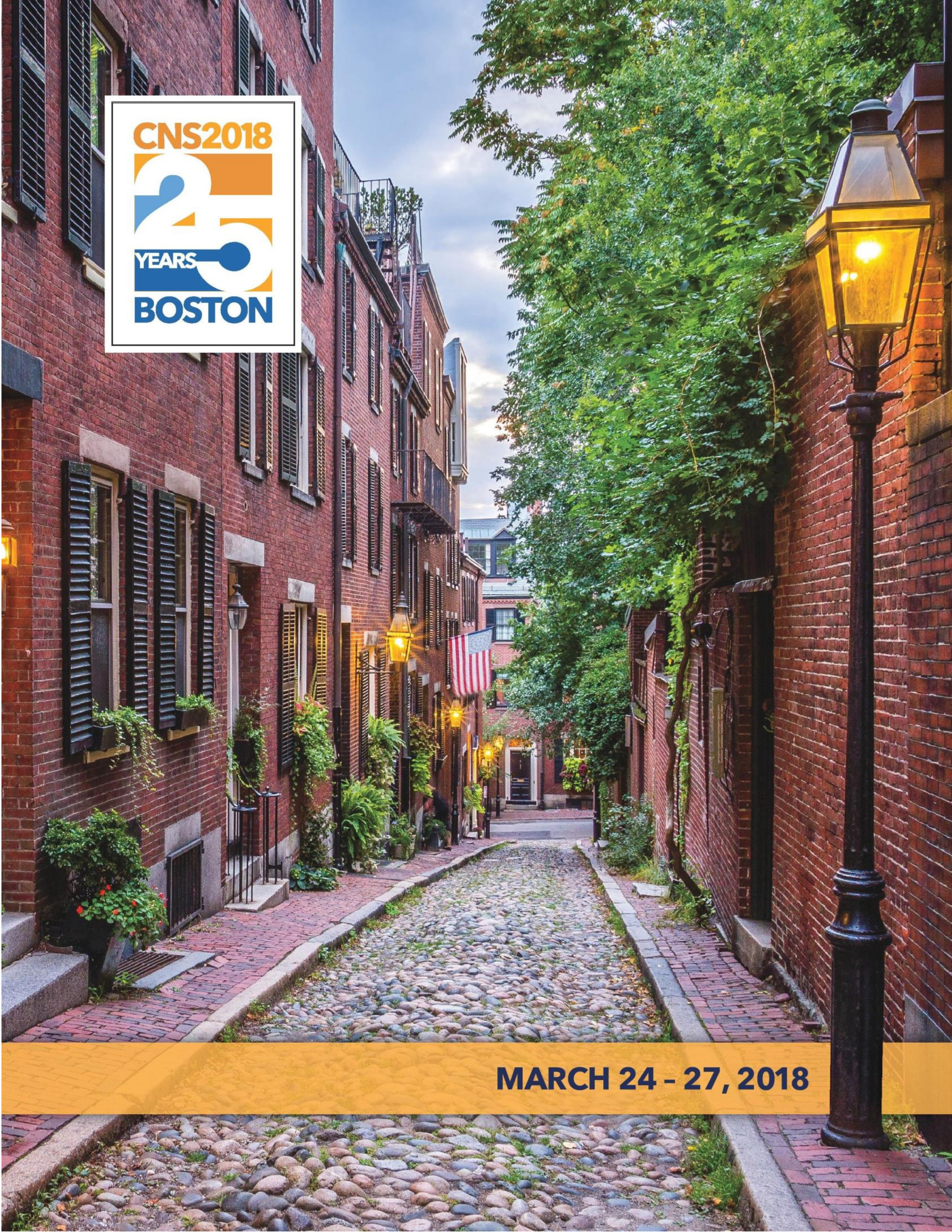
CNS2018

25 YEARS

BOSTON



MARCH 24 – 27, 2018

Behavioural and electrophysiological measurements of lapses in sustained auditory attention

Poster A1, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Alice E Milne[1], Daniel I R Bates[1], Maria Chait[1]; [1]UCL, London

Top-down attention during noisy auditory scenes boosts perception of task-relevant stimuli, while inhibiting irrelevant signals. However, sustaining attention over extended periods of time is challenging and leads to lapses in attention. Recordings from macaque auditory cortex show that neural alpha-oscillations and entrainment reflect transient changes in attentional state. However, it is unknown how the human neural response to auditory stimuli is affected by attentional lapses. We designed a novel paradigm to study unintentional breaks in sustained attention. Participants were required to track pitch changes in a pure-tone pulse stream. To increase perceptual load, the target stream was flanked by two additional pulse-streams of different pitch and pulse rates, along with attention-capturing high-pitch tone pips and a flickering visual Gabor-patch. Trials were 5-mins long with behavioural responses captured semi-continuously (2-7 seconds). Critically, control trials presented the same auditory and visual stimuli but participants performed a low-attention task, responding to the salient tone pips or Gabor orientation changes. Variations in false alarms, misses and reaction times were used to identify periods when attention to the target stream lapsed. EEG data was acquired using the same paradigm and the behavioural data used to determine the occurrence of attentional lapses. These time periods were then used to characterise the dynamic neural changes that result from variations in attentional states, specifically for alpha-band activity and neural entrainment. We report a novel paradigm that behaviourally captures transient changes in top-down attention, and which can be used to effectively study the neural features of an attentional lapse.

Topic Area: ATTENTION: Auditory

Anticipatory EEG Activity during Somatosensory Selective Attention relates with Executive Function

Poster A2, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Staci Meredith Weiss[1], Rebecca Laconi[1], Peter Marshall[1]; [1]Temple University

There is growing evidence that the ability to selectively attend to target stimuli is related to higher-order cognitive skills. We examine whether sensorimotor oscillatory EEG activity during anticipation of tactile stimulation is related to executive function (EF) in adults. During EEG collection, a visual cue directed participants' attention to their right or left hand in preparation for tactile stimulation. Tactile stimulation was delivered via inflatable membranes attached to the index finger of the participant's hands. Participants (N=20) also completed 3 EF tasks on the NIH Cognitive Toolbox, which included measures of behavioral inhibition (flanker), working memory and task-switching (card sort). Analyses focused on the amplitude and lateralization of the sensorimotor mu rhythm (8 – 13 Hz) during anticipation of tactile stimulation. Mu rhythm amplitude was related to the interaction between hemisphere and target hand, $F = 5.57$, $p = .02$. We observed a significant reduction in amplitude over the somatosensory cortex contralateral to the target hand, and no significant change over the ipsilateral somatosensory cortex. Further analyses related scores on EF tasks with contralateral mu rhythm activity. Results indicate that contralateral EEG activity was related to the working memory task, $F= -5.30$, $p < .01$ and marginally related to the behavioral inhibition task, $F = -1.93$, $p = 0.06$. These findings extend the literature on selective attention and EF by indexing attention to a modality (somatosensory) which is not involved in EF tasks. We discuss implications for the malleability of selective attention and development of EF.

Topic Area: ATTENTION: Multisensory

Default-Executive coupling in attention control after traumatic brain injury with task functional magnetic resonance imaging in longitudinal study.

Poster A3, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Shun-Chin Wu[1,2], Lei Wang[1], Fan-pei Gloria Yang[3], Furen Xiao[4]; [1]Northwestern University, Chicago, IL 60611, USA, [2]National Defense Medical Center, School of Medicine, Taipei, Taiwan, [3]National Tsing Hua University, Hsinchu, Taiwan, [4]National Taiwan University Hospital, Taipei, Taiwan

Deficits in goal-oriented executive function such as working memory are common in individuals with Traumatic Brain Injury (TBI). Recent longitudinal neuroimaging studies showed increased activation and connectivity in TBI patients. During a 5-week observation period, we examined changes in goal-oriented executive function in 21 patients with brain injury in post-acute phase, using a face/scene matching 1-back functional magnetic resonance imaging (fMRI) task (Chen, 2012). The block-design fMRI task involved two types of interleaving stimuli: relevant and irrelevant, depending on whether the current stimulus matched the goal category (face or scene). We used multivariate pattern analysis (MVPA) to assess the relevant vs. irrelevant stimuli contrast as indication of clarity for different types of information. All data were preprocessed in SPM 12 with The Decoding Toolbox for MVPA, followed by repeat-measures ANOVA to examine longitudinal change, with a cluster FWER p=.001. Results showed that task accuracy did not change significantly. Significant increases were found in the right dorsolateral prefrontal cortex (DLPFC), right putamen and bilateral premotor cortex, and decreases in the posterior cingulate cortex (PCC), precuneus and right middle temporal gyrus in averaged information map. The combined decreases in PCC and precuneus were correlated with the increases in right DLPFC (r=-0.441, p=0.043), as with right DLPFC and putamen (r=-0.526, p=0.015). These anticorrelated changes in the executive, salience and default model networks in post-acute phase TBI patients suggest neural functional recovery at five-week follow-up that may precede any performance change. Our study can provide useful information regarding appropriate timing for future neurorehabilitation management.

Topic Area: ATTENTION: Nonspatial

Estimation of Mind-Wandering - For the Respondent Conditioning Enhancing the Meta-Awareness Ability to Mind-Wandering

Poster A4, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Issaku Kawashima[1,2], Hiroaki Kumano[1], Keiko Momose[1]; [1]Faculty of Human Sciences, Waseda University, [2]Graduate School of Human Sciences, Waseda University

Mind-wandering (MW) is a thought unrelated to the current tasks. Though the trait to be meta-aware of MW might ameliorate depression and increase creativity, the means to enhance the ability of meta-awareness in an individual is not known. Meta-awareness cannot be attended when one is absorbed in MW. But if one's attention is directed to external stimulus so that MW is interrupted, the person can be made meta-aware of incidences of mind-wandering. Conducting respondent conditioning between an occurrence of MW and an arousal of external attention (i.e., whenever someone slips into the state of MW, the person's attention is directed to the outside) possibly helps enhance meta-awareness ability. The method of detecting MW is crucial for such conditioning protocols that need the detection of MW and the immediate presentation of the stimulus. This study aims to indicate that electroencephalogram (EEG) can estimate the intensity of MW. Fifty people participated in the experiment. We measured their EEG during the performance of sustained attention to response task (SART) with experience sampling questions on how strongly they executed MW. We applied support vector machine regression on the EEG features, including eight frequency band power and coherence of 17 channels, and created a model estimating MW intensity. The verification with hold-out data indicated the robustness of this model (r = .49). The result suggests that MW intensity can be estimated by EEG and the feasibility of respondent conditioning with MW estimation by EEG measuring. This presentation was supported by Tateisi Science and Technology Foundation.

Topic Area: ATTENTION: Other

Characterizing the influence of attentional state on the fidelity and connectivity of stimulus representations across large-scale brain networks

Poster A5, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

David Rothlein[1], Joseph DeGutis[1,2], Michael Esterman[1,3]; [1]VA Boston Healthcare System, [2]Harvard Medical School, [3]Boston University School of Medicine

Attention is thought to modulate performance by facilitating the representation of task-relevant features (representational fidelity) and integrating this information with task-rule representations (representational connectivity). However, attention is not a constant but fluctuates between stable/accurate (in-the-zone) and variable/error-prone (out-of-the-zone) states. Here we ask how different attentional states affect the neural processing and transmission of task-relevant information. Specifically, during in-the-zone vs. out-of-the-zone periods: (1) Do neural representations of task stimuli have greater fidelity? (2) Is there increased communication of this stimulus information across large-scale brain networks? We used fMRI and representational similarity analysis during a visual sustained attention task (the gradCPT) to address these questions. Participants (N=146) viewed a series of city or mountain scenes, responding to cities (90% of trials) and withholding responses to mountains (10%). Representational similarity matrices (RSMs), reflecting the similarity structure of the city exemplars (n=10), were computed within visual and attention networks. Representational fidelity (RF) and representational connectivity (RC) were quantified as the cross-validated inter-participant reliability across RSMs within a given network (RF) and across a pair of networks (RC), and were computed separately from in-the-zone (low RT-variability) and out-of-the-zone (high RT-variability) trials. We found that being in-the-zone was characterized by increased RF within the visual network ($p < 0.05$) and increased RC between the visual and attention networks ($p < 0.01$), suggesting attentional state was associated with the representation and integration of stimulus information into attention networks. More broadly, this work provides a novel means to investigate how cognitive states influence information processing throughout the brain.

Topic Area: ATTENTION: Other

Visual search alpha: A novel window into lateralized visual attention processes

Poster A6, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Matthew D. Bachman[1], Berry van den Berg[2], Lingling Wang[3], Marissa L. Gamble[4], Kait Clark[5], Marty G. Woldorff[1]; [1]Duke University, [2]University of Groningen, [3]GE China, [4]Boston University, [5]University of the West of England

Visual search paradigms evoke the attentional processes used in the identification and processing of a target stimulus in an array of distracting items. A widely studied ERP component elicited in visual search is the N2pc, which is thought to reflect the shifting and focusing of spatial attention. Spatial attention has also been linked to modulations in oscillatory alpha (8-14 Hz), whose decreases in amplitude are thought to reflect increases in local cortical activation. Endogenous control of spatial attentional can trigger lateralized changes in alpha, e.g. when participants are cued to spatially attend to one visual hemifield in preparation for an upcoming stimulus. Here we report novel findings for lateralized alpha activity during visual search, when subjects can only reactively shift their attention to a target after the onset of the array. This “visual-search alpha” appears as a decrease in alpha power ~300-600 ms after array/target onset over parietal-occipital scalp contralateral to the target. We tracked visual-search alpha across three independent visual-search datasets to examine its modulation as a function of: a week-long training regimen (n=13), target-reward associations (n= 24), and target-discrimination difficulty (n=18). Results across all three datasets indicated that this component reflects a target-associated increase in excitation sensitive to both top-down and bottom-up factors, while providing a unique window into attentional processes during visual search. More precisely, we suggest that while the N2pc reflects the deployment of attention at the target location, the alpha reflects attentionally driven focused processing of target-feature information in the face of potential distractor stimuli.

Topic Area: ATTENTION: Spatial

Little to no effects of action video games on visuospatial cognition: evidence from intervention and individual differences studies

Poster A7, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Joseph Arizpe[1,2], Anika Guha[3,4], Amyeo Jereen[3,5], Jeremy Wilmer[3], Joe DeGutis[1,2]; [1]Harvard Medical School, [2]Boston Veterans Affairs Medical Center, [3]Wellesley College, [4]University of California Los Angeles, [5]University of South Florida

Prior research suggests that playing recreational action video games appreciably improves various visuospatial abilities. However, there have been numerous objections to the quality of the evidence and recent attempts have failed to replicate action-video-game-related improvements in visuospatial abilities. To better ascertain the replicability of several seminal interventional and observational reports, we conducted two studies: (1) A video game training study assessing validated visuospatial measures, mental rotation (MR), multiple object tracking (MOT), and flicker change detection (FCD), before and after 12 hours of training, and (2) A massive online study (N=3000) investigating potential associations between self-reported action video game experience and MOT and FCD performance. Our training study was guided by a 'clinical intervention' approach in which participants (non-expert video gamers) and assessors were blinded, reducing the effect of participant/experimenter bias. We also compared action video game training (Medal of Honor) to two active control training video games (World of Goo and Wii Sports) as well as a test/retest control. Post-experiment questionnaires confirmed our success at blinding. Our results failed to replicate the previous action-video-game-related visuospatial improvements, showing no significant differences between any of the training conditions and test-retest for MR, MOT, or FCD. Our online observational study complemented these findings, showing only a small association between reported video game experience and FCD ability, though it was appreciably smaller in magnitude than in a prior report. Together, these findings suggest that short-term video game training does not improve visuospatial abilities and that long-term training produces a modest improvement at best.

Topic Area: ATTENTION: Spatial

An ERP study examining false-belief understanding in adolescents

Poster A8, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Elisabeth E.F. Bradford[1], Victoria E.A. Brunsdon[1], Heather Ferguson[1]; [1]University of Kent, U.K.

To allow successful communication to occur, we need to compute and attribute mental states to other people, allowing understanding of what they may believe, think, or know. These abilities are often referred to as possession of a Theory of Mind (ToM), and a core part of ToM is understanding of belief-states. This study explored belief-reasoning abilities across adolescence, with participants aged 10-21 years old. Electroencephalograpy (EEG) measures were recorded whilst participants listened to a series of short stories regarding a character who is in possession of a true or false belief about an object's location. The character is described as acting in a manner that is either consistent or inconsistent with this true/false-belief state, such as looking for an object in a location that matches where they believe the object to be, or which contradicts their belief about the objects location. Analysis revealed that when the character was in possession of a false-belief, the N400 waveform was more negative going for belief-consistent actions, compared to belief-inconsistent actions, from 250ms after critical word onset. In contrast, when the character was in possession of a true-belief, inconsistent actions triggered a more negative-going deflection than consistent actions. These results suggest that, across adolescence, participants were biased towards an initial egocentric interpretation of the stories, although behavioural measures demonstrated that this egocentrism could be overcome, with participants accurately able to rate the characters' actions as appropriate/inappropriate when they acted in a manner consistent or inconsistent with their belief state.

Topic Area: EMOTION & SOCIAL: Development & aging

Patterns of neural response during emotional face processing in 3-year-old children: a functional near-infrared spectroscopy study

Poster A9, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Julia Cataldo[1], Katherine Perdue[1,2], Ruby Almanza[1], Hannah Behrendt[1,4], Charles Nelson[1,2,3]; [1]Boston Children's Hospital, [2]Harvard Medical School, [3]Harvard Graduate School of Education, [4]University Hospital RWTH Aachen

The ability to classify facial expressions is critical to navigating one's social environment. Prior work has explored the ability to process facial expressions of emotion in infancy, yet relatively little work has been done in the toddler period. Eye-tracking and event-related potentials have documented the emergence of an attentional bias to fearful faces at 7-months of age. The goal of this work is to examine the neural architecture of emotional face processing during early childhood using functional near-infrared spectroscopy (fNIRS). 3-year-old children (n = 40) were shown videos of female faces conveying neutral, happy, angry, and fearful expressions. To investigate the salience of threat-alerting facial cues, participants were also presented with videos of 40% intensity expressions of angry and fearful faces. A 46-channel fNIRS system was used to assess neural activation in the frontal, temporal and parietal cortex. Oxyhemoglobin responses were calculated for each emotional condition. The channel locations of significant differences in oxyhemoglobin response to happy, angry, and fearful faces compared to the response to neutral faces ($p<0.05$) display left lateralization in neural activity for happy and fearful faces. Significant activation to angry faces was found in the left parietal and right frontal cortex. These findings suggest differential patterns of brain response for happy, angry and fearful faces. Significant differences in oxyhemoglobin response to 40% vs. 100% intensity fearful faces were found in the left frontal cortex ($p<0.05$), suggesting increased processing of the lower intensity fearful expression.

