reflected in a larger late positive potential (LPP) for the attended word class and revealed no effects of emotional content or interactions with these. Results suggest that emotional content is initially transiently processed but does not affect the words' further task dependent processing. Future studies will reveal whether tasks other than the presently used morpho-syntactic task disrupt the automatic initial processing of emotional connotation or benefit from emotional content at later stages of processing.

H114

THE FUNCTIONAL ORGANISATION OF VISUAL AND TACTILE LANGUAGE PROCESSING: FMRI EVIDENCE OF CORTICAL PLASTICITY IN INDIVIDUALS WITH USHER SYNDROME *Cheryl M. Capek[1], Bencie Woll[1], Ruth Campbell[1], Karine Gazarian[1], Mairéad MacSweeney[2], Anthony S. David[3], Philip K. McGuire[3], Michael J. Brammer[3]; [1]University College London, [2]BBSU, Institute of Child Health, University College London, [3]Institute of Psychiatry, King's College London* – Previous neuroimaging studies have provided evidence of functional reorganisation in unimodal sensory deprived individuals. In this study, we used fMRI to explore the neural correlates of language processing in people with Usher Syndrome Type I (a genetic disorder in which people are born profoundly deaf and develop progressive loss of peripheral vision and night blindness, typically beginning in adolescence) as they processed materials presented in two modalities: visually and tactilely. Stimuli in both visual and tactile experiments consisted of words (nouns that were fingerspelled), non-words (nonsense hand movements) and a low level baseline. In the visual experiment, stimuli were presented within the limited visual field of the volunteers. In the manual experiment, stimuli were presented onto the volunteer's hand. For both visual and tactile modalities, processing words, as compared to non-words, elicited greater activation in a fronto-temporal network in both hemispheres. In addition, we found differences in the patterns of activation as a function of modality. We also tested deaf, normally-sighted controls who had no previous experience receiving manual fingerspelling. Words conveyed tactilely elicited non-identical patterns of activation in the two groups. In particular, tactilely delivered words elicited greater activation in visual regions in volunteers with Usher Syndrome than controls. These results suggest there is a common network for language processing independent of the modality through which it is perceived as well as regions that are modality-specific. Moreover, these findings provide evidence of cortical plasticity for language processing in adventitiously visually impaired individuals.

H115

DIVIDE AND CONQUER: ELECTROPHYSIOLOGICAL INDICES OF SENTENCE PROCESSING REFLECT DISTINCT CONTRIBUTIONS FROM THE CEREBRAL HEMISPHERES *Edward W. Wlotko, Kara D. Federmeier; University of Illinois at Urbana-Champaign* – Recent behavioral and electrophysiological evidence suggests that the two cerebral hemispheres are sensitive to sentence-level information in different ways. The current study used event-related potentials to examine the effect of sentential constraint on the processing of expected and unexpected sentence completions. Strongly and weakly constraining sentence frames (defined by cloze probability) were completed with expected or unexpected but plausible words, which were presented to the left and right visual fields (LVF and RVF). For RVF/LH presentation, the N400 response was similarly facilitated for strongly and weakly constrained expected items (relative to unexpected items), despite their differing cloze probabilities. For LVF/RH presentation, only strongly constrained expected endings elicited a clearly reduced N400 compared to the other conditions; N400 responses of similar amplitude were observed to expected and unexpected words in weakly constraining contexts, again despite notable differences in cloze probability. These strikingly different patterns of sensitivity to expectancy and constraint support the view that the LH and RH have different language comprehension architectures. A follow-up experiment that systematically varied the cloze probability of sentence completions verified that LH processing is facilitated over a wider range of expectancy than that of the RH. The pattern of electrophysiological results suggests that the graded N400 response observed for cloze probability manipulations with central presentation may actually reflect distinct contributions from each cerebral hemisphere.

H116

PHYSIOLOGICAL RESPONSES DURING FACE PERCEPTION ARE AFFECTED BY SEMANTIC CONTENT OF PRECEDING SENTENCES. *Ayelet Landau[1], Lisa Aziz-Zadeh[1,2], Richard Ivry[1]; [1]UC Berkeley, [2]University of Southern California* – We examined the interaction of language and perception by having participants listen to sentences prior to the presentation of faces. Using EEG, we asked whether the face-sensitive N170 response was modulated by the semantic content of the sentences. Specifically, each trial contained a sentence (auditory presentation) followed by a picture. The sentences either described a face (e.g., "The farmer has a bushy mustache beneath his small nose") or a place (e.g., "The house has a couch near the fireplace"). The pictures were either of faces or places which were unrelated to the sentences. To ensure that participants attended to the sentences and pictures, 10% of the trials contained an implausible sentence or picture. Participants were required to perform plausibility judgments for the sentence and the picture at the end of each trial. As in prior studies, the amplitude of the N170 to face stimuli was larger over the right hemisphere. However, we observed a lateralized context effect in the modulation of the N170. For left hemisphere sites only, this component was larger following the presentation of face-content sentences compared to place-content sentences. These results support an embodied theory of semantics where linguistic concepts are closely linked to perceptual representations of these concepts.

H117

TASK-DEPENDENT SEMANTIC INTERFERENCE IN LANGUAGE PRODUCTION: AN FMRI-STUDY *Katharina Spalek[1], Herbert Schriefers[2], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania, [2]Radboud University Nijmegen* – During picture naming, a target name is retrieved from a multitude of semantic competitors. This co-activation can be demonstrated by presenting distractor words during the naming process: If the distractor enhances the activation of an already active semantic competitor, selection of the picture name is more difficult than during the presentation of an unrelated distractor (the classic picture word interference effect). The present fMRI study investigates if the same selection processes occur when a participant's task is either to name the object or to identify a property of the object. Participants responded to black-and-white pictures with their names or their typical color. The pictures were followed by a word which was either the same as the picture name, semantically related, or unrelated. Relative to a baseline task, activation in picture naming was centered in the left inferior frontal gyrus and the left fusiform gyrus. The left fusiform gyrus showed an effect of condition (same, related, unrelated) for object naming, while the left inferior frontal gyrus showed an effect of condition for color naming. The condition effects for object and color naming were qualitatively different: In object naming, the most highly activated condition was 'related', presumably reflecting increased selection demands during the selection of the object name. In color naming, the most highly activated condition was 'same'. Possibly, during color naming, a natural tendency to retrieve the picture's name is suppressed. This suppression is harder when the distractor word further enhances the availability of the suppressed picture name.