Topic Area: EMOTION & SOCIAL: Development & aging

Mindfulness-Based Stress Reduction Improves Fear Extinction: An fMRI Investigation

Poster A10, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Gunes Sevinc[1,2], Britta Hölzel[3], Muhammed Milad[1], Sara W. Lazar[1,2]; [1]Massachusetts General Hospital, Division of Psychiatry, [2]Harvard Medical School, [3]Technical University of Munich, Klinikum rechts der Isar

Mindfulness based stress reduction (MBSR) programs have been widely utilized to ameliorate psychiatric and stress-related symptoms, however the neural mechanisms that underlie the reported improvements are still largely unknown. Mindfulness meditation involves refraining from cognitive avoidance and thus provides a basis for internal exposure to aversive stimuli. Thus, we hypothesized that mindfulness-based interventions create a context akin to behavioral exposure therapy and thereby alter participants' neurobiological responses to aversive stimuli. In a randomized controlled trial with healthy but stressed meditation-naïve individuals, we tested this hypothesis and investigated neural activation patterns during the recall of aversive stimuli using a well-established 2-day fMRI fear-conditioning and extinction protocol. Participants completed either 8-week MBSR (n=42), or stress-management education (SME, n=25) programs and behavioral changes and alterations in neural activation patterns from pre to post interventions were assessed. The MBSR intervention resulted in significant activations in left inferior frontal gyrus (BA 44) during the recall of extinguished (as opposed to unextinguished) stimuli, suggesting heightened control of memory interference, while SME intervention did not. Moreover, both interventions were associated with enhanced brain activity from pre to post in vmPFC (BA 11) and the hippocampus during extinction recall, and changes in hippocampus marginally correlated with changes in perceived stress levels only for the MBSR intervention. These results indicate extinction learning as a potential mechanism underlying the positive psychological benefits ascribed to mindfulness meditation. These findings may enhance our understanding of how meditation-based interventions work and the role of extinction learning in stress-resilience.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Impulsivity and Apathy Predict Involvement of Inhibitory Control Regions During Cognitive Interference

Poster A11, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Emily Hahn[1], Julia Felicione[1], Aishwarya Gosai[1], Matthew Boggess[1], Alex Rockhill[1], Amy Peters[2], Alik Widge[1], Darin Dougherty[1], Thilo Deckersbach[1]; [1]Massachusetts General Hospital/Harvard Medical School, [2]University of Illinois at Chicago

While impairments in cognitive processing are prevalent across neurologic disorders of the CNS, transdiagnostic approaches reveal similar impairments in many psychiatric diagnosis. Disinhibition and apathy are both neurocognitive symptoms involving goal-directed behavior, and are particularly impaired in mood disorders such as bipolar disorder or depression. For this study, seventy six total subjects (mean age=35, sd=12) including unipolar bipolar patients (n=38) and healthy subjects were scanned using fMRI while participating in the Multi-source Interference Task (MSIT) superimposed on valenced IAPS pictures. The Frontal Systems Behavioral Scale was used to assess cognitive processing phenotypes. Results reveal lower impulsivity and higher apathy predict higher activation in regions during the interference condition of the MSIT/IAPS task, collapsed across valence. Namely,

higher insula activity during interference was predicted by higher apathy scores (r=.35, p=.03). Conversely, higher dACC activation during interference was predicted by lower disinhibition scores (r=-.34, p=.04). Interestingly, no similar trends were found among healthy participants. That said, neural regions elicited by cognitive conflict and apathy are further corroborated, thus supporting linkage to neuropsychological constructs . Taken together, the importance of evaluating cognitive dysfunction in addition to symptoms commonly seen in mood disorders is highlighted and may help provide meaningful insight into transdiagnostic and therapeutic regimens.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Sexually Dimorphic Pupillary Responses During Facial Trustworthiness Evaluation: A Study With Intranasal Oxytocin Administration

Poster A12, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Fatma Gülhan Saraçaydın[1], Didem Gökçay[1]; [1]Middle East Technical University

It has been shown that oxytocin (OT) increases the trusting behavior in humans. In this study, we focused on the role of OT on processing of facial trustworthiness. We aimed to investigate the effects of OT on trustworthiness evaluation and associated pupil dilation. Possible sexual dimorphisms and physiological differences were also subject of interest. In a double-blind between-subjects design, 12 males and 12 females received either 24 IU intranasal OT or placebo (PLC). The participants were required to evaluate trustworthiness of face images with neutral expression. Ratings were collected along a 1 to 9 scale (1: not at all trustworthy; 9: very trustworthy). Changes in pupil diameter were assessed using the TOBII T120 eye-tracker. Intranasal OT resulted in an increase in trustworthiness ratings for both sexes (p< 0.001). However, the effect of OT supported sexual dimorphism in physiology: males receiving intranasal OT showed increased changes in pupil diameter (p=0.033) whereas the reverse situation was observed for females (p<0.001). Independent from the application of intranasal OT/PLC, participants exhibited largest pupil diameters for untrustworthy faces, and smallest pupil diameters for neutral faces (p<0.001). To the best of our knowledge, this is the first study that investigates the relationship between trustworthiness evaluation, task-evoked pupillary responses, and the effect of intranasal OT in both sexes. The results verify our current knowledge regarding OT's crucial role in trusting behavior in humans, and our findings in physiological responses might open new research questions regarding the pivotal role of OT in prosocial behavior.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Keep calm and carry on: ERP evidence for reduced negative anticipation stress in bilingualism

Poster A13, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Rafal Jonczyk[1,2], Guillaume Thierry[3]; [1]Adam Mickiewicz University, [2]Pennsylvania State University, [3]Bangor University

Recent research suggests that bilinguals might process negative information on a shallower level in their second language (L2; Jończyk et al. 2016; Wu and Thierry 2012). In light of these findings, we set out to investigate whether operating in L1 and L2 might differentially modulate emotional anticipation mechanisms, as indexed by the Stimulus Preceding Negativity (SPN)—a slow cortical wave measuring emotional anticipation processes. 20 immersed, highly proficient Polish-English bilinguals viewed word-picture pairs while undergoing electrophysiological recording. Participants were asked to determine upon seeing the picture whether or not it was congruent with the preceding prime cue. Each positive picture (n=62) was paired with a positive and a neutral prime in L1 and L2; each negative picture (n=62) was paired with a negative and a neutral prime in L1 and L2. Incongruent pairs were created by rotating primes and pictures within each valence category. In the experiment, a prime cue (e.g. accident) was presented for a randomized interval ranging between 300 and 400ms (in steps of 10), followed by an interstimulus interval of 3,800 ms—the ancitipation stage. Subsequently, a picture was flashed for 200 ms followed by a blank response window for 2,300 ms. The results demonstrate reduced SPN to negative word-picture pairs in English only and a more negative N400 to incongruent word-picture pairs regardless of language of operation. These findings provide novel evidence that operating in L2 may decrease the electrophysiological activity to upcoming negative stimuli, which may have implications for therapy and stress-management in a bilingual context.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Resting State Functional Connectivity Neural Correlates of Emotional Regulation Strategies

Poster A14, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Yush Kukreja[2], Lauren Goodes[1], Jeffrey Rouse[2], Jeremy Cohen[1]; [1]Xavier University of Louisiana, New Orleans, LA, USA, [2]Tulane University, New Orleans, LA, USA

Emotional regulation involves differing cognitive strategies, namely cognitive reappraisal and expressive suppression. Cognitive reappraisal is an early cognitive reinterpretation of emotionally salient stimuli, and expressive suppression can be conceived as a late response inhibition of affective behavior. Our study investigated whether use of these distinct emotional regulation strategies is associated with unique resting-state functional connectivity patterns. 40 subjects were selected from the Nathan-Kline Institute Rockland Sample: 20 males and 20 females, with an average age of 29.7 (SD=4.61) and 30.9 (SD=6.30), respectively, who were administered the Emotional Regulation Questionnaire (ERQ). The results of the ERQ were computed into sub-scores for cognitive reappraisal and expressive suppression, and used as covariates in resting-state functional connectivity analysis using SPM12 and CONN toolbox. After correction for multiple comparisons, cognitive reappraisal scores showed statistically significant positive correlations with functional connectivity between the left orbito-frontal cortex and multiple brain regions, including left and right precentral gyrus, left and right supplementary motor areas, and several cerebellar regions. Expressive suppression scores showed a statistically significant positive correlation with functional connectivity between left orbito-frontal cortex and left angular gyrus. These results offer preliminary insight into the differing neural substrates of these emotional regulation strategies. Given previous work suggesting an adaptive social and psychological advantage to the use of cognitive reappraisal strategy, future work will not only seek to replicate this finding in a larger sample but will also explore whether these particular functional connectivity patterns show overlap with measures of emotional health.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

The Effects of Age and Emotion on Cognitive Control of Memory and Metacognitive Monitoring

Poster A15, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Sara Gallant[1], Lixia Yang[2]; [1]University of Southern California, [2]Ryerson University

Previous research has identified an age-related positivity effect in memory in which older adults show a motivational shift to remember positive over negative information; however, whether they can strategically control such information once it enters memory is not well understood. The present research thus sought to examine age-related changes in cognitive control of emotional memory and its underlying metacognitive components. Three studies were conducted to assess cognitive control of positive, negative, and neutral words, using a cue-based (Study 1 and 2) or value-based (Study 3) item-directed forgetting task in young and older adults. Metacognitive monitoring was indexed by prospective judgments of learning (JOLs) at encoding (Study 2) and retrospective source attributions during recognition (Studies 1-3). Results consistently demonstrated that young and older adults could strategically control encoding of emotional information by prioritizing relevant over irrelevant words in memory. This was evident when encoding was directed by to-be-remembered (TBR) or to-be-forgotten (TBF) cues as well as by points that signaled a gain or loss of value (+10 vs. -10). Extending previous research on metacognition and aging, results indicated age-invariance in prospective JOLs made during the encoding of TBR and TBF words that varied in emotion. In contrast, age groups differed when retrospectively monitoring the source of words. Whereas young adults' source monitoring was not influenced by emotion or cues, older adults attributed positive items to sources that were higher in value for memory (TBR or +10 cues), consistent with an age-related bias to prioritize positivity.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Brain States Encode both Perceived Emotion and the Physiological Response Induced by Visual Stimuli

Poster A16, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Keith A. Bush[1], Anthony A. Privratsky[1], Jonathan B. Gardner[1], Melissa J. Zielinski[1], Clinton D. Kilts[1]; [1]Brain Imaging Research Center, University of Arkansas for Medical Sciences, Little Rock, AR

Multivariate pattern analysis (MVPA) of functional magnetic resonance imaging (fMRI) has made critical strides in advancing our ability to characterize the functional anatomical encoding of affect in the human brain and to predict affective responses. Central to MVPA-based analysis is the brain state, a temporally-succinct whole-brain fMRI-derived pattern of neural activation, which acts as a unit of cognitive processing. However, if the brain state is the central unit of affective processing, then is must form a predictive link in the chain of conceptual causality within the modal model of emotion, commencing with stimulation and ending in a behavioral or physiological response. To test this central role, we used MVPA-based regression to characterize, via fMRI-derived brain states, both the continuously graded properties of valence and arousal of visual stimuli drawn from the International Affective Picture System (IAPS) as well as the co-occurring autonomic nervous system response measured via the skin conductance response (SCR) of (n=16) demographically diverse (across sex, race, age, and education) healthy subjects. We found that fMRI-derived brain states significantly predicted both the normatively scored valence and arousal properties of the IAPS stimuli as well as the induced SCR-based physiological response; alternatively, SCR significantly predicted only the arousal property. Moreover, brain state exhibited standardized product-moment prediction effect sizes more than four times greater than SCR, supporting its centrality in the modal model. Finally, anatomical encoding of the learned MVPA prediction function displayed remarkable agreement with the anatomical regions long-established in the fMRI-based emotion processing literature.

Topic Area: EMOTION & SOCIAL: Emotional responding

The Brain Activity in Processing Natural Dynamic Happy Facial Expressions

Poster A17, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Yen-Ju Lu[1], Shih-tseng T. Huang[1,2], Sing-Rong Sie[1]; [1]Department of Psychology, National Chung-Cheng University, [2]Center for research in Cognitive Science, National Chung-Cheng University, Taiwan

Spontaneous emotional expressions are related to the person’s real emotions and are important in understanding the meaning and effects of emotions in social interactions. The present study attempts to examine the happy facial expressions and its related brain regions. 27 young adults were recruited and completed an experiment to view dynamic happy and neutral facial expressions as well as objects in motion in an er-fMRI paradigm. We found that emotional faces were having higher activities than the processing objects (non-face) with motion at right middle temporal gyrus, left fusiform gyrus, right superior temporal gyrus, left middle occipital gyrus, right thalamus, and right middle frontal gyrus. It was also found difference in between processing happy expressions and neutral faces at the right superior temporal gyrus, left cuneus, right middle Occipital Gyrus, right inferior frontal gyrus, and right Lingual Gyrus. Processing the neutral faces were higher than processing objects at right middle and superior temporal gyrus, left precuneus, and left angular gyrus. These findings may help to elucidate the nature of processing dynamic happy facial expressions.

Topic Area: EMOTION & SOCIAL: Emotional responding

A Cross-Correlation Analysis of the Relationship Between Central and Autonomic Nervous System Activity at Rest

Poster A18, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Derek Spangler[1], Jean Vettel[1], Matthew Cieslak[2], Barry Giesbrecht[2], Scott Grafton[2], Gold Okafor[2], Viktoriya Babenko[2], Javier Garcia[1], Justin Brooks[1]; [1]U.S. Army Research Laboratory, [2]University of California, Santa Barbara

Bidirectional communication between the central and autonomic nervous system is critical to predominant theories of stress and emotion. However, empirical investigations of the extent to which the brain leads autonomic activity, and vice versa, are lacking. To this end, the current study monitored blood oxygen level dependent (BOLD) responses in 46 subjects (Mean age= 22.37, SD= 3.67) using functional magnetic resonance imaging (fMRI) while collecting impedance cardiography and electrocardiography during a 5-minute resting state. The electrocardiography and impedance signals were utilized to compute the root mean square of successive differences in interbeat intervals (RMSSD) and pre-ejection period (PEP) as metrics of cardiac parasympathetic and sympathetic control, respectively. Regions of interest in the fMRI data were pre-selected as members of the central autonomic network (e.g., amygdala, nucleus tractus solitarius, anterior cingulate cortex, insula) and the supplementary motor area (SMA). Autonomic and BOLD data were averaged in 30s windows and then cross-correlated to estimate the lead-lag relationships between brain and autonomic activity. Preliminary results reveal a biphasic cross-correlation structure consistent with BOLD and autonomic waveforms that oscillate at a similar frequency with a fixed phase delay. This oscillatory relationship occurs at low frequencies (< 0.1 Hz), which is consistent with previously defined functional modulations in the default mode network. These findings are interpreted in the light of bidirectional feedback loops between the brain and body that serve to maintain autonomic balance and homeostasis.

Topic Area: EMOTION & SOCIAL: Other

Comparing human and monkey neural circuits for processing social scenes

Poster A19, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Julia Sliwa[1], Sadie R Marvel[2], Geena Ianni[1], Winrich A Freiwald[1]; [1]The Rockefeller University, New York, [2]Bard College, Annandale-on-Hudson, New York

Recognizing agents, their actions, and their interactions is essential for understanding the world around us. In the monkey brain, these cognitive steps engage serially three distinct neural circuits: The face and body patches, the Mirror Neuron System (MNS) and finally the Exclusively Social Interaction Network, a putative precursor of the Theory of Mind (ToM) network in monkeys. It remains unknown however whether humans and monkeys employ same or different neural strategies to process social scenes. To answer we scanned human subjects with fMRI, while they were presented with the same videos as the ones presented to monkeys, and additionally with videos of social scenes involving human actors. We show that similarly to monkeys, humans 1) engage face and body areas in all social video conditions, and 2) engage the MNS in a generic manner for watching agent-object, agent-agent and object-object interactions. Yet contrary to monkeys, humans 1) spontaneously engage the ToM network also when watching non-acting agents, and 2) equally enhance the activity of the ToM network when watching agents performing goal-directed actions and social interactions. These results identify which neural strategies are shared and which ones adapted to the specific needs of the species.

Topic Area: EMOTION & SOCIAL: Person perception

Neural Mechanisms Underlying Shifts in Imitative Fidelity

Poster A20, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Kevin Jenson[1], Gedeon Deak[1]; [1]UC San Diego

Imitation is a critical component of species-specialized social phenomena such as cultural transmission and pedagogy. In order to utilize imitation effectively, the fidelity of imitation (i.e., how precisely the observed action is copied) should depend on relevant social-contextual parameters. For example, imitation can be costly, causing observers to rate an imitator as less trustworthy or competent in certain contexts; conversely, high-fidelity imitation can increase affiliative emotions of conspecific towards imitators, and is implemented when an individual is ostracized by in-group members. The goal of the current study is to begin to elucidate the mechanisms that underlie these shifts in imitative fidelity. We determined the correlation of participants' brain activity measures derived from electroencephalography (EEG) while participants observed actions and the fidelity of their subsequent imitation, operationalized as the literal reproduction of goal-directed and non-goal-directed actions. We used an in-group ostracism manipulation, a version of the Cyberball task that has been shown to modulate imitative fidelity, in order to induce within-subject variation. While we failed to replicate findings reporting links between ostracism and imitative fidelity, our findings indicate that a general increase in frontal motor inhibition during the encoding of both goal-directed and non-goal-directed actions is correlated with higher fidelity imitation. Additionally, these results raise questions about how motor resonance, and its detection in the EEG (i.e., mu-suppression), should be understood. Motor resonance is typically conceived of as an increase somato-motor cortex activity. However, it might also involve inhibitory processes by recruiting frontal cortices responsible for top-down control of action.

Topic Area: EMOTION & SOCIAL: Person perception

Behavioral and Brain-Imaging Predictors of Working Memory Plasticity in Younger and Older Adults

Poster A21, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Alexandru D. Iordan[1], Katherine A. Cooke[1], Kyle D. Moored[2], Benjamin Katz[3], Sneha Rajen[1], Martin Buschkuehl[4], Susanne M. Jaeggi[5], John Jonides[1], Scott J. Peltier[1], Thad A. Polk[1], Patricia A. Reuter-Lorenz[1]; [1]University of Michigan, [2]Johns Hopkins University, [3]Virginia Polytechnic Institute and State University, [4]MIND Research Institute, [5]University of California, Irvine

Adaptive working memory (WM) training improves WM performance in both young (YA) and older (OA) adults, although benefits may be reduced in OA. Current frameworks of cognitive plasticity propose two components of performance change, specifically (1) within and (2) beyond the range of baseline capacity. However, little is known about the influences of age versus individual differences in baseline psychological (cognitive and motivational) characteristics and brain (functional organization) properties on these two components of plasticity. We investigated these issues in 22 YA and 19 OA who underwent 10 days of computerized WM training, in conjunction with neuropsychological and resting-state functional MRI assessments acquired before training. Both YA and OA improved on the WM task over the course of training, but YA showed a steeper initial learning slope than OA, as modeled by linear spline regression, suggesting greater gains within their range of baseline capacity. Furthermore, baseline cognitive measures (verbal WM and fluid intelligence) predicted greater initial slope for OA, whereas motivation (need for cognition) predicted greater later slope for YA. Finally, brain-wide network properties showed associations, albeit limited, with initial slope in OA; specifically, modularity and local efficiency showed positive correlations, whereas global efficiency showed negative correlation with initial learning slope. Together, these results add credence to a two-component account of WM plasticity and suggest that while OA with higher baseline cognitive and brain function may improve rapidly initially, higher motivation and general interest may be better predictors of sustained performance improvement, particularly for YA.

Topic Area: EXECUTIVE PROCESSES: Development & aging

C957T Polymorphism in dopamine D2 receptor gene predicts sequence learning in younger adults

Poster A22, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Beth Westphal[1], Mark A. Gluck[2], Jessica R. Petok[1]; [1]St. Olaf College, Northfield, MN, [2]Rutgers University, Newark, NJ

Previous patient work suggests that feedback-based sequence learning, or learning a sequence of events leading to reward, relies on mesolimbocortical dopaminergic mechanisms, whereby lower levels of dopamine corresponds to poorer learning. We tested this hypothesis using a healthy younger sample to see whether individual differences in dopamine genotype may influence feedback-based sequence learning. Specifically, the C957T single nucleotide polymorphism (SNP) of dopamine receptor D2 (DRD2) regulates DRD2 availability in the reward-mediating mesolimbocortical pathway, such that carriers of the C-allele have less DRD2 expression than T/T homozygotes. In the present study, healthy college-aged adults, grouped as C/C, C/T, or T/T, completed a feedback-based sequence learning task. As predicted, significantly fewer C-allele carriers were able to reach criterion

and learn the full sequence compared to T/T homozygotes. Of those participants who met criterion, T/T homozygotes tended to show better performance in the feedback-based sequence learning phase (which depends on dopaminergic functioning) compared to participants with the C/C or C/T genotype. Of note, no effects of DRD2 were observed in a probe or retest phase, which are thought to be dopamine independent. The results of this study support previous work that implicates dopamine as an underlying mechanism of feedback-based sequence learning, and expands on these findings to show that dopamine genes help explain individual variability in sequence learning performance. Because our sample was racially diverse, future analyses will explore the relationship between race, genotype, and sequence learning performance.