H118

SOCIAL FEATURE KNOWLEDGE: A TWO-COMPONENT MODEL *Vanessa Troiani, Chivon Anderson, Murray Grossman; University of Pennsylvania* – The neurophysiological correlates underlying social judgments were assessed using BOLD fMRI. We hypothesize a two-component model of social judgments, involving both social knowledge and a resource component that supports judgments of this knowledge in ambiguous social situations. Participants included 14 right-handed English-speakers (mean age = 24.5 years,mean education = 15.8 years). We probed subjects' beliefs about a variety of ambiguous social situations regarded as "scofflaws", such as "Going through a red light at 2am". This was contrasted with truth-value judgments of non-social queries, such as "The first President of the United States of America was George Washington". All statements were evaluated using a 4-point scale of acceptability. An event-related design was used. Images were registered, normalized in Tailarach space, smoothed, and then analyzed with a random effects model. Relative to non-social statements, social situations activated left medial frontal (BA 10), left inferior frontal (BA 44), and left inferior parietal (BA 40) cortex. Non-social statements, relative to social statements, showed increased activation in right posterolateral temporal (BA 39), bilateral dorsal posterior cingulate (BA31), and bilateral supplementary motor (BA 6) cortex. Contrasts involving both social and non-social statements activated left ventral temporal cortex (BA 20). These data support our hypothesis that the social feature knowledge represented in ventral temporal and medial frontal regions, together with executive resources such as working memory supported by inferior frontal cortex, are necessary to judge ambiguous social situations.

H119

INVESTIGATING CONCEPTUAL AND PERCEPTUAL PICTURE PROCESSING WITH CROSS-FORM PRIMING *Eric S. Clapham[1], Aaron T. Karst[1], Jana Kainerstorfer[2,3], Jody L. Johnson[1], John VanMeter[3], C. Mark Wessinger[1]; [1]University of Nevada, Reno, [2]University of Vienna, [3]Georgetown University Medical Center* – The current study uses a cross-form priming paradigm to investigate the extraction and encoding of conceptual information from pictures and words. Using a well-characterized real world picture set we investigated conceptual and perceptual priming. In a two by two design we investigated picture to picture, word to word, word to picture, and picture to word priming. This cross-form design allows the investigation of processing beyond perceptual priming. The priming stimulus was briefly presented with forward and backward masking in order to reduce explicit processing. In order to further ensure that conceptual processing occurred, the task required participants to identify the primed stimulus as animate or inanimate. Behavioral data collected in our lab demonstrates the utility of the cross-form design. All conditions showed facilitation of performance in the form of reaction time gains. This effect is most robust when the prime and the primed stimulus are of the same form (picture to picture; word to word) suggesting that, in addition to semantic processing, perceptual processing also contributes. Nonetheless, facilitation of performance in the crossed conditions (word to picture; picture to word), demonstrates that the priming is also semantic in nature. These results are in agreement with the notion that conceptual information is represented in a common amodal store. That is, regardless of the sensory system responsible for acquiring environmental information, conceptual knowledge utilizes similar cognitive resources. Functional magnetic resonance imaging data are being used to help identify brain regions differentially involved in perceptual and conceptual picture processing.

H120

NEURAL BASIS OF METAPHORICAL ABSTRACTION: AN FMRI STUDY OF EGO-REFERENCE-POINT SPATIAL CONSTRUALS OF TIME *Rafael Nunez, Ruey-Song Huang, Martin Sereno; University of California San Diego* – Research in cognitive linguistics has suggested that abstract thought is largely achieved via conceptual metaphors that map entities from a grounded source domain (e.g., space) onto entities of a target domain (e.g., time) (Lakoff & Johnson, 1980). One such metaphor maps front-of-ego to future and back-of-ego to past. In one variation, the ego moves ("we are approaching Thanksgiving"); in another, an object moves ("Thanksgiving is approaching") (Nunez & Sweetser, 2006). There is little evidence yet of how specific conceptual metaphors are realized in the brain. Our goal was to test specific anatomical hypotheses involving space-time mappings. Recently, Sereno and Huang (2006) found aligned topographic maps of tactile and near-face visual stimuli in the superior part of the postcentral sulcus possibly corresponding to the ventral intraparietal area (VIP) of the macaque monkey. Healthy adults, whose putative VIP areas had been previously mapped with fMRI participated in a subsequent block-design study (8 cycles of 16-second ON vs. 16-second OFF blocks, auditory or visual cues). ON blocks consisted of five moving-ego metaphorical expressions, while OFF blocks consisted of five moving-object expressions. Moving-object temporal expressions more strongly activated the lateral part of the air-puff defined human VIP and MT+ bilaterally than did moving-ego expressions whereas the posterior angular gyrus and superior prefrontal cortex preferred moving-object expressions. The results suggest that temporal concepts may recruit specific brain areas that normally deal with the real moving objects, opening the way to an investigation of the neural basis of metaphorical abstraction.

H121

ELECTROPHYSIOLOGICAL INSIGHTS INTO THE PROCESSING OF NOMINAL METAPHORS *Sophie De Grauwe[1,2], Laura J. Davis[3], Phillip J. Holcomb[2], Gina R. Kuperberg[2]; [1]Rijksuniversiteit Groningen, [2]Tufts University* – We used event-related potentials (ERPs) to examine the time courses of processing metaphorical and literal sentences in the brain. ERPs were measured to sentence-final critical words (CWs) as participants read nominal metaphors (“A is a B”) as well as literal and semantically anomalous sentences of the same form. Sentences were presented word-by-word and participants made acceptability judgments after each sentence. As expected, a significant N400 effect was evoked by CWs of the anomalous (relative to the literal) sentences. However, no N400 effect was evoked by CWs in the metaphorical sentences, suggesting that their metaphorical meanings had been accessed and were not perceived as being semantically anomalous. However, in comparison with both the literal and anomalous sentences, CWs in the metaphorical sentences elicited a significantly larger late positivity. We suggest that this late positivity reflected a delayed cost in neural processing during metaphor interpretation – possibly a reanalysis resulting from a conflict between access to both the literal and the metaphorical meanings of the CWs. This interpretation is most compatible with Giora’s (1997) graded salience hypothesis for less familiar metaphors. In order to eliminate any confound of wrap-up effects on the late positivity, we are currently following up this finding by examining ERPs to CWs when they appear at mid-sentence positions.

H122

BRAIN POTENTIALS IN FORMAL SEMANTICS: LICENSED VERSUS NON-LICENSED NEGATIVE POLARITY ITEMS (NPIS) *Karsten Steinhauer[1], John Drury[1], Paul Portner[2], Matt Walenski[2], Michael Ullman[2]; [1]McGill University, Montreal, [2]Georgetown University; Washington DC* – Negative Polarity Items (NPIs) are elements such as "any", "ever", or "at all", which are unacceptable in sentences lacking an appropriate licensing property, a prototypical case of which is NEGATION (e.g., "John *had/hadn't eaten any pie"). NPI-licensing has been investigated using event-related potentials (ERPs), though only one NPI (English "ever" and its German equivalent "jemals") and one licensing manipulation (negation) has previously been tested. Shao & Neville (1998) compared "ever" to non-NPI never in non-licensing contexts (e.g., "Max has *never/ever been to a party") and reported a LAN/P600 pattern. Saddy et al. (2004) and Drenhaus et al. (2005) studied "jemals" in (non-)licensing contexts (+/-negation) and found a different pattern: an N400 followed by a P600. These previous studies are somewhat problematic in their lack of suitable control conditions: Shao & Neville contrasted different target words (ever/never) while Saddy et al. and Drenhaus et al. both contrasted the same target word in different contexts. We report results from an ERP study which avoided these problems by testing: (i) three NPIs (any/ever/at-all) in (ii) 8 pairs of licensing/non-licensing contexts which were (iii) also tested with non-NPIs to control for effects of context. Preliminary analyses suggest a novel pattern: a P600 effect that was followed by a sustained left anterior negativity (LAN). Possible explanations for the commonalities (P600-effects) and differences (in terms of the attendant relative negativities) across studies will be discussed.