Topic Area: EXECUTIVE PROCESSES: Development & aging

The Associations between Obesity and Visceral Adipose Tissue with Cognitive Function and Achievement in Children

Poster A23, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Lauren Raine[1], Eric Drollette[2], Shih-Chun Kao[1], Daniel Westfall[1], Laura Chaddock-Heyman[2], Arthur Kramer[1,2], Naiman Khan[2], Charles Hillman[1]; [1]Northeastern University, [2]University of Illinois at Urbana-Champaign

Background: Although obesity has been related to measures of academic achievement and cognition in children, the influence of fat distribution, specifically visceral adiposity, on select aspects of achievement and cognitive function remains poorly characterized among preadolescent children. Goals: The aim of this study was to evaluate the relation of adiposity, particularly visceral adipose tissue, on achievement and cognitive function among children. Methods: Children with obesity (ages 7-9 years old, N= 55, 35 females) completed cognitive and academic tests. Normal weight children (N= 55, 35 females) were matched to this group on demographic characteristics and aerobic fitness. Covariate analyses included age, IQ, SES, and fat free VO2. Adiposity (i.e., whole body percent fat, subcutaneous abdominal adipose tissue, and visceral adipose tissue) was assessed using dual energy X-ray absorptiometry. Results: Relative to their normal weight counterparts, children with obesity had significantly lower performance on tests of reading and math. Analyses revealed that among children with obesity, %Fat and SAAT were not related to cognitive abilities. However, higher VAT was associated with poorer intellectual abilities, p's≤0.04; and cognitive performance (i.e. Thinking Ability and Cognitive Efficiency), p's≤0.04. However, among normal weight children, VAT was positively associated with intellectual abilities and cognitive efficiency. Conclusion: The results suggest that VAT was selectively and negatively related with cognition among children with obesity. Along with the dangerous metabolic nature of VAT, its detrimental relationship with obese children's intellectual and cognitive functioning is concerning.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Resting-State EEG Coherence in Young Children with ADHD: A Potential Neural Marker of ADHD

Poster A24, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Sarah Furlong[1], Jessica Cohen[1], Joseph Hopfinger[1], Jenna Snyder[1], Margaret Sheridan[1]; [1]University of North Carolina, Chapel Hill

Attention-Deficit/Hyperactivity Disorder (ADHD) is a highly prevalent neurodevelopmental disorder. However, evidence suggests that ADHD is over-diagnosed in community samples, under-diagnosed in females and minorities, and potentially misdiagnosed in early childhood (<8 years). Current diagnostic tools relying on parental report are not sufficient to address these issues, but neural measures have potential for improving early childhood diagnoses. It is thought that ADHD is characterized by disrupted functional brain network organization, thus that may be a potential diagnostic biomarker. It has been shown with fMRI that distinct brain networks are more segregated from other networks in children (ages 8-12) with ADHD than in typically developing (TD) children. In older children and adults, differences in theta band activity in electroencephalogram (EEG) recordings are associated with differences between individuals with ADHD and controls. Communication across brain networks and theta band power are implicated in the cognitive functions that are impaired in ADHD. In the current study, we recorded resting-state EEG in 52

unmedicated children with ADHD and 52 age- and gender-matched TD children (ages 3-7). We observed significant increases in theta band power (4-7 Hz) over central parietal electrodes in ADHD relative to TD children. Preliminary network analyses did not find group differences in the degree of segregation between distinct brain networks either within theta or across all frequency bands. However, within theta, data-driven assignment of EEG electrodes to brain networks resulted in different network assignment in key regions, including central parietal electrodes, indicating that network organization is altered in young children with ADHD.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Differential effects of prefrontal inhibitory tDCS on voluntary task selection

Poster A25, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Joseph Orr[1], Michael Imburgio[1], Jesus Lopez[1]; [1]Texas A&M University

Voluntary task selection (VTS) refers to the ability to guide task choices by one's internal goals as opposed to external information. Previous fMRI studies have found conflicting results regarding which brain area underlies VTS. While some evidence suggests that the anterior cingulate cortex (ACC) underlies VTS, others suggest that the frontal pole (FP) is most important. However, fMRI studies yield correlational, not causal, conclusions. The current work utilized HD transcranial direct current stimulation to examine the effect of inhibiting the FP or ACC on VTS. Because prior work suggests that the FP is responsible for higher-level processing and the ACC is more involved in lower-level actions, it was predicted that inhibiting the FP would dampen top-down biases while inhibiting the ACC would dampen bottom-up biases. Forty-one participants were assigned to receive stimulation targeting either the FP or ACC, with both groups undergoing 20 minutes of inhibitory 2mA stimulation and sham stimulation in separate, counterbalanced sessions. After stimulation, participants were asked to voluntarily choose between two tasks, with instructions to choose the tasks randomly and equally often. Contrary to predictions, ACC inhibition caused participants to repeat tasks more often, suggesting an increased bottom-up bias. Similarly, inhibition of the FP caused participants to choose to switch tasks more often, indicating an increase in top-down bias. The current work may exemplify the propensity of cathodal stimulation to yield reverse effects at high intensities. The effects of anodal stimulation on VTS are currently being examined to assess the possibility of reversed effects.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Sticky Rules: Conjunctions between Rules and Stimulus-Response Codes Drive Action Selection

Poster A26, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Atsushi Kikumoto[1], Tesufuai Sameshima[1], Ulrich Mayr[1]; [1]University of Oregon

Action selection is often thought of as a hierarchical process, where high-level representations of abstract rules control lower-level stimulus or response selection. Theoretically, such control could occur in a strictly hierarchical manner, in which the rule representation plays no further role once it configures the relevant stimulus-response (S-R) links. Alternatively, rules may become integrated with lower-level settings and contextualize stimulus/response codes in a concurrent manner. To test these accounts, we decoded orthogonal, task-relevant dimensions (cues, rules, stimuli, and responses) from the spectral-temporal profile of the electrophysiological signal (EEG) during a task in which subjects had to select between different, abstract S-R rules on the basis of cues (Mayr & Bryck, 2005, JEP:LMC). Trial-by-trial information about the quality of each representation allowed time-resolved analyses of when and to what degree different representations are active and predict behavioral performance (RTs). Results showed that rules were active and predicted performance prior to stimulus presentation, suggesting that abstract rules can be established in a proactive manner. Yet, after stimulus onset, rules and specific stimulus and response codes were activated concurrently. Further, consistent with the integration account, conjunctive representations that combined rules and S-R codes emerged as a major predictor of performance, over and above rules or S-R codes by themselves. Thus, representations on different hierarchical levels do not function independently, but rather constrain each other to determine the appropriate response. These results demonstrate a powerful approach towards uncovering the cascade of representations that underlies action selection.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Attention from inside out: P1 effects for shifts between internally and externally oriented attention

Poster A27, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Sam Verschooren[1], Sebastian Schindler[1,2], Rudi De Raedt[1], Gilles Pourtois[1]; [1]Ghent University, [2]Bielefeld University

Cognitive flexibility is one of the cornerstones of adaptive behavior. It is often measured in the laboratory using task-switching paradigms. These paradigms usually require processing and switching between two external stimuli or, less often, between competing mental representations held in working memory (WM), thereby ruling out the possibility to explore with them switches between external and internal information. In this study, we devised and validated a novel paradigm where we could examine, using behavioral and standard event-related potential (ERP) methods, shifts between internal retrieval from WM and visual discrimination based on external stimuli. As a control condition, we used shifts of attention between the same external visual discrimination task and another externally-driven visual task. Behavioral results obtained in 23 healthy adult participants showed that the magnitude of the switch-cost was similar for these two conditions. However, the concurrent ERP results showed that shifting away from internal WM and engaging again in the externally driven visual discrimination task was associated with an early and selective attention reduction of the P1 component. Interestingly, this effect was not visible for the control condition. Altogether, these results suggest that common selective attention resources are probably used to shift attention between internal and external information, or alternatively, between two different external events/tasks. Intriguingly, our new ERP results show however that the underlying neural mechanisms (e.g. dynamic of selective attention) could be different between these two conditions. As such, these new findings can inform existing cognitive and neuro-anatomical models on selective attention and flexibility

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

The role of action, choice, and predictive cues in human reinforcement learning

Poster A28, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Cameron D. Hassall[1], Greg Hajcak[2], Olave E. Krigolson[1]; [1]University of Victoria, [2]Florida State University

Converging evidence suggests that reinforcement learning signals exist within the human brain. For example, the reward positivity – a feedback-sensitive component of the event-related potential (ERP) – is thought to index a reinforcement learning (RL) prediction error. According to RL theory, prediction errors are used to update values associated with actions and/or predictive cues. One might therefore expect the reward positivity to diminish or disappear in the absence of action, however evidence for this claim is conflicting. To investigate the impact of choice and action on the reward positivity, we systematically altered a two-armed bandit task such that trials involved an action and a choice, an action (but no choice), or no action. Novelly, we also tested a version of the task in which the preceding choice stimuli (the bandits) were absent. We observed a reward positivity in the standard version of the task only, suggesting that choice, action, and predictive cues may all be necessary to produce this learning signal.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Increasing cognitive control abilities inhibits creative responses, but only if they are not too “far” away: A tDCS study

Poster A29, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Yoed N. Kenett[1], David S. Rosen[2], Emilio R. Tamez[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania, [2]Drexel University

How does cognitive control impact creative cognition? Some have hypothesized that increased cognitive control has a negative effect on creative idea generation but a positive effect on creative idea evaluation. Prior brain stimulation research directly examined the effects of decreased frontally-mediated control on a visual alternative-uses task: Decreased cognitive control facilitated creative idea generation, suggesting that lower inhibition may allow access to more distant associative ideas, thereby increasing novelty. In the current study, we show how increased cognitive control decreases creative idea generation in a novel, verbal variant of the alternative-uses task: Participants completed an uncommon sentence completion task after undergoing either anodal (facilitative), cathodal (inhibitive), or sham (control) transcranial direct current stimulation (tDCS) over left prefrontal cortex. Their responses were rated for their novelty and appropriateness by an independent sample of raters. We found that anodal stimulation increased the appropriateness and decreased the novelty of participants responses. Furthermore, we found that this effect interacted with a computational measure of the semantic distance of these responses: such an increase in appropriateness and decrease in novelty of responses is limited to responses that are not too semantically distant or "far away". Thus, we show for the first time how enhanced cognitive control can inhibit novel idea generation and shed new light on the capacity of cognitive control mechanisms to mediate access to distant, weakly-related associative ideas.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Dynamic Reconfiguration of Inhibition Control Network in Different Bilingual Contexts

Poster A30, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Jianqiao Ye[1], Jing Yang[1], Ruiming Wang[2], Ke Zhou[3], Yan Jing Wu[3]; [1]Bilingual Cognition and Development Lab, Center for Linguistics and Applied Linguistics, Guangdong University of Foreign Studies, Guangzhou, 510420, China, [2]Guangdong Provincial Key Laboratory of Mental Health and Cognitive Science, Center for Studies of Psychological Application, School of Psychology, South China Normal University, Guangzhou 510631, China, [3]College of Psychology and Sociology, Shenzhen University, Shenzhen 518060, China

It is well documented that bilinguals activate non-target language when they process the target language. This parallel activation of two languages in bilinguals requires constant language control, which shares an overlapping brain network with domain-general inhibitory control function. As a result of long-term experience of language learning and language control, bilinguals showed better performance in non-linguistic inhibitory control tasks. Recently, some studies suggest that bilinguals' inhibitory control ability can be modulated by language context in a short timescale. The present study explored the dynamic influences of language contexts on the neural mechanism of inhibition control in trilinguals. Thirty Cantonese-Mandarin-English trilinguals, who were native speakers of Cantonese (L1) and Mandarin (L2) and learners of English (L3) with moderate proficiency, participated in this study. Participants performed picture naming tasks in mixed language blocks, which resulted in three different dual language contexts: the L1-L2, L2-L3, and L1-L3 contexts. Following each context, the participants performed the same flanker task. Our results showed classic flanker effects in the conditions of L2-L3 and L1-L3 contexts, while less interference effect in L1-L2 context. Whole brain analysis of fMRI data during flanker tasks displayed more activations in right prefrontal cortex and subcortical areas in L2-L3 and L1-L3 conditions, compared to L1-L2 context. Group connectivity patterns underlying flanker tasks in the three dual-language contexts converged on common involvement of a cortico-thalamic-striato circuit and bilateral cerebellum for inhibition control task. However, their functional brain networks reorganized dynamically following different dual-language contexts, which suggests neural plasticity in a rather short time.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Temporal metacognition as the decoding of internally generated brain dynamics

Poster A31, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Tadeusz Kononowicz[1], Clemence Roger[2], Virginie van Wassenhove[1]; [1]CEA/DRF NeuroSpin - INSERM Cognitive Neuroimaging Unit, [2]University of Lille

Metacognition, the ability to know about one's thought process, is self-referential. Here, we studied the brain mechanisms underlying metacognitive inferences in an internally generated behavior. Human participants generated a time interval, and retrospectively evaluated the signed magnitude of their timing (first and second order behavioral judgments, respectively) while being recorded with magnetoencephalography. We show that participants could reliably track the magnitude of internally generated time intervals providing evidence for the metacognitive inference process tracking produced duration. Previously associated with timing, beta power (β; 15-40 Hz) tracked internal time estimation but only when participants correctly estimated the magnitude of the produced interval. Additionally, as indicated by demixed Principal Component Analysis, the larger spread of an individual's β power state-space trajectories during timing was indicative of more accurate individual's metacognitive inference. Our results suggest that network inhibition (β power) instantiates a state variable determining future network trajectory; this naturally provides a code for duration and metacognitive inferences would consist in reading out this state variable. Altogether, our study describes oscillatory mechanisms for timing suggesting that temporal metacognition relies on inferential processes of internally-generated dynamics.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Frontal-midline Theta Neurofeedback Training Increases Flow Experience

Poster A32, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Kathrin C. J. Eschmann[1], Lisa Riedel[1], Axel Mecklinger[1]; [1]Saarland University, Saarbrücken, Germany

Flow is defined as a cognitive state that is associated with a feeling of automatic and effortless control, enabling peak performance in highly challenging situations. In sports flow can be enhanced by mindfulness training, which has been associated with frontal theta activity (4-8 Hz). Moreover, frontal-midline theta oscillations were shown to subserve control processes in a large variety of cognitive tasks. Previous theta neurofeedback training studies revealed that one 30-minute training session is sufficient to enhance performance in a finger tapping task (FTT). Consequently, the present study aimed at investigating whether one session of frontal-midline theta neurofeedback training (1) enhances both performance and flow experience during a FTT and (2) transfers to a cognitive control task. Forty-nine participants trained to enhance frontal-midline theta oscillations. Additionally, they performed one pre-training and two post-training sessions, directly and one day after the neurofeedback session, each consisting of a FTT, a flow questionnaire and an n-back task. Participants were able to enhance their theta activity throughout the 30-minute neurofeedback session. Furthermore, the increase in theta power predicted FTT performance increase from pre-training to the first post-training session, irrespective of pre-training performance. Interestingly, training gains in theta power also predicted the increase of flow experience, even when corresponding increases in FFT performance were controlled for. Results for the n-back task were not significant. The present study is among the first to show that frontal-midline theta neurofeedback training is a promising tool to increase flow experience with potential relevance for performance enhancement.

Topic Area: EXECUTIVE PROCESSES: Other

Context-dependent inhibition impairments for executing familiar action task found in patients with frontal glioma

Poster A33, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Chiharu Niki[1], Takatsune Kumada[2], Takashi Maruyama[1], Manabu Tamura[1], Yoshihiro Muragaki[1]; [1]Tokyo Women's Medical University, [2]Kyoto University

【Introduction】 Patients with right frontal lobe damage who showed using unnecessary objects when performing sequential tasks were reported as action disinhibition syndrome (Niki et al., 2009). For example, objects using for “wrap a gift” and those for “calligraphy” were presented to them and they were asked to wrap a gift, they wrote a message for the gift using calligraphy. In this study, we investigated inhibitive action errors in detail. 【Methods】 Patients: 16 patients with frontal glioma (11 right, 5 left). Task: Single tasks and distractor object-paired-tasks were administered. For single tasks, only objects necessary to perform the target task were presented. For distractor object-paired-tasks, in addition to necessary objects, distractor objects that were not be used normally in a target task were also presented. Patients were instructed to perform a target task. “Distractor error” that they used distractor objects were analyzed. 【Results】 Distractor errors were found in 4 left and 7 right glioma patients. 3 left glioma

patients showed distractor errors that were not related to the action goal of target task. On the other hand, all 7 right glioma patients showed only distractor errors that were associated to goal of target task. 【Discussion】 There were two types of distractor errors, which were related or not related to goal of target task. A set of objects such as "calligraphy" would have a context that affect control for action sequence. To use only necessary object, inhibitive function for context emerged from objects might be necessary.

Topic Area: EXECUTIVE PROCESSES: Other

Frontoparietal neurostimulation alters the theta-gamma neural code for working memory

Poster A34, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Marian Berryhill[1], Elizabeth Johnson[2], Adelle Cerreta[1], Dwight Peterson[3], Kevin Jones[4]; [1]University of Nevada, Reno, [2]University of California, Berkeley, [3]Concordia College, [4]Colorado State University

There is considerable interest in maintaining or enhancing working memory (WM), the neurocognitive horsepower associated with ecologically valid measures of cognitive performance. However, despite its importance, research and commercial interventions attempting to increase WM capacity provide mixed results. One emerging approach is to couple WM training with transcranial direct current stimulation (tDCS) to expedite and enhance behavioral training gains, presumably via reinforced neuroplasticity. In the current study, healthy young adults were trained and assessed on a difficult visuospatial WM task over one week, with sham or active tDCS. The high-density electroencephalogram (EEG) was recorded prior to tDCS, and again after completing the training + tDCS program. Participants who received active anodal frontoparietal tDCS demonstrated significant behavioral improvement on the WM task, unlike those who received sham stimulation paired with the same WM training. To elucidate the neural mechanisms behind observed training gains, EEG data were spatially-filtered using the Laplacian transformation, and analyzed for event-related potentials (ERPs), power spectral density, and cross-frequency coupling between theta oscillations and broadband gamma activity (i.e., theta-gamma PAC, considered a "neural code" for WM). Outputs were tested using a Monte Carlo method with cluster-based multiple comparisons correction. Importantly, tDCS changed the profile of frontal theta-gamma PAC and induced frontoparietal voltage shifts in contralateral ERPs. Because WM training alone did not influence WM or the EEG, these findings demonstrate that tDCS altered the theta-gamma neural code.

Topic Area: EXECUTIVE PROCESSES: Working memory

Relations Between Hypothalamic-Pituitary-Adrenal Axis and Autonomic Nervous System Activity and Children's Executive Functions in Environments of Early-life Stress

Poster A35, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Stephen Braren[1], Annie Brandes-Aitken[1], Clancy Blair[1]; [1]New York University

Exposure to early-life environments of stress can influence the development and functioning of cognitive processes such as executive functions (EF). The relation between EF and stress has been associated with both hypothalamic-pituitary-adrenal (HPA) axis and autonomic nervous system (ANS) activity, although most related research has not examined these two physiological systems in tandem. In the current study, we used data from a large, longitudinal sample (N=1292) of low-income children to investigate concurrent functioning of HPA axis and ANS activity in relation to EF. Children were seen in their homes at 48 and 58 months of age and participated in a battery of EF tasks. At 48 months, three child saliva samples were collected and assayed for cortisol, and electrocardiography was recorded before (baseline) and during (reactivity) the EF tasks to measure respiratory sinus arrhythmia (RSA) and inter-beat interval (IBI). Results revealed that baseline cortisol levels were positively associated with working memory and inhibitory control at 48 months. At 58 months, baseline RSA was negatively associated with inhibitory control and baseline IBI was negatively related to working memory. IBI reactivity was positively associated with working memory at 48 and 58 months and attention shifting at 58 months. Conversely, RSA reactivity was negatively associated with working memory at both

ages and attention shifting at 58 months. These results provide insight into how ANS and HPA axis activity differentially relate to children's EF, and point to possible mechanisms of risk and resilience in contexts of adversity that warrant further investigation.

Topic Area: EXECUTIVE PROCESSES: Working memory

Smoothing over the differences in working memory performance by tACS

Poster A36, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Yuri G. Pavlov[1,2], Nadezhda V. Pavlova[1,2]; [1]University of Tuebingen, [2]Ural Federal University

Despite the growing interest to the working memory (WM) in the last decades all existing neuroimaging studies have at least one limitation for investigation of individual differences in WM performance. In order to overcome these limitations, 156 subject were participating in solving highly demanding WM tasks which gave us the opportunity to distinguish EEG activity of individuals with different levels of WM performance. Additionally, using two types of tasks, which required either only retention of stimulus set or manipulation of content, we revealed EEG correlates of temporary storage and central executive components of WM and assessed their contribution to individual differences. The study showed striking individual differences in dynamics of frontal midline theta activity especially in the manipulation condition. Based on these results the second experiment was conducted. Twenty-two healthy adults participated in two testing sessions (after sham and transcranial alternating current stimulation (tACS)). tACS was applied for 20 min over Fpz and CPz at 6 Hz, 1 mA. No after-effects of tACS were observed in the stimulation sessions as compared to sham. The data suggest that tACS delivered before the WM task is not able to produce any observable changes in WM performance. Future studies could apply simultaneous stimulation and EEG recording during maintenance of information in WM for better understanding of the theta tACS effects.

Topic Area: EXECUTIVE PROCESSES: Working memory

Default mode network deactivation as a potential biomarker for working memory deficits in brain tumor patients

Poster A37, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Irena Schouwenaars[1], Miek de Dreu[1], Geert-Jan Rutten, Nick Ramsey, Johan Jansma; [1]ETZ Elisabeth Hospital, Department of Neurosurgery, Tilburg, the Netherlands

Introduction: Brain tumor patients often have cognitive complaints, which can greatly affect their socio-professional life. One important function that can influence cognitive performance is working memory (WM). Previous studies have shown that a high demanding cognitive task causes deactivation in a large set of brain regions: the 'default mode network' (DMN). In this study we examined if the level of deactivation could be associated with WM-capabilities. Materials and methods: Functional MRI scans were acquired in 46 brain tumor patients (26 meningioma, 12 low grade glioma (LGG) and 8 high grade glioma (HGG)) prior to surgery. The patients performed a 2-back task with consonant stimuli. The performance was calculated for each individual patient (number of correct responses/total amount of stimuli). Performance was correlated with DMN network activity (percentage signal change), as well as with individual regions within the DMN. Results: The level of DMN deactivation showed a trend towards significance irf correlated with performance ($r = -0.23$; $p = 0.065$). Within the DMN, we found significant correlation between level of deactivation and performance in the right angular gyrus ($r = -0.37$; $p = 0.006$) and the right posterior cingulate cortex ($r = -0.28$; $p = 0.028$). Conclusion: Our study indicates that patients with better cognitive performance show stronger deactivation within the DMN, specifically in the right hemisphere in the angular gyrus and posterior cingulate cortex. These results the possibility of using the level of deactivation in the right hemisphere as a biomarker for cognitive deficits in patients with a brain tumor.

Topic Area: EXECUTIVE PROCESSES: Working memory

Predicting task performance with multivariate pattern decoding using EEG oscillatory activity

Poster A38, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Elaine Astrand[1]; [1]Mälardalen University, Västerås, Sweden

Working Memory (WM) is central for goal-directed behavior. It is the ability to remember and use relevant information during a short period of time. Tightly coupled with attention, the two processes allow us to tackle many of the tasks that we face every day by filtering the information flow to select only relevant information to process and maintaining and manipulating that information in memory in order to produce an appropriate behavior. As task demands increase, inducing higher cognitive load, more mental resources are required for successful performance. This study seeks to extract a continuous measure from recorded brain activity that correlates to task performance during a dynamic computer game in which relevant and irrelevant distracters appear. ElectroEncephaloGram (EEG) oscillatory activity was recorded from healthy participants while they were engaged in different versions of a visual n-back task. We show that a decoder constructed from two discrete levels of WM load can generalize to WM load on a continuous scale that correlates to trial-by-trial task performance before action. Moreover, this measure allows to assess the impact that an upcoming distracter will have on attention and working memory processing during the task. These results constitute an important contribution towards a wide range of applications in the field of cognitive brain-machine interfaces, particularly towards developing rich neurofeedback techniques to train attention and working memory.

Topic Area: EXECUTIVE PROCESSES: Working memory

IMAGING STRESS EFFECTS ON WORKING MEMORY CAPACITY IN ADOLESCENTS AT-RISK

Poster A39, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Ashley Williams[1,2], Jessica Graham[1,2], Candace Killian-Farrell[1], Josh Bizzell[1], Hannah Waltz[1], Erin King[3], Alana Campbell[1], Aysenil Belger[1,2]; [1]University of North Carolina at Chapel Hill, Department of Psychiatry, [2]Duke University-UNC Brain and Imaging Analysis Center, [3]Emory University

Psychosocial stress has been identified as a key trigger for numerous neuropsychiatric disorders, many of which emerge in adolescence. The late maturation of prefrontal neural networks that regulate the stress response creates a unique target for stress-induced modulation of adolescent brain and cognition. The present study examined the impact of acute stress on neural networks responsible for working memory (WM) in adolescents at risk for complex neuropsychiatric disorders. We hypothesized that as WM load increased, participants would have difficulty recruiting frontal areas to support successful WM. Fifty-four adolescent participants (aged 9-16 years) were imaged during a 0-, 1-, and 2-back before and after an imaging stress task (MIST). Results revealed (1) Stress effects: a significant ($p<.01$ corrected) reduction in prefrontal activation during WM post-stress, coupled with a significant ($p<.01$) increase in posterior occipital activation. (2) Load effects: prefrontal region activation was smaller in the 2-back relative to 1-back condition post-stress. (3) Group effects: adolescents at high-risk (ADHD/ANXIETY/or familial-high risk) showed significantly more sensitivity to this stress effect ($p<.01$), such that low-risk adolescents preserved frontal activation, while those at high-risk rely on sensory areas after stress. (4) Sex effects: Females only showed prefrontal suppression and increased sensory and limbic activation as working memory load increased. These results suggest that patterns of stress response and recovery may procure unique vulnerabilities to cognitive domains, highlighting the importance of controlling or modeling these effects when investigating individual differences in brain and cognition in adolescents.

Topic Area: EXECUTIVE PROCESSES: Working memory

Neural Correlates of the "30 Million Word Gap": Children's language exposure is related to white matter structure

Poster A40, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Rachel Romeo[1,2], Joshua Segaran[2], Julia Leonard[2], Sydney Robinson[2,3], Meredith Rowe[4], Allyson Mackey[3], John Gabrieli[2,4]; [1]Harvard University, Division of Medical Sciences, [2]Massachusetts Institute of Technology, [3]University of Pennsylvania, [4]Harvard Graduate School of Education

Behavioral research has shown that the quantity and quality of young children's language input predicts their later linguistic ability, and that children from lower socioeconomic status (SES) backgrounds receive less language exposure than their higher SES peers, which translates into a measurable gap in children's language skills. The present study investigated which structural neural mechanisms underlie this input-output relationship. Forty SES-diverse children aged 4-6 years completed verbal and nonverbal standardized assessments, followed by a diffusion-weighted imaging (DTI) scan. Families then completed two full weekend days of real-world audio recordings from the child's perspective, from which three measures were derived: the number of words spoken by any adult, the number of child utterances, and the number of conversational turns between the child and any adult. Behaviorally, SES was strongly correlated with both language exposure and verbal and nonverbal scores. However, when SES was partialled out, only conversational turns predicted additional variance in children's verbal scores, even when additionally controlling for adult words and child utterances. Furthermore, the number of conversational turns, independent of SES, was positively correlated with the fractional anisotropy (FA) of the left arcuate fasciculus, which connects "Broca's" and "Wernicke's" area. This suggests that some qualitative aspect of dialogic communication has a greater impact children's brain and behavior than the sheer volume of adult speech. To our knowledge, this is the first evidence directly linking children's language environments with a brain structure known to underlie language development, and which may in turn contribute to the SES language gap.

Topic Area: LANGUAGE: Development & aging

Phase synchronization in the brain's functional reading network during letter processing supports the development of word reading in elementary school children

Poster A41, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Erin White[1,2], Candace Nayman[1], Benjamin Dunkley[1,3,4], Zahra Emami[1], Anne Keller[1,2], Taufik Valiante[2,4,5], Elizabeth Pang[1,2,3,4]; [1]Sick Kids Research Institute, Peter Gilgan Centre for Research and Learning, The Hospital for Sick Children, 686 Bay Street, Toronto, Ontario, Canada, M5G 0A4, [2]Epilespy Research Program of the Ontario Brain Institute, 438 University Ave., #1618, Toronto, Ontario, Canada, M5G 2K8, [3]The Hospital for Sick Children, 555 University Ave., Toronto, Ontario, Canada, M5G 1X8, [4]University of Toronto, Toronto, Ontario, Canada, M5T 1W7, [5]Krembil Research Institute, University Health Network and Toronto Western Hospital, 399 Bathurst St., Toronto, Ontario, Canada, M5T 2S8

Learning to read builds networks in the brain. Here we show developmental changes in functional connectivity (phase synchrony of EEG oscillations) during one aspect of reading: letter recognition. Nineteen adults (21-36 years; 10 female) and 24 children (4-14 years; 10 female) viewed consonant and unfamiliar symbol strings in a 1-back memory task, while wearing a 64-channel EEG cap. Global connectivity strength (mean phase lag index over all EEG sensors) measured network-processing costs, over time and for different canonical frequency bands. Adults showed increased connectivity for symbols 100-230 ms from stimulus onset in gamma band (30-80 Hz; $p<0.05$), due to connections among right occipital, left frontal/central sensors (i.e., right homologue of the visual word-form area and left frontal aspects of the reading network). This effect was not significant for children. Instead, children showed increased connectivity for letters in theta (3-7 Hz) band between 750-1000 ms ($p<0.05$). This was due to left occipital-frontal connections for experienced readers (grade 4-8; n=12), but right occipital-vertex connections for novice readers (grades JK-3; n=12), suggesting a developmental increase in reliance on the left visual word-form area during letter processing. Additionally, novice readers exhibited less connectivity for letters in beta (15-30 Hz) band between 650-935 ms ($p<0.05$), again due to right occipital vertex connections. This effect was not significant in experienced readers. Across all children, beta connectivity strength was negatively correlated with reading skill ($r = -0.65$). Functional connectivity may provide a new metric to quantify developmental changes, and letter competency, in the brain's reading network.

Topic Area: LANGUAGE: Development & aging

Tracking Attention to Spoken Language using EEG Alpha Oscillations

Poster A42, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Megan Boudewyn[1], Cameron Carter[1]; [1]University of California, Davis

STUDY GOALS: Attention is critical to the construction of mental representations of language context during comprehension. We investigated the consequences of momentary lapses in attention during listening comprehension on neural activity and behavior. METHODS: Healthy participants (N=44) listened to two full-length stories while EEG was recorded, and afterwards completed multiple choice comprehension questions. Listening was periodically interrupted by attention probes, in which participants were asked whether their attention immediately preceding the probe's appearance was focused on the story. RESULTS SUMMARY: The results showed that (1) participants spent a substantial amount of time off-task, endorsing attention lapses on over 30% of probes; (2) for probes on which an attention lapse was endorsed, later accuracy on comprehension questions querying pre-probe information was decreased; (3) just prior to the endorsement of an attention lapse, a greater proportion of above-threshold oscillations in the alpha-band (8-12 Hz) was detected compared to just prior to the endorsement of on-task or split-attention listening; and (4) when participants made "I have no idea" responses to comprehension questions, their EEG record revealed a greater proportion of above-threshold alpha oscillations during the original presentation of the information queried by the comprehension questions, compared to correct responses or incorrect guesses. CONCLUSIONS: These results connect changes in neural activity in the alpha band to episodes of mind-wandering during listening comprehension, and in turn to decreased comprehension accuracy. This demonstrates how alpha can be used to track attentional engagement during language comprehension, and illustrates the dependence of successful language comprehension on attention.

Topic Area: LANGUAGE: Other

Neural responses during procedural memory tasks are related to foreign language learning outcomes

Poster A43, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Tyler Perrachione[1,2], Stuart Babcock[1], Michelle Han[2], John Salvatore[2], Jennifer Minas[2], Amy Finn[2,3], John Gabrieli[2], Zhenghan Qi[2,4]; [1]Boston University, [2]Massachusetts Institute of Technology, [3]University of Toronto, [4]University of Delaware

Recent theoretical and empirical work has suggested that aspects of the human faculty for language may rely on cognitive and neural systems for procedural memory. However, little is known about how the neural systems for procedural memory contribute to foreign language learning. In this study, we used fMRI to measure participants' (N=24) neurophysiological responses during procedural memory tasks prior to completing an intensive, month-long, classroom-based, Mandarin Chinese course. The in-scanner task required participants to press buttons in response to an ordinal visual sequence under three conditions: "random", in which the visual sequence was stochastic and which served as the baseline; "serial", in which a 12-item second-order conditional sequence was presented consistently throughout the experiment and which induced implicit procedural learning; and "transformed", in which participants pressed the button corresponding to the adjacent (as opposed to presented) visual stimulus and which induced explicit procedural learning. Participants' attainment of Mandarin language skills was assessed using the standardized Chinese Proficiency Test (HSK), and whole-brain correlations were performed between language learning outcomes and procedural memory task activation. Neural responses in core procedural learning areas presaged participants' Mandarin attainment: prior to the Mandarin course, activation in right cerebellum to the serial condition and right caudate to the transformed condition were significantly correlated with participants' Mandarin proficiency after the course (voxel-wise $p<0.005$; cluster-level FDR $p<0.05$). These results provide preliminary evidence that individual differences in function of neural systems for procedural memory may contribute to individual differences in foreign language learning abilities.

Topic Area: LANGUAGE: Other

Multi-modal and task-modulated inter-hemispheric connectivity changes after left arcuate resection

Poster A44, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Benjamin Chernoff[1], Alexander Teghipco[1], Frank Garcea[1,2], Max Sims[1], Susan Smith[3], Webster Pilcher[3], Bradford Mahon[1,2,3,4]; [1]Department of Brain & Cognitive Sciences, University of Rochester, USA, [2]Center for Visual Science, University of Rochester, USA, [3]Department of Neurosurgery, University of Rochester Medical Center, USA, [4]Department of Neurology, University of Rochester Medical Center, USA

Lesions to the left arcuate fasciculus can cause conduction aphasia—impaired repetition of speech with intact comprehension and spontaneous speech. However, there is ongoing debate about whether the damage to the left arcuate fasciculus is sufficient to cause conduction aphasia, and it is unknown why conduction aphasia is often observed to be a transient phenomenon. The role of the right hemisphere in recovery from aphasia also remains an active area of study. Here we report a comprehensive case study of patient AH, who underwent resection of a temporal-parietal tumor that had infiltrated the left arcuate fasciculus. AH exhibited conduction aphasia intra-operatively as well as a transient global aphasia immediately after surgery, which resolved into a conduction aphasia that lasted for several weeks. We studied AH longitudinally using structural and functional MRI before and after surgery. We observed that there was a reduced intra-hemispheric functional connectivity in the left hemisphere post-operatively compared to pre-operatively; in contrast, there was increased inter-hemispheric connectivity increased post-operatively compared to pre-operatively. These patterns were observed only for task-based language tasks, and were not observed for task-based non-language tasks. Using probabilistic tractography with atlas-defined ROIs, we observed a significant decrease in structural connectivity between left Broca's and Wernicke's areas post-operatively compared to pre-operatively. Those measures of structural connectivity were within the distribution of 52 healthy age-matched control subjects pre-operatively, but outside the distribution post-operatively. These findings have important implications for understanding how inter-hemispheric connectivity may interact with functional reorganization of the language system after left hemisphere injury.

Topic Area: LANGUAGE: Other

Comprehending events on the fly: inhibition and selection during language processing

Poster A45, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Yanina Prystauka[1,2], Zachary Ekves[1,2], Gerry Altmann[1,2]; [1]University of Connecticut, [2]The Connecticut Institute for the Brain and Cognitive Sciences

Language comprehension entails keeping track of the entities introduced into the discourse and of any changes they undergo as a consequence of the events described by that language. Prior research (Hindy et al., 2012; Solomon et al., 2015) has shown that referring to entities that have undergone change (The chef will chop the onion. Then, she will weigh the onion) results in activation of stroop-sensitive voxels in prefrontal cortex, associated in other research with competition during selection of alternative incompatible interpretations (Thompson-Schill et al., 2005); selecting the appropriate state of the onion entails competition between the alternatives. This effect is absent when there is no change (The chef will weigh the onion…) or when the subsequent reference is to a different token of the same object type (The chef will chop the onion. Then, she will weigh another onion). However, due to the poor temporal resolution of fMRI, it is impossible to establish the dynamics of this effect and where in the sentence it occurs. To track this effect over time, dEEG was recorded as participants (N=22) read sentences word by word. We manipulated change (weigh/chop) and token (the/another onion). A time-frequency analysis, synchronized from the onset of the final determiner in the second sentence, revealed a significant increase in alpha (8-12 Hz) in sentences describing state change and referring back to the same token. This increase changed dynamically both in power and topology. This finding is consistent with literature relating alpha oscillations to cortical inhibitory processing and selection mechanisms.

Topic Area: LANGUAGE: Other

Left temporal lesions affect inner speech monitoring in language production: an electroencephalography and neuropsychological study

Poster A46, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Stephanie Ries[1,2], Alexa Cavalea[1], Chase Tengberg[1], Kathleen Y. Haaland[3], Robert T. Knight[4], Nina F. Dronkers[5,6,7]; [1]School of Speech, Language, and Hearing Sciences, San Diego State University, [2]Center for Clinical and Cognitive Neuroscience, San Diego State University, [3]Department of Psychiatry and Behavioral Sciences, and Department of Neurology, University of New Mexico, Albuquerque, [4]Department of Psychology and Helen Wills Neuroscience Institute, University of California, Berkeley, California, [5]Center for Aphasia and Related Disorders, Veterans Affairs Northern California Health Care System, Martinez, California, [6]Department of Neurology, University of California, Davis, California, [7]Neurolinguistics Laboratory, National Research University Higher School of Economics, Moscow, Russian Federation

Healthy adults only err about once every thousand words produced, while patients with left posterior temporal brain lesions make frequent production errors. We tested whether these errors were associated with impaired speech monitoring abilities. Medial frontal and posterior superior temporal regions (pSTG, with stronger activations on the left) have been associated with different aspects of speech monitoring. The medial frontal activity, reflected in the error negativity (Ne, larger in error than correct trials), has been associated with a monitoring mechanism engaged before speech output. The pSTG activity, on the other hand, has been associated with a monitoring mechanism dependent on auditory feedback. Whether these mechanisms interact to enable speech monitoring is unknown. We investigated the effect of stroke-induced brain lesions encompassing the left pSTG on medial frontal monitoring. We recorded scalp electroencephalography in four chronic stroke patients with lesions involving the left pSTG during a picture naming task. The results show a dramatically reduced amplitude difference between errors and correct trials on the Ne in these patients. This contrasts with previous reported results using the same paradigm in chronic stroke patients with lesions outside of the pSTG (in the lateral prefrontal cortex, PFC). PFC patients showed an intact Ne pattern, suggesting a normal speech monitoring mechanism in simple picture naming. The present results suggest interactions between the left pSTG and the medial frontal cortex are necessary for speech monitoring, and begin to shed light on the physiological underpinnings of abnormal speech monitoring in patients with left pSTG brain lesions.

Topic Area: LANGUAGE: Other

Violations of ASL Sentence Processing: Observed Changes in Neural Oscillations

Poster A47, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Tristan Schaefer[1], Kristina Backer[1], Michael Grosvald[2], David P. Corina[1]; [1]Center for Mind and Brain, University of California, Davis, [2]Qatar University

There is interest in characterizing neural oscillatory activity associated with language processing. To date, the majority of studies have focused on changes observed during the processing of spoken languages. Here, we describe results from a time-frequency analysis of EEG data from deaf signers processing American Sign Language (ASL). Using data from Grosvald et al., (2012), we examined oscillatory power changes as signers (n = 20) watched videos of ASL sentences that ended in one of four possible conditions; semantically congruent, semantically incongruent, pseudo-signs, or a non-linguistic gesture (e.g. rubbing one's eye). Thirty-two channel EEG data was analyzed, and power estimates of neural oscillations were computed using the FieldTrip toolbox. In line with previous research on lexical and sentential violations (e.g. Strauss et al 2015; Bastiaansen et al., 2010), we examined changes in power changes in theta (3-7 Hz), alpha (8-12 Hz), and high beta (19-25 Hz) ranges. We observed significant power differences in a temporal window between 400-1000 ms. after the critical sign/gesture in posterior channels (Pz, P3, P4, O1, O2, Oz). Relative to semantically congruent signs, significant increases in theta power were observed for pseudo-signs ($p < .03$) and self-grooming gestures ($p < .04$). In contrast, significant decreases in high beta power were observed only for self-grooming gesture relative to semantically congruent signs ($p < .006$). The data suggest theta enhancement may be related to early stages of lexical ambiguity, while changes in beta frequency may index interruption of the cognitive state by unexpected stimuli (Engel and Fries, 2010).

Topic Area: LANGUAGE: Other

The left anterior temporal lobe is a bidirectional convergence region mediating the relation between names and semantic knowledge for unique entities

Poster A48, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Amy Belfi[1], Brett Schneider[2], Jonah Heskje[3], Joel Bruss[3], Daniel Tranel[3]; [1]Missouri University of Science & Technology, [2]University of Wisconsin-Madison, [3]University of Iowa

Prior research has implicated the left temporal pole (LTP) as a critical region for naming semantically unique items, including famous faces, landmarks, and musical melodies. Such studies typically use a confrontation naming paradigm, where a participant is presented with a stimulus and asked to retrieve its name. Here, we propose that the LTP functions as a two-way convergence region for proper naming. Under this hypothesis, damage to the LTP should result in impairments both in name retrieval when presented with a concept (as in prior work) and in concept retrieval when given a name. We tested this hypothesis using a "recognition-from-name" paradigm. Participants included individuals with LTP damage, and brain-damaged and healthy comparison participants. Participants were presented with names of famous individuals (e.g., Marilyn Monroe), landmarks (e.g., Leaning Tower of Pisa), or melodies (e.g., Rudolph the Red-Nosed Reindeer) and were asked to provide conceptual knowledge about each. Individuals with LTP damage were significantly impaired at conceptual knowledge retrieval when given names of famous people and landmarks, but not melodies. This supports the theory that the LTP is a bidirectional convergence region for proper naming, but suggests that melody retrieval may rely on additional processes other than those supported by the LTP.

Topic Area: LANGUAGE: Semantic

From action to abstraction: The sensorimotor grounding of metaphor comprehension in Parkinson's disease.

Poster A49, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Stacey Humphries[1], Nate Klooster[1], Eileen Cardillo[1], Anjan Chatterjee[1]; [1]University of Pennsylvania

Can embodied cognition theories account for the ability to represent abstract ideas? Metaphors are a linguistic vehicle through which we understand the abstract. Proponents of embodied cognition argue that metaphor comprehension involves simulating the literal sense of the word being used metaphorically. However, evidence for this claim is mixed: some studies find activation of sensorimotor regions when people comprehend metaphors, whilst other studies observe sensorimotor activation for literal but not metaphorical sentences. This discordance may be caused by methodological differences between studies in the novelty of the metaphors and control conditions used, and a lack of control over psycholinguistic features of the stimuli. We designed a highly controlled Registered Report study (peer-reviewed and accepted in principle by Cortex prior to data collection) in patients with motor disturbance (Parkinson's disease) on an extensively normed set of action verb and sound verb metaphors. Embodied theories predict that PD patients will be impaired on action metaphors but not sound metaphors. Metaphor comprehension is assessed with a semantic meaning-selection task. Bayesian inferential methods are used to permit optional stopping and to determine whether the null or alternative hypothesis is more strongly supported by the data. Current data from 9 patients shows that responses to action metaphors are less accurate than those to sound metaphors (87.03% vs. 93.7%), and are slower (7241ms vs. 6837ms). Our study offers an example of a theoretically motivated, methodologically rigorous, registered study accepted provisionally before final results are obtained, in attempt to mitigate pervasive false positive reports in the literature.