H123

SEMANTIC EFFECTS FOSTERED BY THE MANIPULATION OF EXPECTANCY: A HIGH-DENSITY ERP STUDY *Tony Wu, Joseph Dien; University of Kansas* – The present study involved a sentence-reading paradigm that sought to manipulate expectancy. In particular, there were two types of sentences, those with congruent endings and those with incongruent endings. In the low expectancy condition, sentences had a low cloze probability and a low proportion of congruent sentences. In the high expectancy condition, sentences had a high cloze probability and a high proportion of congruent sentences. Event-related potentials were evaluated from 39 participants using high-density (129 channels) EEG recordings. Analyses found evidence of N400 and frontal-N300 event-related potentials displaying semantic effects. The N400 effect was present in the high expectancy condition, while being nearly abolished in the low expectancy condition. The N300 effect was present in both conditions, but weaker in the low expectancy condition. It is suggested that the N300 effect found is the same N300 effect as previously reported in picture priming studies. These observations have implications for the relationship between the semantic processing of words and pictures.

H124

THE RECOGNITION POTENTIAL IN A SENTENCE READING PARADIGM: DOES IT REFLECT AUTOMATIC SEMANTIC RETRIEVAL? *Elizabeth Huber, Joseph Dien; University of Kansas* – Linked to the visual detection of language stimuli, the Recognition Potential (RP) has been characterized as an index of orthographic, lexical and, most recently, semantic retrieval. Rapid stream stimulation (RSS) techniques have traditionally been employed to evoke RP effects. The present research involved a sentence-reading paradigm in concert with high-density (129 channel) ERP recordings. Experimental conditions were developed by varying two factors: 1) the probability that sentence-trials contained semantically congruent endings and 2) the cloze ratings of sentence-final words. Spatiotemporal principal components analysis (PCA) was conducted alongside conventional windowed analyses. In all conditions, a larger RP emerged within 200 ms for semantically congruent sentence-final words. Additional components were discernable within the 300-500 ms window, where meaningfulness and expectancy differentially impacted the results. A right frontal N400 was observed during both high probability/high cloze and high probability/low cloze conditions. In the low cloze conditions, a left-lateralized P400 was observed only when the probability of congruency was high. Given that condition effects were observed for these later components, it is suggested that they reflect controlled processes. In contrast, the RP may reflect automatic or contingently automatic semantic activation. These findings are discussed in light of another recent study from this laboratory with the aim of addressing factors that may alternatively inhibit the RP during passive sentence-reading.

H125

AN ERP STUDY OF NOUN PHRASE INTERPRETATION *Veena D. Dwivedi[1], Natalie A. Phillips[2], Stephanie Einagel[3], Shari R. Baum[3]; [1]Brock University, [2]Concordia University, [3]McGill University* – We used event-related brain potentials (ERPs) in order to investigate the interpretation of ambiguous sentences such as (i) Every kid climbed a tree. In a behavioural study, Kurtzman & MacDonald (1993) showed that plural continuation sentences are preferred (e.g., The trees were in the park) over singular continuations (e.g., The tree was in the park). We employed a 2 X 2 design to explore the interpretation of sentences like (i). The first factor manipulated was the type of context sentence: it was either Ambiguous (with respect to the number interpretation associated with the direct object "a tree") as in (i) or Unambiguous as in (ii) Every kid climbed a different tree or (iii) Every kid climbed the same tree. The second factor, Number, related to the continuation sentence. That is, either the first noun phrase was plural as in (iv) The trees were in the park or singular as in (v) The tree was in the park. We examined ERPs at the noun and verb in continuation sentences such as (iv) and (v) following one of the 3 possible context sentences, (i), (ii) or (iii). ERPs at the Verb in the ambiguous conditions and the unambiguous singular control condition, exhibited a negative waveform compared to the unambiguous plural control condition. This result was interpreted as reflecting increased cognitive load regarding noun phrase interpretation in these constructions (Kluender & Kutas, 1993; van Berkum et al., 1999). Furthermore, the findings are discussed in terms of off-line norming data collected.

H126

ASSESSING THE NEURAL BASES OF CONCEPTUAL COMBINATION WITH FMRI *G. Andrew James[1], W. Kyle Simmons[2], Aron K. Barbey[1], Xiaoping P. Hu[1], Lawrence W. Barsalou[1]; [1]Emory University, [2]National Institute of Mental Health* – Recent neuroimaging evidence from studies of individual concepts has found that conceptual processing relies on well-established neural networks in the brain's modality-specific systems for perception, action, and interoception. Neuroimaging studies, however, have not studied the fundamental process of conceptual combination in which people combine two or more concepts to form complex conceptual structures. A 3T fMRI experiment was conducted to identify general mechanisms involved in conceptual combination, and to assess whether conceptual combination recruits modality-specific brain networks. Conceptual combination was assessed by contrasting the processing of simple noun phrases (modifier plus head noun) with the individual concepts comprising them. On each trial, a modifier from one of three modalities (mental state, motion, location) was presented alone, followed by a head noun presented alone. Head nouns were comparable across the three modifier domains, controlled for semantic category, typicality, frequency, and length. Visual cues following the modifiers instructed participants to either process each concept independently (i.e. “leaping” and “horse”) or to process the conceptual combination (i.e. “leaping horse”). Participants only received a given concept once in a counterbalanced design. Catch trials (a modifier not followed by a head noun) enabled deconvolution of neural responses for modifiers vs. head nouns, which were always a short fixed interval apart in a fast event-related design with random ISIs between trials. Analyses identified brain areas associated with modifiers vs. head nouns, the processing of modifiers and head nouns in conceptual combination vs. in isolation, and modality-specific effects associated with both modifiers and head nouns.