Topic Area: LANGUAGE: Semantic

A Late Slow Frontal Positivity ERP reflects the resolution of contextual ambiguity during narrative discourse comprehension

Poster A50, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Patrick Ledwidge[1], Adam Ramsey[1], Jeremy Foust[1]; [1]Baldwin Wallace University

The goal of this study was to identify the event-related potential (ERP) correlate(s) of contextual ambiguity resolution during narrative discourse comprehension. Thirty-seven neurotypical college-students read narrative discourses during 256-channel ERP recording. The contexts of the discourses were initially ambiguous if read without a descriptive title (Untitled Discourse group: n = 19), but clear if preceded by a title (Titled Discourse group: n = 18). For the Untitled Discourse group, however, the contexts

became more clear after reading the last word of sentence 2 (Critical Word 2) and sentence 3 (Critical Word 3), as determined offline by a separate sample. ERPs of interest were the N400 and P600 recorded to the last word of each sentence (Critical Words 1-3). For the Untitled Discourse group, N400 amplitudes (272-452 ms) became less negative from Critical Words 1-3, suggesting greater ease of lexical-semantic retrieval as the discourses unfolded. P600 amplitudes (456-700 ms) increased from Critical Words 1-3 for the Titled Discourse group. Unexpectedly, amplitudes of a Slow Frontal Positivity (SFP) ERP (684-1000 ms) increased from Critical Words 1-3 for the Untitled Discourse group only. The SFP did not occur for the Titled Discourse group. P600 amplitudes for the Untitled Discourse group were larger to Critical Word 3 than Critical Word 2. Our results suggest that the SFP reflects the resolution or revision of contextual ambiguity during narrative discourse comprehension. Alternatively, the P600 is proposed to reflect discourse context-updating when an existing context is available or after the resolution/revision of contextual ambiguity.

Topic Area: LANGUAGE: Semantic

Do faces affect foreign-accented speech comprehension in children? An ERP investigation

Poster A51, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Abigail Cosgrove[1], Carla B. Fernandez[1], Sarah Grey[2], Janet G. van Hell[1]; [1]Pennsylvania State University, [2]Fordham University

Spoken language provides listeners with information about the speaker's identity, such as age, sex, or accentedness. In spoken communication, foreign-accented speech can challenge comprehension, especially for listeners with limited experience with foreign-accented speech. Using ERPs, we had adults and children (aged 9-11) with little exposure to foreign-accented speech listen to sentences containing a semantic anomaly or pronoun error (and correct counterparts), produced by Chinese-accented and non-accented speakers of English. Adults and children both showed an N400 response to semantic violations in both accent conditions, but pronoun violations elicited a neural response in non-accented speech, but not in foreign-accented speech (Grey & Van Hell, 2017; Grey et al., in prep). In the present study, we examined whether presenting faces as a cue to foreign speaker identity could aid foreign-accented speech comprehension, particularly neural responses to pronoun violations. Prior to listening to Chinese-accented or non-accented speakers (producing the same sentences as above), listeners saw faces congruent with each speaker's accent. In adults, pronoun violations in foreign-accented speech (as well as non-accented speech) elicited a neural response, indicating face cues aided comprehension. Preliminary analyses of the child data, however, indicate that face presentation did not modulate pronoun processing in foreign-accented speech: children still did not show a neural response to pronoun violations in foreign accented speech (but showed sensitivity to pronoun violations in non-accented speech and semantic violations in both accent conditions). This suggests that adults but not children use faces as a cue to speaker identity to aid foreign-accented speech comprehension.

Topic Area: LANGUAGE: Semantic

What's, uhh, coming next? Effects of speech disfluency on event-related potentials during sentence processing

Poster A52, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Meredith Brown[1,2], Nathaniel Delaney-Busch[2], Barbara Storch[1], Edward Wlotko[3], Gina Kuperberg[1,2]; [1]Massachusetts General Hospital, [2]Tufts University, [3]Moss Rehabilitation Research Institute

Speakers are more likely to produce disfluencies such as filled pauses ("uh", "um") before unpredictable words, making disfluency a potentially useful pragmatic cue during sentence processing. This event-related potential study investigates how filled pauses modulate the N400 – an index of lexico-semantic processing – by crossing expectancy with disfluency. In addition, we ask whether and how listeners can adjust their use of disfluencies during processing, given only implicit information about the distributional characteristics of speech disfluencies over the course of an experiment. To do this, we manipulated the proportion of filler trials in which disfluencies preceded unpredictable versus predictable words between two participant groups. In one group of participants (reliable condition, n=24), disfluencies preceded unpredictable words (and predictable words were produced fluently) on 75% of all trials. In the other group (unreliable condition, n=24), disfluencies were equally likely to precede unpredictable and predictable words. Crucially, critical items were identical across both groups; the overall frequency of disfluency also did not differ between groups. Results showed that critical words following disfluencies elicited a larger-amplitude N400 than critical words in fluent sentences, regardless of expectancy. This suggests that disfluencies orient listeners' attention to upcoming speech, leading to deeper semantic processing of both expected and unexpected words. This effect was stronger in the reliable group (when disfluencies preceded unexpected words relatively often). This finding suggests that listeners are able to use the distributional characteristics of a speaker's disfluencies to implicitly adjust how they use speech disfluency to influence semantic processing of incoming words.

Topic Area: LANGUAGE: Semantic

The involvement of left inferior frontal and posterior superior temporal gyri in processing Chinese relative clauses

Poster A53, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Kun-Yu Xu[1], Jeng-Ren Duann[1], Denise Wu[1]; [1]National Central University

Different from the consistent advantage of processing subject-relative clauses (SRCs) over object-relative clauses (ORCs) observed in most Indo-European languages, empirical evidence for processing Chinese RCs has been controversial. Consequently, even less studies have explored the neural correlates underlying such processing. Previous neuroimaging findings have associated the effects of syntactic complexity with several cortical sites including the left inferior frontal gyrus (IFG) and the superior temporal gyrus (STG). To examine the involvement of these regions in processing Chinese SRCs and ORCs, a mixed functional magnetic resonance imaging (fMRI) study was conducted in which participants read sentences with the center-embedded structure and then made yes-no answers to probe questions about the sentences. The fMRI results showed that enhanced significantly higher activity within the left IFG (BA47) and the posterior STG whenever participants processed SRCs compared with ORCs. However, only in the STG, the brain activity was evidently correlated with the behavioral performance. The current findings further confirmed the role of the STG in integrating lexical-semantic and syntactic information during the sentence comprehension and, in terms of temporal sequence of activations, the STG might take action before the IFG when processing syntactically complex sentences.

Topic Area: LANGUAGE: Syntax

Effects of age on across-participant variability of cortical reinstatement effects

Poster A54, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Preston Thakral[1], Tracy Wang[2], Michael Rugg[3]; [1]Harvard University, [2]University of Texas at Austin, [3]University of Texas at Dallas

In the current functional neuroimaging study, we assessed whether age-related decline in episodic memory is associated with a reduction in the specificity of retrieved content. We addressed this question by employing across-participant multi-voxel pattern analysis (MVPA) to examine whether increasing age is associated with differences in the variability of cortical reinstatement effects. During study, participants (24 young and 24 old) viewed objects and concrete words. Test items included studied words, the names of studied objects, or unstudied words. Participants judged whether the items were recollected, familiar, or new by making 'remember', 'know' and 'new' responses, respectively. MVPA was conducted in regions of the 'core recollection network'. We employed a leave-one-participant-out classification approach where the classifier was trained on a subset of the participants (young and old, young only, or old only) and tested on the data from held-out participants. Classifiers were trained on the study phase data to discriminate trials as a function of content (i.e., picture or word). The classifiers were then tested on the test phase data (i.e., study-test classification, an index of cortical reinstatement). When the classifier was trained on all participants, study-test classification was significantly above chance. Thus, cortical reinstatement effects generalize across different people. Study-test classifier accuracy did not, however, differ as a function of the age-specific classifiers (i.e., classifiers trained on young only versus old only data). These findings suggest that increasing age is not associated with a difference in the variability of cortical reinstatement effects.

Topic Area: LONG-TERM MEMORY: Development & aging

Memory and processing speed predict functional independence differentially in non-Hispanic and Hispanic White middle aged and older adults

Poster A55, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Ariana Stickel[1], Andrew McKinnon[1], John Ruiz[1], Lee Ryan[1]; [1]University of Arizona

Although good cognitive functioning is associated with maintaining functional independence in non-Hispanic White older adults, little is known about the link between cognitive functioning and independence in Hispanics. The present study compared the relationships between cognition and functional independence in aging (50-94 years old) Hispanics (n = 85) and non-Hispanic Whites (n = 97) selected from the National Alzheimer's Coordinating Center (NACC) and Alzheimer's Disease Neuroimaging Initiative (ADNI) databases*. Ethnic groups were matched on age, education, gender, and apolipoprotein e4 status. Functional independence was measured with the Functional Activities Questionnaire (FAQ). Neuropsychological tests included Logical Memory Long Delay and Trails A and B-A. Controlling for age and education, poorer performances on Logical Memory and Trails A were associated with lower functional independence. Further, an interaction between ethnicity and cognition indicated that slowing on Trails A was associated with lower functional independence among non-Hispanic Whites but not Hispanics. Trails B-A was not predictive of FAQ. These results suggest that associations between cognition and functional independence are not uniform across ethnic groups. Although memory may be a more generalizable predictor of functional independence, processing speed is not. *Funded by NIA/NIH Grant U01 AG016976 (NACC) and NIH U01 AG024904 and DOD W81XWH-12-2-0012 (ADNI).

Topic Area: LONG-TERM MEMORY: Development & aging

Decreased hippocampal-prefrontal functional connectivity predicts episodic memory in Alzheimer’s disease

Poster A56, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Eun Hyun Seo[1], Jinsick Park[2], Mina Heo[3], IL Han Choo[4]; [1]Premedical science, College of Medicine, Chosun University, Gwangju, Korea, [2]Hanyang University, Seoul, Republic of Korea, [3]Center for Development of BioMedical Technology, Chosun University Hospital, Gwangju, Korea, [4]School of Medicine, Chosun University Hospital, Gwangju, Korea

Background: Alzheimer’s disease (AD) is characterized by progressive cognitive decline including memory impairment. Hippocampal-prefrontal functional connectivity (HPFC) is crucial for episodic memory process. However, the relationship between them remains unclear in AD spectrum. Therefore, this study investigated the relationship between HPFC and episodic memory in cognitively normal (CN) elderly and individuals with mild cognitive impairment (MCI) and AD. Methods: The resting-state functional and structural MRI raw data, clinical and neuropsychological data were downloaded from the Alzheimer’s Disease Neuroimaging Initiative database. BOLD time course was extracted from hippocampus and medial prefrontal region after preprocessing. Correlation analysis between these two was performed. The correlation coefficient was defined as HPFC index. Multiple linear regression was conducted to examine the ability of HPFC to predict memory. In the final analysis, 58 CN, 48 MCI, and 28 AD were included. Results: Memory score was significantly different among the CN, MCI, and AD group, whereas there was no significant group-difference in HPFC index. Multiple linear regression model revealed that left HPFC was significantly predicted memory score in total group. In subgroup analysis, AD group showed significant associations between bilateral HPFC index and memory score ($R2= 0.239$, $p=0.045$ for left HPFC, $R2=0.338$, $p=0.007$ for right HPFC). However, CN and MCI showed no significant associations between them. Conclusions: Our findings indicate that decreased intrinsic HPFC can predict episodic memory in AD. Given that

hippocampus and medial prefrontal area are main nodes of default mode network (DMN), disrupted DMN may related to poor episodic memory performance in AD spectrum.

Topic Area: LONG-TERM MEMORY: Development & aging

Multiple brain markers predict risk of progression on the Clinical Dementia Rating Scale in clinically normal older adults

Poster A57, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Taylor E. Neal[1], Jenny S. Rabin[1,2], Aaron P. Schultz[1,2], Keith A. Johnson[1,2,3], Reisa A. Sperling[1,2,3], Trey Hedden[1,2]; [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Brigham and Women's Hospital

The goal of this study was to assess how brain markers associated with age-related changes in cognition influence the rate at which cognitively normal individuals (CDR=0) progress to mild functional impairment as indicated by a Clinical Dementia Rating of 0.5. Participants included 259 clinically normal older adults (M=73.4 years old) from the Harvard Aging Brain Study with at least one follow-up neuropsychological assessment and all imaging measures at baseline. Participants were assessed at baseline for magnetic resonance imaging markers of brain volume and thickness, white matter lesions and diffusion characteristics, and resting state functional connectivity in multiple networks; positron emission tomography markers of glucose metabolism and amyloid burden; and cognitive factor scores of episodic memory, executive function, and processing speed performance and change over time in these cognitive scores. Cox regression models were used to assess the time to progression to CDR of 0.5 as predicted by baseline brain markers and cognition, covarying for age, sex and education. Sixty-four participants (24.7%) progressed to a CDR of 0.5 over an average follow-up of 3.73 years (range: 1-6 years). Low hippocampal volume, decreased functional connectivity of the default mode and salience networks, high amyloid burden, and lower memory performance all significantly contributed to the rate of progression while controlling for contributions of other biomarkers, cognitive measures, and covariates. These results indicate that brain markers independently influence the rate of progression on the CDR global score over and above the predictive value of baseline or change in cognitive performance.

Topic Area: LONG-TERM MEMORY: Development & aging

The neurocognitive effects of digital memory augmentation

Poster A58, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Chris B. Martin[1], Bryan Hong[1], Andrew Xia[1], Christopher J. Honey[2], Morgan D. Barense[1,3]; [1]University of Toronto, [2]Johns Hopkins University, [3]Rotman Research Institute

Digital memory augmentation (DMA) is a promising approach to mitigate age-related memory impairments. In DMA, portable devices are used to capture information about everyday episodes, making them available for later review. Previous research has shown that DMA can produce substantial autobiographical memory benefits across cognitively healthy and impaired individuals. For the purpose of the current study, we developed a novel, smartphone-based DMA application that allowed participants (64+ years of age) to create and replay rich digital memories during their daily lives. In contrast to extant DMA technology, however, our application supported replay in a manner that was distributed both within and across days. Using a within-subjects design, digital memories were randomly assigned to one of two conditions: replayed or hidden. Content in the replayed condition was replayed by participants multiple times each day, whereas digital memories in the hidden condition were never replayed. We assessed autobiographical memory for real-world episodes in each condition using a cued-recall test that was administered after 7 and again after 14 days of use. Application use was discontinued after the second behavioural assessment, and fMRI was used after a one-week delay to probe for differences in neural representations related to previously replayed and hidden autobiographical events. Our results revealed that distributed replay significantly boosted recall of event-specific episodic details, and that previously replayed digital memories were associated with distinct patterns of fMRI activation. Taken together, these findings provide novel insight into the neurocognitive effects of DMA, and highlight the real-world value of translational memory research.

Topic Area: LONG-TERM MEMORY: Episodic

Strategically orienting retrieval toward remote and recent memories: An episodic specificity account

Poster A59, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Emily Leiker[1,2], Mason Price[2], Jeffrey Johnson[2]; [1]Boys Town National Research Hospital, [2]University of Missouri

Numerous studies have demonstrated that episodic retrieval depends on the age of the memory trace. Whereas these findings are typically couched in terms of the quality of the trace, recent ERP studies have indicated that retrieval also depends on how cue processing is differentially oriented to memory age. One account of such differences involves specificity, such that orienting toward remote versus recent memories is respectively directed at recovering less versus more specific information. Here, this hypothesis was tested with an "episodic specificity induction" procedure, in which an unrelated task immediately preceding a memory test can have an effect on the processing engaged during the test. Participants (N = 32) encoded pictures during two laboratory visits separated by one week. ERPs were then recorded while participants undertook a series of memory tests separately targeting the pictures from each visit. Prior to each test block, participants were shown a series of words and, for each, they had to complete either one (the general induction) or three elaborate judgments (the specific induction). The induction procedure affected behavioral performance, with the general condition giving rise to lower levels of retrieval accuracy. Importantly the ERPs also differed according to the induction manipulation across remote and recent retrieval, similar to previous orienting effects of memory age, despite the fact that difficulty was controlled in the present study. The findings suggest that memory age can give rise to expectations about the specificity of traces, thereby modulating the nature of strategic retrieval cue processing.

Topic Area: LONG-TERM MEMORY: Episodic

Memory Reactivation with Neurostimulation during Sleep Elicits Electrophysiological Responses that Predict Behavioral Changes

Poster A60, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Ryan J. Hubbard[1], Nicholas A. Ketz[1], Aaron P. Jones[2], Bradley Robert[2], Natalie B. Bryant[2], Steven W. Skorheim[1], Shane Roach[1], Vincent P. Clark[2], Praveen K. Pilly[1]; [1]Information and Systems Sciences Laboratory, HRL Laboratories, LLC, Malibu, CA, [2]The University of New Mexico, Albuquerque, NM

Slow-wave sleep (SWS) plays an important role in memory consolidation, as neural patterns of memory related activity are reactivated during UP states of the ongoing slow oscillations. Previous work has demonstrated that reactivations can be induced by presenting encoding-related cues, such as sounds or odors, during sleep. Here, we utilized transcranial current stimulation (tCS) to reactivate memories, and assessed neurophysiological changes during sleep associated with later performance in a virtual reality-based declarative memory task. During encoding of events, subjects received unique Spatio-Temporal Amplitude Modulated Patterns (STAMPs) of tCS currents, which were later re-applied specifically during UP states of SWS to cue memory reactivation. We analyzed significant changes in spectral power in specific frequency bands across 32 channels of the scalp EEG following stimulation events, and compared to separate sham data in which no stimulation was applied within subjects. We then employed cluster-based permutation statistics to quantitatively examine the significant differences between stim and sham power changes that were correlated with overnight behavioral performance changes on two consecutive nights. STAMPs led to modulations in power across several frequency bands, but only certain clusters were predictive of episodic recall changes. Namely, we identified spatiotemporal clusters in the theta (4-8 Hz), alpha (8-12 Hz), and beta (16-30 Hz) frequency bands in which EEG power significantly correlated with behavior. These results provide further insight into the neural processes related to successful memory consolidation during sleep.

Topic Area: LONG-TERM MEMORY: Episodic

Theta oscillations during active and passive decision making for navigation

Poster A61, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Elizabeth Chrastil[1,2], Mathias Goncalves[1], Kylie Moore[3], Chantal Stern[1], Erika Nyhus[3]; [1]Boston University, [2]University of California, Santa Barbara, [3]Bowdoin College

"Active" navigation seems to yield better spatial knowledge than "passive" navigation, but it is unclear how active decision making influences learning and memory. We previously found that actively making decisions about where and how to explore a novel environment facilitated learning the path structure of a maze. Here, we tested the relationship between decision making and spatial memory by examining the role of theta oscillations during navigation. Theta rhythm is theorized to play a role in setting the dynamics for encoding and retrieval and is known to contribute to spatial coding in both animals and humans. Theta oscillations in prefrontal cortex could indicate integration of new information into memory and communication with the hippocampus. We tested individuals on a maze-learning task in which participants made discrete decisions about where to explore at each choice point in the maze. Half of the participants were free to make decisions at each choice point, and the other half passively explored by selecting a marked choice (matched to active exploration) at each intersection. They were then tested on their knowledge of the maze by traveling from object A to object B within the maze corridors. Exploration and test in this novel environment occurred while undergoing electroencephalography (EEG). Preliminary results show an advantage for active decision making during learning and indicate that the active group had greater theta power during choice points in exploration, particularly in prefrontal cortex. These results suggest that hippocampal-prefrontal interactions are vital for learning and memory during active decision making.

Topic Area: LONG-TERM MEMORY: Episodic

Noninvasive stimulation increases fMRI connectivity during autobiographical memory retrieval more so than during rest

Poster A62, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Kristen Warren[1], Molly S Hermiller[1], Steven VanHaerents[1], Joel L Voss[1]; [1]Northwestern University

Episodic memory is supported by the hippocampus and a distributed network of cortical regions. We have previously shown that noninvasive brain stimulation targeting this hippocampal-cortical network (HCN) increases resting-state fMRI correlations among network regions and improves episodic memory. However, the relevance of resting-state fMRI connectivity to cognitive processing is uncertain. Therefore, we investigated the effects of network-targeted brain stimulation on fMRI connectivity measured during a specific memory demand: autobiographical retrieval. Furthermore, we compared these effects of stimulation on memory-related fMRI connectivity to those observed via resting-state fMRI in the same subjects. Subjects (N=16) underwent resting-state and autobiographical-retrieval fMRI scans followed by five consecutive days of high-frequency (20 Hz) repetitive transcranial magnetic stimulation to left lateral parietal cortex. Follow-up fMRI occurred 24 hours after the last day of stimulation. There were significant changes in fMRI connectivity with the hippocampus in a variety of distributed brain regions during both resting-state and autobiographical-retrieval scans. Changes in connectivity were more robust during autobiographical retrieval compared to resting state. Regions with significantly different stimulation-induced changes in autobiographical-retrieval versus resting-state scans were analyzed using hierarchical clustering of connectivity graphs, which identified three distributed networks. One comprised predominately frontal regions that increased interconnectivity, one comprised frontal regions that decreased interconnectivity, and the third comprised the HCN and additional parietal regions that showed increased interconnectivity. These findings suggest that the effects of noninvasive stimulation on fMRI connectivity are assessment-specific, with greater effects when targeted brain networks are involved in relevant cognitive processing.

Topic Area: LONG-TERM MEMORY: Episodic

Differential effects of negative emotion on item-specific and contextual memory precision

Poster A63, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Rose Cooper[1], Maureen Ritchey[1]; [1]Boston College

Negative emotional arousal has distinct effects on encoding and reconstruction of episodic memories. Past work has suggested that negative emotion differentially affects memory for item-specific and contextual information, which are mediated by dissociable cortico-hippocampal systems. It remains unclear, however, whether negative emotion predominantly affects retrieval of episodic details (memory success) or the fidelity of episodic information (memory precision), and whether changes in success or precision are limited to item-specific or contextual information. Following Xie and Zhang (2017, Cognition), we predicted that negative affect would enhance memory precision for item-specific details. This may come at a cost to memory for contextual information, which then becomes more gist-like following negative arousal. Alternatively, contextual details might become more precise if arousal generally enhances encoding fidelity. To test these alternative hypotheses, we developed a novel paradigm wherein participants encoded objects embedded within 360 degree panorama scenes, each preceded by either a negative or neutral image to induce affective state. Item-specific memory was tested by asking participants to reconstruct each object's color, varying within a 360 degree spectrum, and contextual memory precision was assessed by asking participants to find each object's original location within the panorama. We observed differential effects of negative emotion on memory: whereas negative affect enhanced item-memory precision, as predicted, we found that it decreased the likelihood of remembering item-specific details. In contrast, negative emotion did not influence memory success or precision of contextual information. Therefore, negative emotional arousal has both content-specific and process-specific effects on our ability to recollect episodic information.

Topic Area: LONG-TERM MEMORY: Episodic

Visual free recall of real-world scenes reveals high capacity and exquisite detail in memory

Poster A64, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Wilma Bainbridge[1], Elizabeth Hall[1], Chris Baker[1]; [1]National Institute of Mental Health

Research over the past several decades has characterized the impressive storage capacity in visual long-term recognition memory and the characteristics of verbal free recall. However, little work has examined the capacity and resolution of visual free recall using a purely visual task, in spite of evidence that recognition and recall may utilize separate neural mechanisms. In the current study, we conducted a quantification and characterization of visual recall for complex real-world images using a visual recall task - drawing. Participants (N=30) studied real-world scene images and, after a distractor task, drew as many images as possible from memory. To serve as benchmarks, separate participants created 1) drawings from the scene category names to estimate the canonical representations of a category, and 2) drawings from each image with no memory component. We leveraged online crowd-sourced experiments on Amazon Mechanical Turk to score these drawings along several properties. Participants' drawings were highly diagnostic of their specific corresponding photographs rather than their scene categories, and the objects they remembered were predictable by graph-based visual saliency maps. Participants remembered 151.3 objects on average across all images, yet drew surprisingly few additional objects (false alarms). Additionally, we find evidence for different mechanisms of recognition and recall, through differences in which images tend to be recalled versus recognized. Overall, these results provide new insight into the capacity and detail with which people recall complex visual images.

Topic Area: LONG-TERM MEMORY: Episodic

Temporal Contiguity Deficits in Medial Temporal Lobe Amnesia

Poster A65, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Joseph Di Lascio[1], Daniela Palombo[1], Per Sederberg[2], Marc Howard[1], Mieke Verfaellie[1]; [1]Boston University, [2]Ohio State University

According to the Temporal Context Model (TCM), episodic memory depends on reinstatement of a prior experienced context, which is thought to rely on the medial temporal lobes (MTL; Howard et al., 2006). This hypothesis has proven difficult to directly

test under common behavioral experimental protocols, such as free recall, due to near floor performance by patients with MTL lesions. To circumvent this issue, we tested MTL amnesic patients and matched healthy controls on a modified free recall protocol with serial repetition of presented items. This technique was successful in boosting free recall in amnesia, thereby allowing examination of statistical properties such as probability of first recall and lag conditional response probability (lag CRP), which refers to response probability as a function of temporal lag. Because items studied closely together in a study list share a similar temporal context, they also tend to be recalled in proximity to each other. As expected, amnesic patients had fewer recalls as well as disrupted temporal contiguity effects as measured using the lag CRP. We quantify the differences in recall dynamics between patients and controls using a version of the TCM (Sederberg, et al., 2008) with a parameterization that allows for more direct measurement of temporal contiguity effects. A model in which parameters affecting overall recall, primacy, and the recovery of temporal context are allowed to vary between groups best describes the effects of amnesia. These findings provide novel evidence that the MTL is necessary for recovering a prior episodic context, in accordance with TCM.

Topic Area: LONG-TERM MEMORY: Episodic

A Synergistic Ecphory Account of Pupillary Old/New Effects During Episodic Memory Retrieval

Poster A66, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Mingjian He[1], Elena Festa[1], William Heindel[1]; [1]Brown University

Locus coeruleus-noradrenergic (LC-NA) activity has been associated with memory retrieval (Devauges & Sara, 1991). Pupillometry measures of LC-NA activity in humans have established a pupillary old/new effect in explicit recognition memory paradigms, with old stimuli eliciting greater pupil dilations than new stimuli during test (Vo et al. 2008). While this pupillary effect was first interpreted as reflecting cognitive effort (Papesh et al. 2012), recent findings alternatively support memory-trace strength (Otero et al. 2011) or attentional orienting (Mill et al. 2016) interpretations. The present study assessed the pupillary old/new effect in an explicit recognition task under two conditions manipulating overall memory performance, and investigated whether the pupillary effect generalizes to an implicit memory (stem-completion priming) task. A multiple regression modeling approach (Krishnamurthy et al. 2016) was employed to quantify pupillary responses independent of confounding factors across time points. Implicit memory results showed reduced rather than increased pupil dilation for successfully primed compared to unsuccessfully primed or new stem items (a reverse old/new effect). Explicit recognition results confirmed the standard old/new pupillary effect, and found a larger effect for correct than incorrect trials. Taken together, results suggest that the pupillary old/new effect does not reflect memory strength per se regardless of task demands, but rather reflects an interaction between memory strength and processes specific to explicit episodic memory retrieval. We propose that the pupillary old/new effect reflects synergistic ecphory (Tulving 1982), a theoretical framework that reconciles previous findings while also integrating neurobiological accounts of LC-NA modulation of memory retrieval (Sara 2000).

Topic Area: LONG-TERM MEMORY: Episodic

Reinstatement of spatial information in a hybrid spatial-episodic memory task

Poster A67, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Nora A Herweg[1], Ashwini D Sharan[2], Michael R Sperling[2], Armin Brandt[3], Andreas Schulze-Bonhage[3], Michael J Kahana[1]; [1]University of Pennsylvania, [2]Thomas Jefferson University Hospital, [3]University Medical Center Freiburg

The context in which we experience events helps to organize them in memory. To investigate the influence of spatial context on the organization of episodic memories, we recorded intracranial EEG data in 23 patients with medication-resistant epilepsy while they performed a hybrid spatial-free recall task. Patients navigated through a virtual town and items were presented at a sequence of locations. We relate neural similarity between encoding and retrieval events (i.e. correlation of time-frequency spectra) to the spatial contexts associated with those events. Prior research has shown reinstatement effects in the hippocampus and several cortical brain regions, but few studies have addressed the relative timing of these effects. Here, we examined the time course of reinstatement in the hippocampus and the parahippocampal gyrus, regions which have been linked to both, spatial processing and

the retrieval of contextual information. We observed distinct temporal profiles of spatial context reinstatement: slopes were more positive in the parahippocampal gyrus than the hippocampus ($p = 0.051$). Qualitatively, spatial information (i.e. neural similarity as a function of spatial proximity) decreased in the hippocampus and increased in the parahippocampal gyrus leading up to recall. In the same time window, we observed significantly greater than chance theta phase to gamma amplitude coupling between the two regions ($p < 0.05$), revealing a physiologically plausible mechanism for information transfer. These results confirm the role of the MTL in retrieval of contextual information and, more specifically, contribute to our understanding of the interplay of its sub-regions during retrieval of spatial information.

Topic Area: LONG-TERM MEMORY: Episodic

Resting-state hippocampal functional connectivity depends on handedness

Poster A68, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

John Scofield[1], Jeffrey Johnson[1]; [1]University of Missouri

A hippocampal-cortical network of regions, including lateral parietal, medial prefrontal, and posterior cingulate cortices, has been identified across numerous fMRI studies of episodic memory retrieval (recollection) and resting-state functional connectivity. Consistent over many of these studies is the finding that this network exhibits a left-lateralized bias, particularly in posterior parietal regions and lateral prefrontal cortex. Given that these results are predominantly based on samples of right-handed participants, the current study set out to test the hypothesis that handedness contributes to such lateralization. Resting-state fMRI data were obtained from multiple publicly-available projects (the 1000 Functional Connectomes Project and the Autism Brain Imaging Data Exchange) to provide samples of matched left- and right-handed participants that were sufficient in size for between-group analyses. Whole-brain functional connectivity based on hippocampal seeds revealed differential effects in a left-lateralized fronto-parietal network that were stronger for right-handers. By contrast, left-handed subjects exhibited stronger connectivity in bilateral inferotemporal regions. These differences were supported by across-subject multivariate pattern analysis (MVPA) that classified the handedness of subjects at above-chance levels. The findings highlight the notion that handedness is associated with differences in brain function and suggest that lateralization specific to the hippocampal-cortical memory network is attributable in part to these differences.

Topic Area: LONG-TERM MEMORY: Episodic

Caudate Activation in Adolescents during Goal-Directed Memory Performance is Associated with Mood, Anxiety, and Sensation Seeking

Poster A69, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Emily Oot[1,3], Jennifer Sneider[1,2], Julia Cohen-Gilbert[1,2], Derek Hamilton[4], Anna Seraikas[1], Maya Rieselbach[1], Carolyn Caine[1], Arkadiy Maksimovskiy[1,2], Lisa Nickerson[1,2], Sion Harris[2,5], Marisa Silveri[1,2]; [1]McLean Hospital, [2]Harvard Medical School, [3]Boston University School of Medicine, [4]University of New Mexico, [5]Boston Children's Hospital

Adolescence is a period of development characterized by rapid changes in brain structure and function. Incongruous maturation rates across brain systems during this period can manifest in both psychopathological symptoms and maladaptive behaviors, helping to explain why rates of depression, anxiety and risky activity (e.g. substance use) are elevated in adolescence. The present study aimed to elucidate the link between adolescent clinical characteristics and patterns of brain activation in the striatum. Healthy adolescent participants (n=32, 15 female) underwent functional magnetic resonance imaging (fMRI) during performance of a virtual water maze task. The task involved navigating to a hidden platform based on learning that was completed prior to imaging. Blocks of hidden trials, dependent on spatial memory, were alternated with motor control trials where the platform was visible. The caudate nucleus was examined as a region of interest due to its role in goal-directed action, as well as in spatial learning/memory. Participants also completed self-report scales of depression (CES-DC), anxiety (MASC), impulsivity (BIS) and sensation seeking (BSSS). A significant positive association was observed between caudate activation during navigation to the hidden platform and thrill seeking scores on the BSSS ($p=0.026$). A significant negative association was observed between caudate activation and both depression (CES-DC) and anxiety (MASC) scores on hidden ($p=0.041$, $p=0.028$, respectively) and visible trials ($p=0.046$, $p=0.032$,

respectively). These findings suggest that personality and clinical characteristics may differentially influence neuronal recruitment of goal-directed motivational systems involved in learning and memory, which could in turn impact the trajectory of maturation through adolescence.

Topic Area: LONG-TERM MEMORY: Episodic

Improving Memory with Real-Time Phase-Locked Reactivation during Sleep

Poster A70, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Laura Batterink[1], Florczak Susan[1], Santostasi Giovanni[1], Zee Phyllis[1], Sanchez Daniel[2], Paller Ken[1]; [1]Northwestern University, [2]SRI International

Slow-wave sleep (SWS) is characterized by synchronized neural activity alternating between active upstates and quiet downstates. The slow-oscillation upstates are theorized to provide a window of opportunity for memory consolidation, and memory reactivation underlying consolidation may occur preferentially during these times. Memory reactivation occurs spontaneously during sleep and can also be induced by presenting learning-related cues associated with a prior learning episode. This technique, targeted memory reactivation (TMR), selectively enhances memory consolidation. We previously found that slow-wave phase at time of stimulation predicts this behavioral memory benefit, supporting the hypothesis that memory reactivation is most likely during cortical upstates (Batterink, Creery & Paller, 2016). In the present study, we directly tested this idea by using an open-loop real-time algorithm to deliver auditory cues to sleeping subjects at these hypothesized optimal and suboptimal slow-oscillation phases. Consistent with our hypothesis, we found that cues that were targeted to occur at the a priori optimal phase were associated with a larger memory benefit compared to cues targeted at the suboptimal phase. These results provide direct evidence that memory processing occurs preferentially during cortical upstates, and also suggest that TMR effects may be enhanced by selectively targeting the cortical upstate in real time.

Topic Area: LONG-TERM MEMORY: Other

Impoverished Semantic Memory in Mild Cognitive Impairment

Poster A71, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Nathaniel Klooster[1], Arun Pilania[1], David A. Wolk[1], Anjan Chatterjee[1]; [1]University of Pennsylvania

Mild Cognitive Impairment (MCI) may be a useful target to identify prodromal cognitive manifestations of Alzheimer's Disease pathology. While MCI patients may show some impairment in language abilities, semantic memory is often considered minimally affected although is often not well-tested with standard psychometric batteries. Here, we test the hypothesis that people with amnestic-MCI show evidence of semantic memory impairments. To test this hypothesis, we assessed depth and richness of semantic knowledge. The Word Associates Test (WAT) is a receptive measure of depth of vocabulary used in first and second-language learning research. Participants choose four correctly matching synonyms or collocates from among eight possibilities for each target word. The number of senses a word can take (e.g. pound: to beat down; a unit of weight; an enclosure for stray dogs; the British unit of currency) is a widely studied measure of semantic richness in psycholinguistic studies. In the Senses-listing task, participants are given one minute to list as many senses as possible for target words chosen from normed databases. MCI patients performed significantly worse on the WAT and the senses-listing task than demographically matched healthy comparison participants. Deficits on both receptive and productive measures of semantic richness and depth of vocabulary knowledge suggest that semantic memory is frequently impoverished in patients with MCI. Our ongoing work is examining the sensitivity of these experimental measures as compared to standard neuropsychological tests, and the behavioral correlations with biomarkers such as medial temporal lobe integrity and cerebral amyloid pathology.

Topic Area: LONG-TERM MEMORY: Semantic

Generalization in an object category learning paradigm is better in the morning than the evening

Poster A72, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Anna Schapiro[1], Mollie Bayda[1], Eileen Cho[1], Roy Cox[1], Robert Stickgold[1]; [1]Harvard Medical School / Beth Israel Deaconess Medical Center

Prior work has demonstrated that features of objects that are shared with other members of a category are better remembered after a night of sleep. We set out to test whether sleep would also benefit generalization to novel object category exemplars. Participants learned visual and verbal features of three categories (A, B, and C) of "satellite" objects. At the end of this training, we exposed them to two additional satellites, each composed of a combination of features from categories A and B. These satellites provided a bridge between the two categories, supporting the potential generalization that other combinations of features from A and B could also produce plausible satellite objects. In Experiment 1, we tested participants before and after a night of sleep, or before and after a day awake. There was no benefit of sleep, but instead a strong effect of time of day, where participants generalized better in the morning. In Experiment 2, we manipulated bridge item exposure to match initial generalization behavior across groups (despite testing at different times of day) and potentially reveal a sleep effect, but there was again no effect of sleep. In Experiment 3, tests were separated by a 24-hour delay, and we replicated the finding that generalization is much better in the morning and that sleep confers no benefit. These results suggest that for this paradigm, memory processing during sleep does not benefit generalization, and instead there is a strong benefit to testing in the morning.

Topic Area: LONG-TERM MEMORY: Semantic

Mechanisms Underlying Memory Distortion for Emotional Orthographic Associates with EEG

Poster A73, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Nicholas Griffin[1], David Schnyer[1]; [1]The University of Texas at Austin

While all people are prone to memory distortion, cognitive biases may differentially affect how memory becomes distorted. Negative attention bias, commonly exhibited in individuals with depressive symptoms, has been shown to increase memory distortion for negative information. Using orthographically associated words in a false memory paradigm, we examined differences in endorsement of emotional memory lures between healthy (HC) and high depressive (HD) symptom groups. In addition, we collected electroencephalography data to investigate neurocognitive mechanisms underlying memory differences between groups. Participants encoded lists of neutral words that were orthographically similar to either neutral or negative critical lures. Then, they completed a recognition memory test including items shown at encoding (old items) and associated critical lures (novel items). The depressive group showed increased hits and false alarms (FA) relative to the control group and quicker overall response times than the control group. Event-related potentials were calculated for hits to old items, and correct rejections (CR) and FA to lure items. Post-hoc, the group was split into high and low FA groups. Examining the FA and CR difference among high FA participants, we found significant interactions between depressive group and valence such that HCs showed more positive amplitude differences for neutral relative to negative lures early in frontal and late in left parietal regions, while HDs showed the opposite pattern. While HC retrieval patterns were consistent with the emotional recognition literature, this suggests that HDs instead use a negatively biased retrieval strategy during familiarity and recollection-related processes when making incorrect item endorsements.

Topic Area: LONG-TERM MEMORY: Semantic

Explicit probabilistic sequence learning in Tourette syndrome

Poster A74, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Eszter Tóth-Fáber[1], Zsanett Tárnok[2], Andrea Kóbor[3], Karolina Janacsek[1,4], Alexandra Rádosi[1], Eszter Dóra Szabó[1], Dóra Merkl[2], Szabina Oláh[2], Orsolya Hegedűs[2], Péter Nagy[2], Réka Vidomusz[2], Dezso Nemeth[1,4]; [1]Eötvös Loránd University, Budapest, Hungary, [2]Vadaskert Child Psychiatry Hospital, Budapest, Hungary, [3]Brain Imaging Centre, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary, [4]Institute of Cognitive Neuroscience and Psychology, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary

Tourette syndrome (TS) is a neurodevelopmental disorder characterized by motor and vocal tics and also by frontal/basal-ganglia abnormalities. Basal-ganglia abnormalities often lead to impairments in procedural learning. However, examining procedural learning in TS have produced contradictory results: Some studies have reported intact or even enhanced procedural learning, while others have found impairments. However, procedural learning is a multicomponent process and previous studies investigated only certain aspect of this mechanism. In this study, we investigated the implicit and explicit learning of sequences in children with TS and typically developing (TD) children using a probabilistic sequence learning task. These two processes of procedural learning could be selectively impaired in TS. We used the explicit version of the Alternating Serial Reaction Time (ASRT) task which enables us to measure both implicit and explicit sequence learning in parallel. According to our results, explicit sequence learning could be altered in TS as children with TS did not learn the explicit sequence in the task while TD children did. Examining implicit learning, both groups showed similar sequence learning, indicating intact implicit sequence learning in TS. This is in line with those previous studies showing the relative strength of implicit sequence learning in TS. This subprocess of procedural learning plays an important role in the acquisition of several cognitive and motor skills, such as language learning and playing sports.

Topic Area: LONG-TERM MEMORY: Skill learning

Having your cake and eating it too: Flexibility and power with mass univariate statistics for ERP data

Poster A75, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Eric C. Fields[1,2], Gina R. Kuperberg[3,4]; [1]Boston College, [2]Brandeis University, [3]Tufts University, [4]Massachusetts General Hospital

Event-related potential studies generate large amounts of data across time and space. Statistical analyses in the ERP literature often do not sufficiently address the multiple comparisons problem that this creates. ERP researchers therefore face a catch-22: pre-specifying time windows and spatial ROIs for analyses requires knowing in advance where effects will appear, but choosing analysis parameters based on the observed data is biased and can significantly inflate the Type I error rate. This problem is often exacerbated by low power, leading to studies and statistical tests that provide little evidence for true effects despite reporting significance. Mass univariate statistics have been proposed as one solution, but it is often assumed that this approach sacrifices power to maintain flexibility and Type I error rate. However, simulation studies comparing mass univariate approaches to traditional mean time window approaches have not tested this assumption. We present such simulations using the newly released Factorial Mass Univariate Toolbox (https://github.com/ericcfields/FMUT/wiki). Our results show that when spatial and temporal assumptions are matched, mass univariate approaches actually yield greater power than the mean amplitude approach. This was true for both broadly-distributed and focal ERP components. In addition, whereas the mean amplitude approach requires knowing where effects will appear in space and time, our simulations indicate that mass univariate approaches show only modest decreases in power when broad spatial and temporal ROIs are used. These results suggest that mass univariate statistics offer the ideal balance of power and flexibility for many or most ERP studies.

Topic Area: METHODS: Electrophysiology

Dissociating Alzheimer's Disease from Amnestic Mild Cognitive Impairment Using Time-frequency-based EEG Measures

Poster A76, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Wendel Friedl[1], Paul Kieffaber[1]; [1]College of William and Mary

This work explores the utility of using magnitude and phase angle indices derived from electroencephalogram (EEG) recording using spectral decomposition as unique biomarkers of Alzheimer's Disease (AD) and amnestic mild cognitive impairment (aMCI), respectively. Experimental stimuli included both auditory and visual oddball discrimination tasks, elicited during a brief (approximately 20 minute) recording session. Participants were 60 older adults from an outpatient memory clinic diagnosed with either aMCI (n=29; M=73.0; SD=9.32) or AD (n=31; M=78.29; SD=8.28) according to NIA-AA criteria. AD-diagnosed participants exhibited significantly higher gamma-band evoked power response in both auditory and visual oddball trial conditions (FDR adjusted p-value ≤ 0.05) over time ranges consistent with common event-related potentials (ERPs) corresponding to each sensory modality (visual mismatch-negativity (vMMN) and P300 for visual oddballs, frequency and interval MMN in the auditory domain). These results contribute to a growing body of literature seeking to document illness-related abnormalities in time-frequency EEG signatures that may serve as reliable indicators of the pathophysiological processes underlying the cognitive deficits observed in AD and aMCI-afflicted populations.