H127

ASSESSING MODALITY-SPECIFIC CATEGORY REPRESENTATION WITH ARTIFICIAL CATEGORIES AND FMRI *Zhaohui Liu[1], W. Kyle Simmons[2], G. Andrew James[1], Xiaoping P. Hu[1], Lawrence W. Barsalou[1]; [1]Emory University, [2]National Institute of Mental Health* – Most evidence for modality-specific category representations comes from experiments using natural categories. Using high resolution fMRI in a fast-event related design, we performed an experiment in which participants learned three novel categories, each associated with a nonsense syllable name. Each category's instances shared the same visual shape of a calligraphy-like character and never repeated. After learning the categories outside the scanner the day before, participants were scanned as they performed two tasks. In the category verification task, participants received a category name, followed by a visual instance, and indicated whether the instance belonged to the category. In the naming task, participants received a visual instance, followed by a category name, and indicated whether the name labeled the instance correctly. Verification and naming trials were blocked but separated by random ISIs. Catch trials that contained various subsets of the events on verification and naming trials enabled the deconvolution of BOLD responses for the first stimulus, second stimulus, and response (which always occurred in a fixed temporal sequence). Names and instances of the familiar categories were compared to names and instances of unfamiliar (but comparable) visual stimuli, with linguistic and visual processing held constant. Deconvolution analyses of fMRI data allowed us to establish the brain areas that represented the familiar categories relative to the unfamiliar categories, either when activated by a category name, or when activated by a visual instance. Because activations for input stimuli were removed, we were able to isolate conceptual representations of the familiar categories.

H128

READ ALL ABOUT IT: THE TIME-COURSE OF INFERRING OBJECT CONFIGURATION FROM SENTENCE CONTEXT. *Diane Swick[1,2], Jary Larsen[1], Jennifer Yang[1], David Wilkins[1]; [1]VA Northern California Health Care System, [2]UC Davis* – How do language comprehension and object recognition processes interact? We used event-related potential (ERP) recordings to examine whether imagistic information is accessed during sentence comprehension, and if so, when. The presentation of short sentences was followed by pictures that either matched the expected configuration of the first noun phrase (Match), did not match (Mismatch), or were Distractors (Zwaan et al., 2002). Participants decided whether the pictured object was mentioned in the sentence. The major ERP analyses were focused on the N400 component, which reflects the ease of integration into an ongoing semantic context. Mismatch effects in the N400 would suggest that the object properties implied by sentential context can produce a violation of semantic expectancies. Mismatch effects in earlier ERP components would suggest that sentence contexts can influence perceptual processing. Behavioral data indicated that RTs were slower for Mismatches than for Matches, replicating earlier findings (Zwaan et al.). A typical N400 component was elicited by Distractors, with an onset of approximately 200 ms. A much smaller and later N400 effect was elicited by Mismatches, with an onset of approximately 300-400 ms. Thus, the N400 component was sensitive to configurational mismatch, suggesting that object properties inferred from sentential context, rather than overtly coded, can influence semantic integration processes, although their representational format (perceptual or amodal) remains unclear. Preliminary analyses of earlier ERP components did not find differences between Match and Mismatch trials, suggesting that perceptual processes were not affected. The effects of object prototypicality on these results will be discussed.

H129

OBSERVED ICONIC AND METAPHORIC SPEECH-ASSOCIATED GESTURES ARE PROCESSED DIFFERENTLY BY VENTRAL AND DORSAL PREMOTOR CORTEX *Jeremy Skipper, Susan Goldin-Meadow, Howard Nusbaum, Steven Small; The University of Chicago* – Speech-associated gestures are hand and arm actions that are co-expressive with spoken language. Iconic gestures present images of concrete actions whereas metaphoric gestures present images of actions corresponding to abstract ideas. Ventral (PMv) and dorsal (PMd) premotor cortex have been shown to be differently engaged by the directness with which observed actions can be matched to a motor plan for the production of those actions. We test the hypothesis that PMv would be more involved in processing iconic gestures because their meanings more directly indicate actions whereas PMd would be more involved in processing metaphoric gestures because their meanings are less directly related to actions. During fMRI, participants listened to stories. Participants also listened to these stories while watching the actress telling the stories. The actress sometimes made no visible hands movements, made iconic, metaphoric, or deictic gestures, or made hand movements that were not meaningful with respect to spoken content like scratching or adjusting clothing, i.e., self-adaptor movements. Behavioral results indicate that participant's understood stories better when gestures were observed. A variant of "reverse correlation" analysis revealed that both the PMv and PMd were sensitive to gestures but not self-adaptor movements. The PMv was more sensitive to iconic gestures whereas the PMd was more sensitive to metaphoric gestures. These results suggest that PMv and PMd are differentially involved in extracting the semantic information contained in gestures based on the correspondence between the observed hand and arm movements and the meaning of those movements.

H130

SEMANTIC PRIMING BY A SENTENCE CONTEXT IN LEFT HEMISPHERE DAMAGED APHASIC PATIENTS *Eileen Cardillo[1], Fred Dick[2], Nina Dronkers[3]; [1]University of California - San Diego, [2]Birkbeck College, University of London, [3]VA Northern California Health Care System* – Although widely explored, the nature of the lexical-semantic deficit observed in Broca's aphasia and its relation to the brain region of the same name has remained elusive. In particular, semantic priming studies have suggested that patients with Broca's aphasia may be especially impaired in the automatic activation of word meanings on the basis of semantic context, implicating left inferior frontal cortex in this process. However, others contend that the behavior of Broca's patients in these tasks is better characterized as a deficit in controlled semantic processes. We explored these hypotheses using a Voxel-Based Lesion Symptom Mapping (VLSM) analysis of patient behavior in an auditory sentence-priming task. Twenty left-hemisphere damaged patients with and without diagnoses of Broca's aphasia made lexical decisions on words that were preceded by semantically congruent, neutral, or incongruent sentence contexts. It was predicted that if Broca's area is critical for automatic activation processes, then patients with lesions affecting this region should show impaired facilitatory priming on congruent trials. However, if Broca's area subserves controlled semantic processes, then it was predicted that these patients would show deviant inhibitory priming on incongruent trials. The VLSM analysis indicated that individuals with lesions affecting left inferior frontal cortex and left insula experienced significantly greater inhibitory priming on incongruent trials than those patients whose lesions spared these areas. Thus, results suggest a controlled rather than automatic processing deficit associated with damage to Broca's area.

Linguistic processes: Syntax

H131

THE EFFECTS OF AGE OF ACQUISITION AND PROFICIENCY ON PAST TENSE GENERATION IN SPANISH-ENGLISH BILINGUALS: AN FMRI STUDY *Eric Waldron, Arturo Hernandez; University of Houston* – Previous research indicates that age of acquisition (AOA) and proficiency modulate neural activity during grammatical processing in late second language (L2) learners. Furthermore, no study has investigated whether these effects differ depending on the regularity of a grammatical function in individuals who are immersed in L2 at an early age. To address these issues, twelve college-aged English/Spanish bilinguals with varying second language AOA and proficiency levels were asked to covertly generate the past tense form of regular and irregular English verbs while being scanned with fMRI. AOA and English vocabulary scores were used as regressors. For individuals with later AOA, areas of activation were seen in the left middle frontal and precentral gyri and right BA 44 for irregular verbs, while the opposite contrast with early AOA revealed no significant areas of activation. For regular verbs, later AOA correlated with areas of activation in bilateral precuneus, right BA 44 and superior parietal lobule, while earlier AOA correlated with activations in the right post-central gyrus and left insula. Greater proficiency correlated with activation foci in the right medial temporal gyrus for irregular verbs, while the left superior temporal gyrus and cuneus were activated preferentially in individuals with lower levels of proficiency. These results are consistent with findings that later age of acquisition and lower proficiency levels rely on areas of the brain normally involved in attentional processing and executive function while earlier AOA and greater proficiency correlate with areas of the brain implicated in phonological and motor planning.