Topic Area: METHODS: Electrophysiology

The Role of Inter-region Information Synchrony in Processing Visual Stimuli

Poster A77, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Heather Bruett[1], Marc Coutanche[1]; [1]University of Pittsburgh

The brain processes the many aspects of visual stimuli via the coordinated activity of a number of relevant regions. The processing targets of these regions can be uncovered by “decoding” multivoxel activity patterns, which can represent subtle distributed information. An approach that examines the timeseries of pattern discriminability – informational connectivity – can help determine which regions contain information in the same trials – in other words, which regions are acting in synchrony. I will present fMRI data that were analyzed via multivariate analysis tools and informational connectivity to determine how information synchrony plays a role in processing scenes and objects. We ask how regions within the scene and object processing networks can decode scenes and objects from “pseudo-scenes,” which contain certain elements present in typical scenes but lack other visual components. We find that the strength of informational connectivity within these networks differs based on the object or scene discriminations examined. The findings are particularly methodologically interesting, as they suggest that informational connectivity can identify functionally-relevant networks with greater specificity than can other measures, such as functional connectivity and psychophysiological interaction (PPI).

Topic Area: METHODS: Neuroimaging

Objective Measure of Imagined Hand Manipulations: An EEG Study

Poster A78, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Christopher Donoff[1], Christopher Madan[1,2], Sarah Elke[1], Anthony Singhal[1]; [1]University of Alberta, [2]University of Nottingham

The present study employed an objective test of imagined hand manipulations to investigate how oscillatory power changes as a function of electrode site, mental imagery accuracy, left- or right-hand stimuli, and participant handedness. In contrast to the whole-body Test of Ability in Movement Imagery (TAMI), each item in the current objective test provided five finger-movement instructions followed by four line-drawings of hands. Only one of the line-drawings was the correct final hand conformation, resulting in an objective way to measure mental imagery accuracy. EEG data was recorded using a 256-channel array while participants completed the TAMI, the novel hand-specific test inspired by the TAMI, and the Edinburgh Handedness Inventory. We were interested specifically in recording mu (8 – 13 Hz) and frontal-midline theta (4 – 8 Hz) brain oscillations, due to their involvement in motor and higher-order mental processes, respectively. Mu suppression has been observed at the onset of motoric action, indicative of an active state. Using the Better OSCillation (BOSC) detection method, the results from the hand-manipulation test depicted significantly more mu oscillations for incorrect versus correct trials, depicting the mu-suppression effect. There was also a significant increase in the amount of frontal-midline theta detected over central electrodes compared to more lateral sites. From these results, the hand-manipulation test appeared to require an increase in higher-order mental functions, such as working memory, to complete the task. This may have reduced the degree of motor-cortex region involvement, preventing any observed lateralized brain activity typically seen in movement imagery studies.

Topic Area: METHODS: Neuroimaging

EEG-Based Source Imaging Revealed Lower Beta-Band Top-Down Modulation of Early Visual Areas

Poster A79, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Hua Zhong[1], Guang Ouyang[1], Yunqing Hua[1], Akaysha Tang[1]; [1]The Laboratory of Neuroscience for Education, Faculty of Education, The University of Hong Kong

Top-down neural feedback from motor system to early visual areas is known to influence perceptual processing. These top-down feedbacks have been extensively studied under various task conditions using different brain imaging methods. Here, building upon the study by Ouyang et al (submitted to CNS 2018, poster ID 713), we applied a blind source separation algorithm (second-order blind identification, SOBI) to high-density EEG (128 channels) data collected from a color visual oddball task and examined how neural activities in early visual areas in the human brain are modulated by top-down input associated with the action of a button press response. We found that the button press response consistently evoked an oscillatory response in the early visual areas (BA17, 18, 19) across all 9 participants observed. We applied Morlet wavelet transformation to the time series of single trial neural source activities within a time window surrounding the time of button press response. The wavelet analysis revealed a clear motor response-elicited enhanced oscillatory activity pattern in the frequency band centred at 13 Hz, covering a width of 4 Hz, with peak power latency of 582+/-35 ms. These results demonstrate that (1) SOBI-aided source analysis allows the measurement of top-down signals fed back into specific early visual areas; (2) these top-down feedback signals are in the lower beta band, consistent with findings from non-human primate studies.

Topic Area: METHODS: Neuroimaging

P300 and theta-band oscillation: two expressions of a single novelty response

Poster A80, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Xueyan Niu[1], Guang Ouyang[1], Yunqing Hua[1], Akaysha Tang[1]; [1]The Laboratory of Neuroscience for Education, Faculty of Education, The University of Hong Kong

Theta band oscillatory activity and P300 component in event-related potentials are both associated with novelty-related processing typically studied under separate experimental paradigms. The relation between these two forms of neural signatures of novelty has only been explored using scalp recorded EEG data at a few selected electrodes locations and no reference to the underlying neural generators was made in this context. The present work is built upon the study presented by Ouyang et al (submitted to CNS 2018, poster ID 713) where second order blind identification (SOBI) was used to recover neuronal sources, from high-density EEG (128 channels) data collected during a visual oddball task. Applying a Fourier transform to single-trial ERPs of the recovered P300 source, we explored the relation between the P300 and theta expressions of the novelty response to low versus high probability stimuli. We found that the low probability stimuli (50 trials) generated a significantly greater power, specifically in theta band (4-8Hz) activity, than did the high probability stimuli (200 trials) (one-tailed $t(14) = 2.03$, $p = .03$, effect size Cohen's $d = 0.52$). This result demonstrated a direct relation between oddball induced P300 in the ERP and theta-band activity in a neuronal source consisting of a network of regions across frontal, temporal, and occipital lobes.

Topic Area: METHODS: Neuroimaging

Novelty enhances the reliability and timing consistency of neuronal source response

Poster A81, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Guang Ouyang[1], Yunqing Hua[1], Changsong Zhou[2], Akaysha Tang[1]; [1]Laboratory of Neuroscience for Education, Faculty of Education, The University of Hong Kong, [2]Department of Physics, Institute of Computational and Theoretical Studies, Hong Kong Baptist University

Brain response to unexpected or novel environmental changes is critical for learning and survival, therefore should be reliable and consistent across instants. While the P300, a large-amplitude neural response to low-probability stimuli, has been extensively investigated using scalp-recorded event-related potentials (ERPs), its neural origin, reliability and variability at single trial level are under-explored. Applying second-order blind identification (SOBI) algorithm to continuous data collected during a color visual oddball task, we characterized novelty responses in two contrasting neuronal sources: an early visual source (peak latency 111±16 ms) localized to occipital gyrus and a late P300 source localized to a network of frontal, occipital and temporal lobe structures. Single-trial analysis of single subject source data showed that 1) both sources showed significantly greater ERP amplitudes to the rare than to the frequent stimuli (50:200); (2) In only the P300 source, single trial ERP response to low-probability stimuli is significantly more reliable (fewer misses) and consistent (lower standard deviation of latency) than to the frequent stimuli; 3) In 9 out of 11 participants, the single-trial P300 peak latencies predicted reaction times of button-press to low-probability stimuli; 4) The early visual and late P300 sources are correlated in peak latency during trials of low- but not high-probability stimuli. Methodologically, these results demonstrate a new capacity for estimating single-trial response characteristics in functionally specific brain regions. Scientifically, these results suggest that novelty detection is a significant neural computation performed at both early sensory processing stage and subsequent evaluation and action generation stage.

Topic Area: METHODS: Neuroimaging

Measuring Prefrontal Functional Connectivity Development in Preschool-aged Children Using fNIRS

Poster A82, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Jaeah Kim[1], Alexander Rüsch[1], Jana M. Kainerstorfer[1], Erik D. Thiessen[1], Anna V. Fisher[1]; [1]Carnegie Mellon University

Brain function is crucially tied to the organization of networks of regions that collaboratively process information and regulate behavior, called functional networks. Study of functional networks is often based on analyzing resting state functional connectivity (rsFC). Some functional networks develop rapidly early on in infancy, while others show gradual and protracted development over decades into adulthood. While rsFC has been measured in adults, older children, and sleeping infants, it has been relatively rarely measured in young children, in whom significant development of certain networks (such as that supporting executive function) is expected, but with whom traditional neuroimaging methods (e.g., fMRI, EEG) and adult rsFC paradigms are difficult to employ. We previously developed and tested a paradigm, called NB-rsFC, combining functional near-infrared spectroscopy (fNIRS) and a novel task designed to approximate resting state in children. Compared to traditional rsFC, this paradigm allows movement and provides a minimum amount of engagement, such that young children can comply for extended measurement durations. In this study, we used NB-rsFC to measure rsFC in prefrontal cortex (PFC) longitudinally in 17 children aged 3-5, measured twice at each of 2 timepoints 2-4 month apart (4 scans total). Comparison of rsFC between timepoints 1 and 2 using a classification algorithm showed developmental differences between scans across timepoints, compared to scans within timepoints (permutation test, $p < 0.05$). In addition to further validating the sensitivity and feasibility of the NB-rsFC paradigm, these results suggest noticeable development of functional connectivity within PFC even in a short 3 month period.

Topic Area: METHODS: Other

Characterizing inter-individual differences in brain morphology

Poster A83, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Christopher R. Madan[1,2]; [1]University of Nottingham, [2]Boston College

The most defining feature of the human brain is its folding structure; the underlying principle of these cortical folds has been a long-standing topic of investigation and continues to be a mystery. Despite this, there are general inter-individual consistencies in the macroscopic organization of cortical folds, and these consistencies form the basis of use of cortical parcellation atlases. Standard measures of cortical morphology, however, often quantify volumetric properties of the cortex (i.e., volume, thickness, surface area) rather than shape-related characteristics. An exception, however, is the quantification of gyrification. Nonetheless, several studies have observed that a mathematical measure, fractal dimensionality, is more sensitive to inter-individual differences in brain morphology than extant measures, including gyrification. Here I present results demonstrating that fractal dimensionality is useful in characterizing age-related changes in brain structure for both cortical and subcortical structures. Further analyses compare fractal dimensionality with more distinct measures of shape such as the power spectra of cortical folding (i.e., different spatial frequencies in cortical folding) and subcortical surface-to-volume ratio and surface texture. On-going work further evaluates the utility of these shape measures as a biomarkers for dementia.

Topic Area: NEUROANATOMY

Organized patterns of cortical thinning observed across the healthy adult lifespan.

Poster A84, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Phillip Agres[1], Micaela Chan[1], Liang Han[1], Neil Savalia[1], Gagan Wig[1,2]; [1]Center for Vital Longevity and School of Behavioral and Brain Sciences, University of Texas at Dallas, Dallas, TX, 75235, USA, [2]Department of Psychiatry, University of Texas Southwestern Medical Center, Dallas, TX, 75390, USA

Healthy aging is associated with cortical gray matter thinning, however in a non-uniform manner. Evidence for similarities and differences in rates of thinning across cortical regions have been made at the level of cortical lobes and gyral & sulcal landmarks. This approach has led to observations of thinning distinctions between regions involved in associative versus sensory/motor processing. Given this functional distinction, it is possible that patterns of cortical thinning exhibit more specific processing-related distinctions of the brain. To test this hypothesis, we examined regional covariance of thinning patterns across participants sampled from the healthy adult lifespan (N=248; 20-89yrs). Cortical thickness change data were calculated across two time-points spanning approximately 3.5 years (i.e., longitudinally). Brain regions and their associated functional systems were pre-defined from resting state functional correlations (rsFC). Greater cortical thinning similarity was observed between nodes (regions) within the same functional system than with nodes of other systems, controlling for effects of age and baseline cortical thickness. To understand more deeply the systematic relationships of regional thinning similarity, sub-groups comprised of regions exhibiting highly similar thinning patterns across participants were identified using a community detection algorithm. Nodes were clustered into communities overlapping with their rsFC functional systems at a local level, but segments of large spatially distributed systems, such as the default network, were split across multiple communities at sparse thresholds. These results indicate that cortical regions within rsFC-defined systems exhibit similar thinning patterns across the lifespan, and that structural covariance of cortical thinning may delineate local cortical distinctions.

Topic Area: NEUROANATOMY

Insular Functionally Connected Sub-regions of Healthy Developing Youth

Poster A85, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Aliyah Jones[1], Yu-Ping Wang[2], Jeremy D. Cohen[1]; [1]Xavier University of Louisiana, [2]Tulane University

Insular Cortex is a multimodal region with connectivity throughout the brain and involved in a wide range of cognitive functions. Typical analysis of fMRI data creates activation maps by testing each voxel separately for correlation with an experimental paradigm or preforming a statistical analysis on a specific region of interest (ROI). A cluster-based analysis creates activation maps, which gives each voxel in the acquisition volume a priori chance of being discovered. Previous functional connectivity studies employing cluster analyses of insular cortex in adults show a range of 2 to 8 distinct functional clusters. The goal of this study was to identify insular sub-regions of shared functional connectivity with other brain regions using cluster analysis. Subjects (N=247) collected from the Philadelphia Neurodevelopmental Cohort (PNC) consisting of youths aged 8-21 years were used to compute

insular clusters. Results showed activation in the anterior/middle region that was connected to anterior cingulate cortex and parietal insular regions, the posterior granular area connected to the somatomotor cortices and posterior cingulate, and the transitional dysgranular area connected to the anterior cingulate cortex. This data suggests that insular clusters in developing youth are similar to adult insular organization. This is the first step towards increased understanding of how insular cortex organizes with other brain regions during early life.

Topic Area: NEUROANATOMY

Collective listening: Effects of groove, tempo, and visual coupling among audience members on physical engagement with the music

Poster A86, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Laurel Trainor[1,2], Dobromir Dotov[1], Daniel Bosnyak[1]; [1]McMaster University, [2]Rotman Research Institute

Music has a bonding role in social groups. Motor synchronization as a mechanism for social interaction has been investigated in dyads but it is more difficult to ascertain analogous effects in large groups. Does listening to music in a group versus individually lead to higher physical responses? Does it facilitate social engagement and is synchronized movement instrumental? We conducted a behavioral study with 33 participants who listened collectively to musical pieces while their head movements were recorded. Visual cues to movements of others were manipulated by asking audience members to close their eyes on half of the trials. Separate songs were selected for each combination of low/high groove and slow/fast tempo. The first two latent vectors extracted from head movements with principal component analysis showed oscillatory patterns with greater amplitude in eyes-open conditions and higher frequency in high-groove conditions. Movement energy was highest with eyes-open and with high-groove songs. This is consistent with social facilitation. Energy was positively correlated with grooviness ratings. Additionally, the contribution of the second latent vector increased with high-groove songs, indicating more diversified, higher-dimensional movements. The role of visual coupling was further investigated using relational measures such as event synchronization and the maximum cross-correlation between participants. Synchronization was higher in eyes-open trials. In the eyes-open high-tempo conditions pairs of participants who were visually coupled were better coordinated than pairs of participants who were separated by a large distance, suggesting that the social facilitation was partly dependent on movement coordination.

Topic Area: PERCEPTION & ACTION: Audition

Stochastic resonance like cross-modal enhancement as a universal neural computation and cognitive processing principle

Poster A87, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Patrick Krauss[1], Achim Schilling[1], Konstantin Tziridis[1], Holger Schulze[1]; [1]University of Erlangen-Nurenberg

Stochastic resonance (SR) is ubiquitous in nature and refers to a phenomenon that signals otherwise sub-threshold for a given sensor can, at least partially, be detected anyway by adding noise of a suitable intensity to the sensor input. Most objective functions to quantify such information transmission require knowledge of the signal to be detected. In a previous study we demonstrated that the autocorrelation of the sensor output, a quantity always accessible, can be used to quantify and hence maximize information transmission even for unknown and variable input signals. In a further study we demonstrated by implementing a phenomenological computational model that adaptive SR based on output autocorrelations might be a major processing principle of the auditory system that serves to partially compensate for acute or chronic hearing loss, e.g. due to cochlear damage, whereas the noise necessary for SR to work corresponds to increased spontaneous neuronal firing rates in early processing stages of the auditory brainstem. We proposed the possibility that the neuronal noise which is crucial for SR to work may be injected into the auditory system via somatosensory projections. In support of our model, Huang et al. (2017) demonstrated that electro-tactile stimulation applied to the index finger significantly improves speech perception thresholds. We here argue that somatosensory input driven SR in the auditory system by may be just one instance of a more general principle: multisensory integration causing SR-like cross-

modal enhancement. We hypothesize that this mechanism corresponds to a universal neural computation and cognitive processing principle.

Topic Area: PERCEPTION & ACTION: Audition

FOXP2 Variation Modulates Auditory Feedback Control of Speech Production

Poster A88, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Siyun Zhang[1], Hanjun Liu[1]; [1]The First Affiliated Hospital, Sun Yat-sen University

Multiple lines of evidence have demonstrated the crucial role of auditory feedback in the sensorimotor integration for speech processing. Much less is known, however, about the neurobiological basis of auditory-motor control of speech production. Mutations of FOXP2 gene in humans have been found to be associated with disorders of language and speech production. In the present study, we tested the effect of a FOXP2 common variant, rs6980093 (A/G) on the vocal and event-related potential (ERP) responses to pitch feedback perturbations (-50 and -200 cents) during vocal production in a population-based cohort of 133 Chinese speakers (18-29 years old). The behavioral results showed that the GG genotype were associated with significantly smaller magnitudes of vocal compensations for pitch perturbations of -200 cents relative to the AA and AG genotypes. Furthermore, the AA and AG genotypes exhibited significant positive correlations between the magnitude of vocal compensation and the variability of normal voice fundamental frequency, while the GG genotype did not. At the cortical level, there was a significant main effect of FOXP2 genotype on the amplitudes of ERP P2 responses to pitch perturbations of -200 cents, showing significantly larger P2 amplitudes associated with the GG genotype as compared to the AA and AG genotypes. These findings show the first neurobehavioral evidence that FOXP2 variation can modulate the auditory-motor processing of pitch feedback errors during vocal production at the levels of both behavior and cortex, and provide important insights to the neural and genetic basis of speech motor control.

Topic Area: PERCEPTION & ACTION: Audition

Age effects on ventral visual pathway representations: Evidence for dedifferentiation and hyperdifferentiation

Poster A89, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Zachary Monge[1], Erik Wing[1], Benjamin Geib[1], Lifu Deng[1], Simon Davis[1], Ziwei Zhang[1], Roberto Cabeza[1]; [1]Duke University

Activation patterns for different visual stimuli (e.g, faces vs. houses) in the ventral visual pathway (VVP) have been shown to be less differentiated (i.e., dedifferentiated) in older (OAs) than younger (YAs) adults. Here, we tested the hypothesis that age-related dedifferentiation would be greater for visual features (e.g., spatial frequency) in posterior VVP (e.g., V1) than for semantic features (e.g., meaningful associations) in anterior VVP (e.g., anterior temporal lobe [ATL]). During fMRI scanning, 21 YAs and 20 OAs viewed 96 scenes. We combined representational similarity analyses with a Deep convolutional Neural Network (DNN). DNNs can be trained to classify images with a high level of accuracy and accurately model the VVP. The scenes were submitted to a pre-trained DNN (16-layered VGG16 network), which, for each layer, yielded a stimulus representational dissimilarity matrix (RDM). The stimuli RDMs were then correlated with co-variance in activation patterns across the 96 scenes in multiple VVP regions. We used the second-order stimulus RDM-brain RDM correlation as our measure of differentiation. The results showed a clear cross-over in differentiation: (1) for visual features (early DNN layers), differentiation in posterior VVP (e.g., V1) was reduced in OAs (age-related dedifferentiation); however, (2) for semantic features (late DNN layers), differentiation in the anterior VVP (e.g., ATL), was greater in OAs (age-related hyperdifferentiation). In OAs, the anterior VVP hyperdifferentiation was associated with better performance on a perceptual discrimination task, suggesting compensation. In sum, we found age-related dedifferentiation of visual features in posterior VVP but hyperdifferentiation of semantic features in anterior VVP.

Topic Area: PERCEPTION & ACTION: Development & aging

Short Form of the California Odor Learning Test

Poster A90, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Conner Frank[1], Jingwen Liu[1], Claire Murphy[1,2]; [1]San Diego State University, [2]University of California San Diego

Olfactory function is impaired in a number of neurodegenerative diseases, notably Alzheimer's disease and Parkinson's disease, thus odor tests may prove to be useful as biomarkers of disease. The California Odor Learning Test is a learning and memory test designed to be analogous to the California Verbal Learning Test. Stimuli for the test are four odors in each of four categories: fruits, spices and herbs, personal products and condiments. Subjects complete 5 learning trials before producing short and long delay, free and cued recall scores, discrimination scores and odor identification scores. To produce a test that can be administered more quickly, we have produced a form with three odors in three categories. We administered the two forms to cognitively normal older adults on two different days, in counterbalanced order. Odor thresholds were administered to determine sensitivity for odor and the MMSE was administered to screen for dementia. We compared the number of items recalled on the learning trials over trials 1-3 in the two forms. Analyses indicated that the number of items recalled in the two forms were highly correlated. A shorter version of the California Odor Learning Test will allow for inclusion in studies and clinical assessment with significant time constraints and may prove beneficial in the application of olfactory tests to detection of neurodegenerative diseases. Supported by NIH grant # AG004085-26 to CM.