H132

AN ERP INVESTIGATION OF SYNTACTIC PRIMING IN LANGUAGE COMPREHENSION *Kristen Tooley, Matthew Traxler, Tamara Swaab; University of California at Davis* – An ERP experiment investigated the nature of syntactic priming in language comprehension. Syntactic priming is defined as the facilitated processing of one grammatical structure due to overlapping information in a previously encountered structure. This phenomenon is well-established in language production, but not well understood in language comprehension. Previous studies using eye-tracking (Traxler & Pickering, 2005) and ERPs (Ledoux et al, in press) indicate that priming in comprehension may be specifically linked to repetition of the verb. The current study sought to determine whether this effect is due to semantic overlap per se, or genuinely reflects priming of a syntactic structure represented with the verb. Subjects read prime and target sentence pairs in which the initial verb of the prime was either repeated (R) or synonymous (S) to that of the target: e.g., R-prime: The woman abducted by the stalker managed to escape; S-prime: The woman kidnapped by the stalker managed to escape; Target: The man abducted by the spy refused to tell what he knew. ERPs were measured to the earliest disambiguating point in the sentence ("by"), and a significant P600 reduction was found for targets preceded by R-primes but not S-primes, indicating facilitation of syntactic processing for R-primes only. There was no significant reduction of the N400 component (associated with semantic integration) at the verb. These results indicate that verb repetition is crucial for syntactic priming in comprehension, and provide strong evidence that the process being facilitated is syntactic, rather than semantic.

H133

EVENT-RELATED BRAIN POTENTIAL (ERP) EVIDENCE FOR BOTTOM-UP SYNTACTIC DERIVATION COURSE IN BRAZILIAN PORTUGUESE *Aleria C. Lage, Miriam Lemle, Maurício Cagy, Antonio Fernando Catelli Infantosi; UFRJ - Universidade Federal do Rio de Janeiro* – Semantic violations coinciding with direct object merge have been related to post-stimulus negative waves peaking around 400ms (N400). Our ERP experiment investigates subject and object merges by analyzing the electrophysiology during the syntactic/semantic integration efforts. The hypothesis was that the course of the syntactic derivation is bottom-up, taking off from standard findings in Generative Grammar. We tested 80 congruous and 80 incongruous S-V-O sentences with heavy verbs in Brazilian Portuguese, like "The boy ate the apple" ("O menino comeu a maçã") and *"The mug kissed the man" (*"A caneca beijou o homem"). Different amplitude ERPs were expected after N400, since subject merge would be later than verb-object. Electrophysiological activities in the cortex of 29 healthy native speakers were collected during linguistic stimulation (36-channel digital EEG), and signal processing techniques were applied to estimate the individual ERPs for each anatomic region. We also treated the results statistically, to know whether the ERP amplitude and latency differences were relevant. Compared to the electrocortical activities during congruous sentence computation, the ones related to incongruous sentence revealed a quite smaller N400, perhaps because right before the verb-object merge the speaker knew that it would not be semantically possible; and an ERP around 700ms with an expressive greater amplitude, that seems to be related to subject merge to VP, since the subject was the only semantically manipulated constituent. This leads us to consider the bottom-up derivation course hypothesis as the appropriate one.

H134

SYNTACTIC MODULATION OF BETA AND THETA RYTHM IN ONLINE SENTENCE PROCESSING *Lilla Magyari[1], Marcel C. M. Bastiaansen[1,2], Peter Hagoort[2,1]; [1]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, [2]F. C. Donders Centre for Cognitive Neuroimaging, Radboud Universiteit Nijmegen, The Netherlands* – The aim of the present study was to explore the oscillatory brain dynamics related to syntactic processing during language comprehension. A time-frequency (TF) analysis of power changes was performed on magnetoencephalographic (MEG) data. Subjects had to read Dutch sentences in three experimental conditions: correct sentences, sentences containing moderate syntactic violations (word-category violations, where a noun was replaced by the corresponding verb, e.g. hunter vs. hunt) and series of words without syntactic structure (the same words as in the correct sentences, but now in random order). A statistical evaluation of the TF data, based on random permutation testing (Maris, 2004), revealed power differences between correct sentences and violated sentences in the theta (here roughly 3-9 Hz) and lower beta (13-18 Hz) frequency ranges. The theta power differences were concentrated over right parietal areas, whereas the beta power differences were present over midfrontal, right parietal and left parietal areas (the latter only in the contrast correct – random word order). For the beta frequency range, the condition differences were produced by a linear increase in power over the correct sentences, which suddenly dropped when a word category violation was encountered, and was completely absent in the random word order sentences. The systematic modulation of the power changes corresponding to the level of the syntactic structure distortion suggests that theta and beta oscillations are involved in normal syntactic processing. Reference: Maris, E. (2004), Randomization tests for ERP topographies and whole spatiotemporal data matrices, Psychophysiology, 41, 142-151.

H135

INVESTIGATING THE ROLE OF LEFT INFERIOR FRONTAL GYRUS IN SYNTACTIC AND REFERENTIAL AMBIGUITY RESOLUTION *David January, John C. Trueswell, Sharon L. Thompson-Schill; University of Pennsylvania* – Contrary to traditional hypotheses which hold that LIFG is the neural substrate of syntax, recent studies (e.g., Thompson-Schill et al., 1997) show that LIFG is selectively engaged in the resolution of conflict between competing representations. Novick et al. (2004) hypothesized that sentence comprehension deficits following damage to LIFG might be explainable through the Constraint-Based Lexicalist theory of parsing, which holds that successful comprehension relies on the integration of multiple (partially) independent cues to structure, including frequency, referential needs, and structural biases (Snedeker & Trueswell, 2004; MacDonald, 1994). We report an fMRI study testing this hypothesis and also the generality of LIFG conflict resolution. Specifically, subjects listened to sentences which were temporarily either syntactically ambiguous (“turn over the hippo with the sponge”, containing temporary conflict between an instrument interpretation and a modifier interpretation of “with”) or referentially ambiguous (“turn over the hippo that has the sponge” in the context of a hippo holding a sponge and another hippo, containing temporary conflict concerning which hippo “hippo” refers to). Degree of conflict was varied parametrically within each ambiguity type. In the referential series, the point at which the referent was uniquely identified by the sentence was delayed by varying the context. In the syntactic series, conflict was varied by increasing the number of cues in conflict with the ultimate correct interpretation of the sentence. If LIFG resolves both syntactic and referential conflict, we expect co-localized activity in both the referentially and syntactically ambiguous conditions, increasing with the duration or strength of conflict.

H136

THE INTERACTION OF UNIVERSAL AND LANGUAGE-SPECIFIC PROPERTIES IN THE NEUROCOGNITION OF LANGUAGE COMPREHENSION: EVIDENCE FROM THE PROCESSING OF WORD ORDER PERMUTATIONS IN JAPANESE *Susann Wolff[1], Matthias Schlesewsky[2], Ina Bornkessel-Schlesewsky[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, [2]University of Marburg* – One of the most potent challenges in modelling the neurocognition of language lies in the need to account for the fact that a single neural language processing system is apparently equipped to support the comprehension of a highly diverse set of human languages (over 6000). Within this diversity, one of the key properties that the comprehension system must be able to accommodate is a flexible ordering of sentence constituents. Previous electrophysiological findings on the processing of permuted structures in German have revealed a distinct ERP response, namely an early central negativity (“scrambling negativity”) for dispreferred but grammatical word orders. In an auditory ERP study, we examined whether a similar neural response can also be observed in analogous constructions in Japanese. Our main finding was that unambiguously marked initial objects do not generally elicit a scrambling negativity in comparison to initial subjects, but only when followed by a prosodic boundary. We interpret this result and its deviation from the German pattern as evidence for the application of a universal “least effort”-based processing strategy, which interacts with language-specific properties. Thus, initial objects only engender local processing cost when they are incompatible with a minimal (one argument) structure. While this is always the case in German, the high tendency towards the omission of subjects in Japanese leads to a compatibility with a minimal structure by default, i.e. unless contradicted by prosodic properties. This account derives cross-linguistic similarities and differences in the electrophysiological processing patterns associated with word order phenomena.

H137

NEURAL SYSTEMS INVOLVED IN THE COMPREHENSION OF AMERICAN SIGN LANGUAGE (ASL) AND NON-LINGUISTIC GESTURE: AN FMRI STUDY *Aaron Newman[1], Elissa Newport[2], Ted Supalla[2], Daphne Bavelier[2]; [1]Dalhousie University, Halifax, NS, Canada, [2]University of Rochester, Rochester, NY* – Signed languages, such as American Sign Language (ASL), present unique opportunities to further our understanding of the factors underlying the neural bases of language. An important question concerns the relationship between the neurocognitive systems used in the comprehension of sign language compared to meaningful non-linguistic gestures. In separate event-related fMRI runs, deaf native signers and hearing non-signers viewed movies of a native signer producing ASL classifier constructions (including what has been termed “spatial syntax”) and movies in which non-signers described the same events, using only gesture without accompanying speech. Deaf native signers showed highly similar patterns of left-lateralized activation for ASL and nonlinguistic gesture, comprising the left hemisphere (LH) inferior frontal gyrus (IFG), anterior superior temporal sulcus (STS), and angular gyrus (AG). Additionally ASL, but not gesture, activated the LH posterior STS in deaf signers. Hearing non-signers showed bilateral activation of the same LH regions as signers and their RH homologues, and no differences between activation patterns for ASL and gesture. The LH posterior STS region activated exclusively by ASL in signers was activated by both ASL and gesture in non-signers. These results suggest neuroplastic changes in deaf native signers, whereby the perception of meaningful body movements, both linguistic and non-linguistic, become reliant on a more left-lateralized network of regions compared to the strongly bilateral activations observed in hearing non-signers. As well, a region of the left posterior STS appears to become specialized for language processing only in ASL signers.

H138

THE ELECTROPHYSIOLOGY OF SEMANTIC RELATEDNESS: GETTING CLOSER THAN CLOZE *Aniela I. França, Miriam Lemle, Maurício Cagy, Antonio Fernando Catelli Infantosi; UFRJ - Universidade Federal do Rio de Janeiro* – How much closer is "school" to "student" than "beach" to "trunks"? An event-related brain potential (ERP) experiment with 32 native speakers of Brazilian Portuguese was performed to gauge semantic relatedness between prime/target words presented sequentially. Differing theoretically from the statistical notion of semantic field, typical of Cloze, our account of semantic relatedness bears on overlapping aspects of prime/target word definitions. The assumption is that whenever target is involved in the definition of prime, speakers are bound to merge the pair into a prepositional phrase: "school with student". Conversely, if target does not define prime, this syntactic structure will not pop up. Four sets of paired stimuli with grading relatedness were randomly presented: (i) 50 pairs for targets contained in the definition of prime (school/student); (ii) 50 pairs that needed two mediating constructions (beach/trunks: beach with man/man in trunks); (iii) 50 pairs of unrelated words ("wood/telephone"); (iv) 150 word/non-word pairs (house/blicket). We obtained two ERPs related to each target. The first, at 200ms, probably stems from phonological processing and showed no statistical difference among the sets. The second wave, a negativity peaking at around 400ms, had significantly earlier latencies with targets in (i) than those in (ii), (iii) and (iv). Set (i) targets also presented the highest amplitude waves. No significant difference was obtained comparing ERPs from targets in sets (iii) and (iv). These results indicate that semantic relatedness between words might be measured syntactically and that this tool is more accurate than criteria purported by Cloze Theory.

H139

TAKING AGE INTO ACCOUNT IN BILINGUALISM: ERPS TO MORPHO-SYNTACTIC PROCESSING. *Margaret Gillon-Dowens[1], Horacio A. Barber[2], Oliver Müller[3], Manuel Carreiras[1]; [1]University of La Laguna, Tenerife, [2]University College of London, U.K., [3]University of La Laguna, Tenerife* – Most ERP studies of morpho-syntactic processing in both monolingual and bilingual readers have been carried out with populations of young adults. Previous studies with this type of population in Spanish revealed effects of Left Anterior Negativity (LAN) and late positivity (P600) in response to gender and number violations within sentences visually presented. The aim of this study was to investigate the electrophysiological correlates of gender and number agreement in the Spanish language, with participants over the age of 40, who were either native speakers of Spanish, or late learners with over 15 years of exposure to Spanish and a high degree of proficiency. Results replicated the P600 effect previously reported with younger populations. Interestingly, the topographical distribution over the scalp of the LAN effect was similar for both monolingual and bilingual older groups, but different from that of the younger readers; older groups showed the syntax-related negativity over left central areas. From this we can conclude that the processing of morphosyntactic violations in monolinguals and late bilinguals produces similar early ERP effects when age is controlled for. However, the differences found in topography between the older and younger participants show that age is a factor of importance in these processes.

H140

INDIVIDUAL DIFFERENCES IN SYNTACTIC PROCESSING AS REVEALED BY ERPS AND FMRI *Eric Pakulak, Stephanie Hyde, Zachary Jacobs, Helen J. Neville; University of Oregon* – Previous studies have indicated that event-related potentials (ERPs) are sensitive to specific aspects of linguistic proficiency within the population of normal monolingual English speaking adults (Pakulak & Neville, under review; Weber-Fox et al., 2003; Yamada et al., 2001). While several studies have examined auditory syntactic processing using PET or fMRI, none of these studies have examined individual differences in linguistic proficiency in monolinguals using these methods. In the present study we directly compare data from ERPs and event-related fMRI to further examine individual differences in brain organization for language in adult monolinguals who vary on aspects of linguistic proficiency. Adult monolingual speakers of English were given three subtests of the Test of Adolescent and Adult Language (TOAL-3) and the composite standardized scores were used to form two groups. Stimuli consisted of naturally spoken English and "Jabberwocky" sentences, the latter formed by replacing open class words with pronounceable pseudowords. ERPs were recorded to insertion phrase structure violations and averaged to the critical word in each sentence, and the fMRI BOLD response to each critical word was evaluated. ERP results revealed a more focal left anterior negativity and larger, more widespread late positivity in higher proficiency vs. lower proficiency subjects. These modulations in the amplitude and distribution of ERP components related to language proficiency were then used to constrain the interpretation of modulations in fMRI activations in lower versus higher proficiency subjects.

H141

EVENT RELATED POTENTIALS INDICES OF SYNTACTIC PROCESSING IN MUSIC AND SPEECH *Ahren Fitzroy, Lisa Sanders; University of Massachusetts, Amherst* – Event-related potential (ERP) research shows that linguistic grammatical violations elicit a negativity 150-300 ms after word onset largest over left anterior electrode sites (LAN). Recent evidence indicates that violations of musical syntax result in a similar negativity with a more right lateralized distribution (RAN). The amplitude and distribution of these components is modulated by the severity of violations and listener proficiency. However, responses to syntactic violations in music and speech have never been directly compared. The current study was designed to test the hypotheses that 1) results from previous music studies generalize to other types of harmonic violations, 2) there are general processing systems involved in automatic responses to syntactic violations in music and speech, and 3) expertise effects on syntactic processing are domain specific. ERPs were measured in response to blatant and more subtle syntactic violations in sentences and chord progressions in musicians and non-musicians. Severity of violation was manipulated for speech by including insertion errors in normal English sentences and sentences with nonwords in place of open-class items, and for music by substituting out-of-key chords into progressions from a distantly or closely related key. Correctly detected syntactic violations in music elicited a RAN. Groups who showed early modulations of ERPs in response to subtle syntactic violations tended to do so for both music and speech. Musical expertise had a larger effect on responses to music than language violations. Results suggest there are both shared neural systems supporting syntactic processing of music and speech and domain-specific effects of experience.

H142

UNDERSTANDING NESTED LOCATIVES: AN EVENT RELATED POTENTIALS INVESTIGATION *Marguerite McQuire[1], Kim Verhouf[2], Seana Coulson[3]; [1]Language & Communicative Disorders, UCSD/SDSU, [2]Nijmegen Institute for Cognition and Information at the Radboud University Nijmegen, [3]Cognitive Science, UCSD* – Cognitive linguists have proposed that linguistic descriptions of spatial relationships that mirror the way we search through space are easier to process than those that do not. This hypothesis predicts that descriptions which begin with a general spatial location and "zoom in" to a more specific region require fewer cognitive resources than those that "zoom out". Two experiments, each with 12 healthy native English speakers, contrasted brain potentials elicited while reading sentences that began with a short object phrase, and were followed by 4 prepositional phrases indicating the location of the object. Sentences differed in the sequencing of locative prepositional phrases. At phrase 2, the effect of "zooming out," (My cell phone is… under my coat, ON THE FRONT SEAT) was compared to "zooming in," (My cell phone is… on the bus, ON THE FRONT SEAT). Both experiments suggest sentences that "zoom out" elicit a left anterior negativity (LAN) relative to sentences that "zoom in." A second point of comparison involved the consistency of zooming direction. Switching from "zooming out" to "zooming in" between the third and fourth phrase (Experiment 1) and switching from "zooming in" to "zooming out" (Experiment 2) engenders a late positive complex (LPC) at the sentence-final word relative to sentences whose prepositional phrases consistently "zoom in" or "zoom out." Taken together, these data suggest that sentences that present a search trajectory inconsistent with the way we search for objects in physical space require additional discourse level computations.

H143

BEFORE AND AFTER: AN ERP INVESTIGATION OF LATE SECOND LANGUAGE LEARNING IN AN INTENSIVE LANGUAGE COURSE *Erin White, Fred Genesee, John Drury, Karsten Steinhauer; McGill University* – Are second language (L2) attainment and the neurological changes associated with L2 learning limited by a critical period (Johnson & Newport, 1989)? While some ERP studies report that late (adult) L2 learners cannot elicit the LAN/P600 response typically associated with morpho-syntactic processing in native speakers and child learners (Weber-Fox & Neville, 1996), others suggest that regardless of age of acquisition, L2 proficiency levels are responsible for "native-like" neuro-cognition (Steinhauer et al., 2006). Furthermore, under certain circumstances ERP responses may begin to approximate that of native speakers after relatively little L2 instruction (Osterhout et al., 2006). We present pre-post ERP data of 30 Korean speakers both at the beginning and end of a 9-week intensive intermediate level English course. Participants read correct sentences and those containing a violation of English grammar not directly transferable from their L1 (verb-subject agreement, inflection, or phrase structure). L2 learning among these late learners led to both quantitative and qualitative changes in the ERP signal. By the end of the course, the P200 amplitude elicited in response to content words decreased, suggesting that orthographic processing had became less effortful. Furthermore, the agreement condition elicited a P600 effect that was not present before the course, suggesting morphological processing was beginning to resemble that of native-speakers. The results will also be discussed in terms of cognitive variables thought to influence rate of L2 learning (phonological short term memory span, motivation to learn, implicit/explicit learning) and the role they play in predicting changes in the ERP signal.

H144

A PARAMETRIC FMRI STUDY OF PHRASE STRUCTURE EFFECTS DURING SENTENCE COMPREHENSION *Colin Humphries, Jeffrey Binder; Medical College of Wisconsin* – Event-related fMRI was used to investigate the neural systems involved in sentence comprehension. Stimuli were auditory subject-verb-object sentences. Subject and object phrases consisted of an article, adjective, and noun (e.g., "the heavy door"). The verb phrase consisted of a modifier verb followed by an infinitive (e.g., "tried to open"). The words in each of the three phrases were presented in either correct or reversed (e.g., "door heavy the") order, giving a total of eight conditions. Subjects were required to rate each stimulus on how similar it sounded to a normal sentence on a scale from 1 to 4. A broad network of left hemisphere brain areas showed greater BOLD signal for stimuli in which the words in the three phrases were in the correct order compared to those in which all of the words were reversed, including left inferior frontal gyrus (BA 44/45/47), left anterior superior temporal sulcus (STS), and left posterior STS. Activation in these regions generally increased in proportion to the number of correctly ordered phrases in the sentence, though some areas showed a nonlinear, exponential increase indicating additive interactions between the phrases. We propose that the identified brain areas are involved in integrating phrasal syntactic elements during sentence comprehension.

H145

MAKING "IT" CONCRETE: AN EXAMINATION OF ANTECEDENT CONCRETENESS EFFECTS IN PRONOMINAL CO-REFERENCE USING EVENT-RELATED POTENTIALS *Ryan A. Downey[1], Janet Nicol[2], Tracy Love[1], David Swinney[1]; [1]SDSU/UCSD Joint Doctoral Program in Language and Communicative Disorders, [2]University of Arizona* – Two experiments using event-related potentials (ERPs) examine: (1) whether the concreteness effect found with ERPs (greater negativity associated with concrete nouns) by Kounios & Holcomb (1994) may be observed when concrete vs. abstract nouns occur in auditory sentence contexts; and (2) whether the effect (re-)emerges at the point of a subsequent co-referring element, a pronoun (see examples below). Data from previous reaction time (RT) studies support "deep", conceptual reactivation of the licensed antecedent (Nicol & Swinney, 1989; Love & Swinney, 1996) at the pronoun. In Experiment 1, with visual presentation, concrete nouns elicited greater frontal negativity than abstract nouns in the 300-500 ms window (consistent with the "concreteness N400," (cN400); Kounios & Holcomb, 1994). Pronouns coreferent with abstract nouns produced greater centroparietal negativity than those coreferent with concrete nouns starting ~300-900 ms following pronoun onset (traditional N400), suggesting that pronouns with abstract antecedents may be harder to integrate into ongoing context. Experiment 2 presented sentences auditorily. Interestingly, at the antecedent, no concreteness effect appeared. However, a cN400 occurred at the pronoun, with concrete it being more negative than abstract it, starting ~300 ms following pronoun onset. Taken together, these results provide evidence that deep, conceptual properties of antecedent nouns (concreteness) may be reactivated immediately at the pronoun during auditory (but not visual) presentation of sentences. Issues regarding processing under different presentation modalities (auditory vs. visual) are discussed. EXAMPLES: Phil knows all about prison(concrete). He loves to talk about it(concrete). Phil knows all about passion(abstract). He loves to talk about it(abstract).

H146

THE INTERACTION OF PROSODY AND VERB TRANSITIVITY BIASES DURING THE PROCESSING OF SPOKEN GARDEN PATH SENTENCES: AN ERP STUDY *Inbal Itzhak, Efrat Pauker, Shari Baum, John Drury, Karsten Steinhauer; McGill University* – The important role of prosody in syntactic parsing has been shown in previous psycholinguistic investigations of auditory sentence processing (e.g., Kjelgaard & Speer, 1999). ERP data have demonstrated the immediate online use of prosodic information, including (1) the prosody-induced reversal of 'garden path effects' and (2) a specific ERP brain response at prosodic phrase boundaries, the closure positive shift (CPS) (Steinhauer, Alter, & Friederici, 1999). However, various semantic and contextual constraints may also influence syntactic parsing decisions. In the case of verbs that could appear either in an Early Closure construction (an intransitive interpretation) or in a Late Closure construction (a transitive interpretation), one factor that may have an impact on the parsing decision is the verb's transitivity bias. That is, the relative probability of that a given verb will occur with/without a direct object (Trueswell, Tanenhaus, & Kello 1993; Garnsey et al. 1997). It is possible that when the parser encounters a verb that is more frequently used intransitively, it will tend towards Early Closure, whereas a transitively biased verb may lead the parser towards a Late Closure analysis. The present study used ERPs to investigate the interaction of transitivity bias and prosody during the processing of closure ambiguities. Implications for sentence processing models will be discussed.

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BRAIN RESPONSES TO CONTEXTUALLY UNGRAMMATICAL VERB INFLECTION IN ADULTS, TYPICALLY DEVELOPING CHILDREN AND CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT *Arild Hestvik, Richard G. Schwartz, Valerie Shafer, Yael Neumann, Yan Yu, Baila Tropper; CUNY Graduate Center* – Children with Specific Language Impairment (SLI) typically make errors in verbal tense inflection when producing speech. It is not known whether they also can perceive when a verb inflection is ungrammatical. To determine this, we conducted a study obtaining brain responses to auditorily presented ungrammatical sentences. 23 adults, mean age 31 (SD = 6); 14 typically developing (TD) children, mean age 9.6 (SD = 1); and 7 SLI children, mean age 9.9 (SD = 1.3) participated. The stimuli were spoken sentences like “Yesterday, I walked to school”, “Yesterday, I walk to school”, “Yesterday, I went to school”, “Yesterday, I go to school”. Thus, the present tense verbs were always ungrammatical. (A separate control experiment obtained ERPs to the same sentences but without “Yesterday”, so that all verbs were grammatical.) Adults exhibited a left anterior negativity to the ungrammatical verb inflections, starting around 200ms after the offset of the verb, but there was no difference between irregular and regular verbs. TD children showed an ERP to ungrammaticality that was similar in latency and topography to the adult group, but limited to irregular verbs. The SLI children did not show any effects of ungrammaticality. (However, this could be due to the lower number of subjects; data collection is on-going and a larger child group will be analyzed for the conference.) The preliminary conclusion is that SLI children’s brain responses do not reflect ungrammaticality of verb inflection, suggesting that their production errors are matched by a general lack of grammatical control of tense.

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MEMORY OUTCOME AFTER TEMPORAL LOBE SURGERY IN CHILDHOOD *C. Yaro, J. H. Cross, F. Cormack, F. Vargha-Khadem, T. Baldeweg; UCL Institute of Child Health, UK and Great Ormond Street Hospital for Children NHS Trust, London, UK* – Temporal lobectomy (TL) is a successful surgical treatment for patients with intractable temporal lobe epilepsy. Verbal memory loss after resection of the language-dominant temporal lobe is a well documented finding in adult patients. However, little is known about long-term memory outcome in children. We investigated memory in patients who underwent TL in childhood. In addition, we evaluated if language lateralisation as determined using functional MRI (fMRI) influences memory outcome. Mean age at surgery was 13.5 years and minimum post-surgical follow-up was 5 years. A total of 31 patients were tested (15 left- and 16 right-sided surgery) of whom 14 had developmental tumours (DT) and 17 hippocampal sclerosis (HS). 5 patients with full-scale IQ <70 were excluded. Cognitive outcome was measured using standardised tests of intelligence (WAIS-III) and memory (Doors & People Test, Wechsler Memory Scale-adapted). Patients with left-sided TL showed significantly poorer performance on verbal memory tasks (story, name and paired associate recall), but no side-specific effects were revealed for visual memory. Furthermore, pathology type influenced cognitive outcome, with DT patients demonstrating better overall memory and IQ than HS patients, regardless of side of resection. Atypical language fMRI lateralisation (defined as right-sided or bilateral) was found in 50% of cases (53% left and 47% right). Preliminary analysis suggests that language lateralisation away from the resected temporal lobe is beneficial for verbal memory outcome irrespective of side of surgery. In summary, children show an adult-like pattern of verbal memory deficits after left TL. However, this may be ameliorated by language reorganisation.

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