Topic Area: PERCEPTION & ACTION: Development & aging

Intentionality modulates the impact of reward and punishment on performance during sequence learning

Poster A91, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Adam Steel[1,2], Chris Baker[1], Charlotte Stagg[2]; [1]Laboratory of Brain and Cognition, National Institute of Mental Health, National Institute of Health, Bethesda, MD 20016, [2]Wellcome Centre for Integrative Neuroimaging, FMRIB Centre, John Radcliffe Hospital, University of Oxford, Oxford, OX3 9DU, United Kingdom

Reward and punishment motivate human performance. For example, during unintentional (non-explicit) serial reaction time task (SRTT) learning, punishment boosts early sequence-learning. However, their effect on intentional learning is unknown. We addressed this question in two experiments using the SRTT augmented with control, reward, or punishment feedback. Participants responded to a stimulus in one of four locations; in a block of trials the stimulus followed a fixed- or random-sequence. The difference in RT in sequence and random blocks indexed sequence-knowledge. Trial-by-trial feedback was given based on the participant's performance. In the first experiment (unintentional learning), 36 participants were equally divided in the three feedback groups; these participants were told not to explicitly learn the sequence. In the second experiment (intentional learning), 36 participants were divided into the three feedback groups and told to explicitly learn the sequence. In both experiments, immediately after training, participants were tested for sequence-knowledge and for awareness. We found that intentionality affected the influence of punishment on sequence-learning. With unintentional learning, punishment boosted early sequence-knowledge, but, with intentional learning, punishment had no effect. Reward did not impact sequence-learning in either experiment and all groups showed equal sequence-knowledge. Finally, intentional learners showed more sequence-awareness than unintentional learners but feedback did not modulate awareness. Together, these results show that intentionality modulates the impact of feedback on early sequence learning: punishment aids unintentional, but not intentional, learning. While the cause remains unclear, this study suggests that feedback's utility depends on the learner's goal.

Topic Area: PERCEPTION & ACTION: Motor control

Effects of sharing goals with others on sense of agency and motor performance

Poster A92, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Kazuki Hayashida[1], Yuki Nishi[1], Michihiro Osumi[1], Shu Morioka[1]; [1]Kio university

Goal sharing (GS) with other people influences motor performance (MP) (Takagi, 2017). We hypothesized a sense of agency (SoA) that has been increased by GS would be related to MP. We created an original intentional binding (IB) task to measure SoA and MP and examine our hypothesis. Thirty healthy same-gender pairs participated in the study. Fifteen pairs were placed into the GS group, and other fifteen pairs were grouped into the no-GS group. Both the GS and no-GS groups were asked to stop an object moving in the horizontal direction on a PC display, using the press of a key at the instant when the object arrived at the center of the screen (18 trials × 10 block). The task score was calculated using data describing the distance between the stopped object and the center of the screen. In the GS group, the total scores for each pair of participants were calculated and displayed on the screen, while only the individual scores were displayed in the no-GS group. A beep was sounded several hundred ms after the object was stopped with the key press. The participants estimated the time interval from the key press to the beep, and this estimated time was taken as a surrogate maker of SoA. We found that SoA and MP had higher values in the GS group than no-GS group ($p < 0.01$), indicating that goal sharing increased SoA and MP. Processes including sharing of goals with others are important for the improvement of MP.

Topic Area: PERCEPTION & ACTION: Motor control

Sense of agency and motor performance are stronger when an individual is capable of motor prediction

Poster A93, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Shu Morioka[1], Kazuki Hayashida[1], Akihiro Masuike[1], Yuki NIshi[1], Michihiro Osumi[1], Satoshi Nobusako[1]; [1]Kio University

Sense of agency (SoA) is a neurological component of consciousness that provides awareness of being the initiator and executor of one's own actions. In this study, we developed a set of intentional binding (IB) tasks to track motor performance and investigate changes in SoA with or without motor prediction. Thirty university students were instructed to stop a circular object moving horizontally across a computer screen by pressing a key when it reached the center of a target circle. The task consisted of a "formula" condition in which the object's speed was six levels and constant, and the movement pattern was governed by an undisclosed rule, and a "random" condition in which the object's speed may not be constant. A "beep" sound was presented several hundred ms after the key press, and participants had to estimate the delay. The distance error (between the object and target centers) was used to approximate the motor performance index (MP); the time error (between the estimated and actual delays) represented the IB value, which is an index of SoA. Each task comprised 10 blocks of 18 trials/block. Afterwards, all participants were asked whether they noticed the rule; 18 (motor prediction group; MPG) answered affirmatively, and 12 negatively (no motor prediction group; NMPG). MP and SoA were significantly increased in the MPG than the NMPG, and SoA in the NMPG gradually declined over time. Our data suggest that the capacity for successful motor prediction is important for improving both motor performance and SoA.

Topic Area: PERCEPTION & ACTION: Motor control

Role of Facial Expression Conflict in Motor Inhibition

Poster A94, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Cheng-I Lam[1], Trung Nguyen[1], Che-Yi Hsu[1], Chi-Hung Juan[1]; [1]Institute of Cognitive Neuroscience, National Central University, No.300, Jhongda Road., Jhongli county, Taoyuan City - 32001, Taiwan

Emotional facial expression discrimination plays an important role in our social interaction and communication. Present study aims to investigate the interaction between conflicting facial expression and motor inhibition with a conditional stop signal task with gripping force. The task introduced a continue Go signal, which requires the same motor response as in a go trial but share similar properties with stop signal. Two experimental conditions were manipulated to elucidate the relationships: 1) Subjects are required to stop or continue with action according to signal which is in specific facial expression (i.e. Facial Expression Discrimination

Condition). 2) The stop signal and continue signals are only in simple feature difference and no facial expression discrimination required (i.e. No Facial Expression Discrimination Condition). Current results found that the reaction time of unsuccessfully inhibiting response is longer in facial expression discrimination condition than condition without discrimination. Interestingly, the result shows pattern of decreasing non-cancelled reaction time along with stop signal delay. Current result suggests that when facial expression conflict is involved, the interference on early controlled stage in unsuccessfully inhibit response process and ongoing response is getting stronger than condition without discrimination involved, and result in later end point of the race. In summary, the result supports the hypothesis that facial expression conflict interacts with motor inhibition. Therefore, we think that this study may provide us with a better picture on how the motor control behavior is modulated within the social related context.

Topic Area: PERCEPTION & ACTION: Motor control

Neuroanatomical differences between monozygotic twins discordant for musical practice

Poster A95, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Örjan de Manzano[1], Fredrik Ullén[1]; [1]Karolinska Institutet

Using primarily neuroimaging techniques and musical expertise as a model, scientists have studied the neural correlates of skill acquisition and built a convincing case for that musical training can cause brain regions to grow and/or become better developed. However, in arguably all previous studies, training differences were confounded with genetic predispositions. This presents an issue because firstly, brain anatomy is highly heritable in many regions. Secondly, we know that different individuals may require different amounts of practice to reach a certain skill level, and that despite similar amounts of practice there can still be individual differences in skill. Genetic factors could influence brain development in a way that affects self-selection, skill acquisition and achievement within a certain domain, including music. In order to resolve this issue, we have studied a sample of monozygotic (genetically identical) twins who differ greatly in musical training. Using neuroimaging, we found that that even when eliminating genetic influences as a causal factor, large differences in musical practice can nonetheless be associated with significant differences in brain structure. The playing twins had increased cortical thickness, white-matter fractional anisotropy and cerebellar volume in regions which jointly constitute the core of the brain's auditory-motor network.

Topic Area: PERCEPTION & ACTION: Multisensory

Where's my foot? The disappearing 'foot' trick in healthy individuals and individuals with Body Integrity Identity Disorder

Poster A96, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Kayla D. Stone[1], Femke Bullock[1], Anouk Keizer[1], Rianne Blom[2], Manja Engel[1], H. Chris Dijkerman[1]; [1]Utrecht University, [2]University of Amsterdam

Body ownership (the feeling that my body belongs to me) can be easily perturbed in healthy individuals by inducing bodily illusions. For example, dis-integrating vision, touch, and proprioception can produce the feeling that your limb is 'lost' or 'relocated', such as in "the disappearing hand trick" (DHT). Following this illusion, participants report that the hand feels as though it is no longer part of the body, that it does not belong to them anymore, and that they do not know its location (Newport and Gilpin, 2011 (Current Biology)). This experience is critically linked to the feeling of body ownership and partly mimics the feelings associated with body ownership disorders. For instance, in body integrity identity disorder (BIID), individuals feel like part of their bodies (usually their legs) do not belong to them or that it should not function, leading to the desire to amputate (amputation-variant) or paralyze (paralysis-variant) that part of the body. Therefore dis-integrating sensory input around the lower body (and thus simulating the desired bodily state) might transiently relieve the feelings associated with BIID. In the current study, we modified the DHT and instead applied it to the feet in a group of healthy controls and in a small sample of individuals with BIID. Results revealed that the illusion can indeed be applied to the feet (measured via a 20-item questionnaire), which was experienced as particularly pleasant for amputation-variant BIID participants as it mimicked the desired state of their bodies/limbs. Inducing bodily illusions might temporarily relieve BIID symptoms.

Topic Area: PERCEPTION & ACTION: Multisensory

Reading and neuropsychological performance: Relationships in patients with mild-to-moderate TBI

Poster A97, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Keith Main[1], Salil Soman[2], Emma Gregory[1], Maxwell Rappoport[3], Micaela Thordarson[3], Jennifer Kong[3], J. Wesson Ashford[3,4], Stephanie Kolakowsky-Hayner[5], Maheen Adamson[1]; [1]Defense and Veterans Brain Injury Center, [2]Harvard Medical School, [3]War Related Illness and Injury Study Center, [4]Stanford School of Medicine, [5]Santa Clara Valley Medical Center

Background: A nontrivial minority of traumatic brain injury (TBI) patients experience post-concussive symptoms. Many find that their reading ability is impaired. To better understand the neurocognitive profile of TBI-related reading deficits, we evaluated reading and neuropsychological performance in a sample of TBI patients and neurologically healthy controls. Methods: Thirty-seven patients with mild-to-moderate TBI were recruited from the Santa Clara Valley Medical Center. Thirty neurologically healthy controls were recruited from the surrounding community. All participants completed the Repeatable Battery for Assessment of Neuropsychological Status (RBANS). Participant reading rates were quantified using the Pepper Visual Skills for Reading Test (VRST), the Test of Word Reading Efficiency (TOWRE), and the International Reading Speed Texts (IReST). Results: We conducted t-tests and correlations on the data using the RBANS and reading test scores. T-tests showed that controls had significantly better scores than TBI patients. Pearson's correlations demonstrated that RBANS performance is correlated with reading rate. We conducted multiple linear regression analyses using the measures of reading rate (VSRT, TOWRE, IReST) as outcome variables and Age, Education, and the RBANS subtests as predictors. We found RBANS contributed variance to the model beyond Age and Education. Analysis of the sub-tests demonstrated the language and attention subtests were significant. Discussion: These results indicate that general cognitive slowing contributes to diminished reading fluency. Future work will attempt to connect these results to diffusion tensor imaging (DTI) data which quantifies the integrity of white matter pathways.

Topic Area: PERCEPTION & ACTION: Other

The effect of writing style on mu rhythm while appreciating Chinese calligraphy

Poster A98, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Shwu-Lih Huang[1], Wei-Li Tu[1], Guang-Yi Lai[1]; [1]National Chengchi University

Empathy or embodied simulation, with the mirror neuron system (MNS) as the underlying mechanism, was proposed to be involved in art appreciation in previous studies. In this research, Chinese calligraphy was used as the material to explore this issue further. Rich information about the gesture of artist can be found in the brushstroke of Chinese calligraphy. It is reasonable to propose that MNS plays an important role in appreciating Chinese calligraphy. Furthermore, appreciating calligraphic words written in a style with higher expressivity (e.g., running hand) should arouse higher activity in MNS compared to other styles with lower expressivity (e.g., regular script). To verify this hypothesis, two styles of hand-written Chinese calligraphy (running hand and regular script) and one style of print-word (boldface) were included as the conditions of independent variable. The dependent variable recorded the power of mu rhythm that reflecting MNS activity while the naïve participants were viewing the presented single-word. As predicted, the results showed that the amplitude of mu suppression was larger for the style of running hand than regular script in time interval of 1200-1600 ms after stimulus onset. The difference was significant in interval 1300-1400 ms for site C3, and 1300-1400 ms and 1500-1600 ms for site C4. This finding indicated that appreciating different styles of Chinese calligraphy activate MNS differently. It also provided another evidence for the involvement of MNS in art appreciation. The actual role of MNS in appreciating Chinese calligraphy is worth exploring in the future.

Topic Area: PERCEPTION & ACTION: Other

Neural correlates of the emergence, stabilization and evaluation of conscious visual percepts

Poster A99, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Marine Vernet[1], Shruti Japee[1], Valentinos Zachariou[1], Sara Ahmed[1], Savannah Lokey[1], Leslie Ungerleider[1]; [1]Section on Neurocircuitry, Laboratory of Brain and Cognition, NIMH/NIH, Bethesda, MD, USA

Awareness is one of the most intriguing functions of the human brain. Nevertheless, which neural mechanisms mediate it remains controversial. In the present fMRI experiment, we aimed to disentangle three models that predict that visual awareness arises from: 1) enhanced activity within the ventral stream (known to mediate object recognition); 2) information reaching the fronto-parietal network (known to mediate visuospatial processes and attention); or 3) the monitoring of one's own attentional state, subserved by other brain areas, such as the superior temporal sulcus (STS) or temporo-parietal junction (TPJ). Visual awareness, defined as the subjective feeling of seeing, was evaluated with a gradual scale, from not seeing anything (rating 1), to seeing something that cannot be categorized (rating 2), to categorizing with low (rating 3) or high certainty (rating 4). Brain regions associated with awareness should display a gradual increase of activity as these ratings increase. Conversely, dichotomous activity (ratings 3&4 > 1&2) should reflect attentional mechanisms of percept stabilization. Finally, increased activity when one is certain (of seeing or not seeing) rather than uncertain (ratings 1&4 > 2&3) should be related to confidence. Gradual activity was found in a subset of fronto-parietal and higher-order visual areas, jointly contributing to the build-up of awareness. Dichotomous activity was found in fronto-parietal and early visual areas, confirming a stabilization mechanism, in which the attentional network modulates activity in early visual cortex. Finally, confidence-related activity was found in STS/TPJ. In conclusion, our study dissociates the closely related mechanisms of awareness, attention, and certainty.

Topic Area: PERCEPTION & ACTION: Vision

Neural correlates of consciousness in the medial temporal lobe: an intracranial EEG study of attentional blink.

Poster A100, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Jim Herring[1,2], Thomas Reber[3], Florian Mormann[3], Heleen Slagter[1,2]; [1]Department of Psychology, University of Amsterdam, The Netherlands, [2]Amsterdam Brain and Cognition, University of Amsterdam, The Netherlands, [3]Department of Epileptology, University of Bonn Medical Center, Bonn, Germany

What determines whether we become aware of a piece of information or not? Conscious access has been robustly associated with activity within a distributed network of cortical regions. Yet, subcortical regions, including the hippocampus, influence cortical activity and their precise contributions to conscious perception remain unclear. Here, using intracranial electrophysiological (iEEG) recordings and an attentional blink (AB) task, we examined the role of several regions in the medial temporal lobe (MTL; the hippocampus, amygdala, parahippocampal gyrus and entorhinal cortex) in conscious perception. Medial temporal lobe activity was recorded while 9 epilepsy patients performed an attentional blink task in which a second target (T2) followed a first target (T1) after 150, 300, 450 or 600ms. Typically, T2 perception is greatly reduced when T2 follows T1 within about 500ms (i.e., the attentional blink). Patients displayed a robust attentional blink, with lower T2 detection rates at short compared to long intervals. In current analyses, we examine AB-related differences in neural processing in the MTL, as reflected in event-related potentials and spectral content, specifically in the theta band. Initial results demonstrate increases in theta activity following perceived versus invisible T2's in the hippocampus. Next analyses will explore early T1-induced changes in activity predicting a failure to perceive T2. Together, these findings will reveal contributions of the MTL to conscious perception with high spatial and temporal precision.

Topic Area: PERCEPTION & ACTION: Vision

Parieto-frontal regions and alpha power involved in postdiction

Poster A101, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Laetitia Grabot[1], Virginie van Wassenhove[1]; [1]CEA, NeuroSpin, Cognitive Neuroimaging Unit

Current hypotheses suggest that perception results from the integration of discretized neural sequences. In postdiction, a stimulus arriving late can retro-actively influence the perception of an earlier stimulus, as in the Rabbit illusion, in which the intermediate flash in a sequence of 3 flashes is spatially mislocalized due to the temporal regularity of the sequence. The possible implication of oscillatory mechanisms in postdiction has been surprisingly unexplored despite the fundamental role of timing in this phenomenon. While computational models have proposed that postdiction arises from top-down expectations, no empirical evidence has yet been provided. Here, we tested this hypothesis by using the Rabbit illusion in a combined MEG-EEG study. The inter-stimulus interval of visual sequences was calibrated so that a given physical sequence yielded ~50% correct and ~50% illusory perceptual outcomes. This design allowed comparing different percepts elicited by the same stimulation. First, we observed that, when the illusion was perceived, parieto-frontal regions were more activated after the last stimulus. This finding validates the notion of posterior representational updating. Second, the analysis of oscillatory activity showed an increase of pre- and post-stimulus alpha power, in visual regions, predicting the illusory perception of the sequence. Increased attention, indexed by a decrease in alpha power, may reduce the sensory uncertainty of the spatial location of the intermediate stimulus. Overall, our results suggest that high-order areas may contribute to the postdictive reconstruction of a visual sequence, consistent with the hypothesis that the Rabbit illusion results from uncertain sensory evidence combined with prior expectations.

Topic Area: PERCEPTION & ACTION: Vision

Psychological dimensions and their neural correlates in response to architectural interiors

Poster A102, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Alex Coburn[1], Oshin Vartanian[2], Marcos Nadal[3], Yoed Kenett[1], Anjan Chatterjee[1]; [1]University of Pennsylvania, [2]University of Toronto, [3]University of Vienna

People today spend most of their lives indoors. Yet little is known about the effects of built environments on psychological and brain function. In this study, we addressed two questions. First, are there principal dimensions of psychological experiences in response to the built environment? Second, do those dimensions correlate with neural activity? In Experiment 1, participants (n=800) rated 200 images of building interiors on semantic differential scales. Using Principal Components Analysis, we identified three components that explained 90% of the variance in ratings: coherence (ease with which one organizes and comprehends a scene), complexity (a scene's informational richness and generated interest), and hominess (extent to which the scene reflects a personal environment). Whereas coherence and complexity are well-established dimensions in assessing natural scenes, hominess emerged as a new dimension in relation to architectural interiors. In Experiment 2, participants (n=18) performed the tasks of beauty judgments and approach-avoidance decisions when viewing the same images in the fMRI scanner. Parametric analyses demonstrated that, regardless of the task, hominess and complexity scores were correlated with greater neural activity in the left cuneus and the right lingual gyrus, respectively. In contrast, coherence scores were correlated with greater neural activity in the right precuneus and the left inferior occipital gyrus only when participants were judging beauty. Our results suggest that architectural encounters are explained by dimensions of coherence, complexity, and hominess. Neural responses in visual cortices to complexity and hominess are insensitive to context, whereas responses to coherence are evoked when people judge beauty specifically.

Topic Area: PERCEPTION & ACTION: Vision

To trust, or not to trust? Individual differences in psychophysiological reactivity predict trust under acute stress

Poster A103, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Stephanie Potts[1,2], William T. McCuddy[1], Devi Jayan[1], Anthony J. Porcelli[1,3]; [1]Marquette University, [2]Veterans Administration, St. Louis Health Care System, [3]Clinical & Translational Science Institute of Southeast Wisconsin

The acute stress response represents an evolutionarily ancient array of biological responses to challenge or threat that facilitate survival by promoting adaptive behaviors. 'Adaptive' in the evolutionary sense, however, does not easily translate to explain stress' effect on human decisions. Much research demonstrates that acute stress alters decision-making, yet outcomes are influenced by a wide range of methodological, contextual, and biological factors. Further, little is known about how it affects decision-making in social contexts in which people so often act. This is of great importance in today's increasingly complex social environment, replete with potential stressors, where cooperation and trust are critical. Here the aim was to explore acute stress' effect on social decision-making, while accounting for factors that may contribute to varied decision outcomes. Ninety-six participants were exposed to either a non-social or social stressor, or control procedure, after which they performed a social decision-making task requiring cooperation and trust with a 'partner'. Task performance occurred at different times with respect to exposure to examine the roles of temporally distinct biological stress pathways, as well as variation in psychophysiological stress reactivity. Overall acute stress exposure was associated with reduced trust, but a more complex pattern emerged when accounting for individual differences. In keeping with the complexity of the stress response itself, acute stress can enhance or reduce propensity to trust based on an individual's unique pattern of psychophysiological reactivity to exposure.

Topic Area: THINKING: Decision making

Anterior insula-nucleus accumbens connectivity in PTSD: clinical and decision-making correlates

Poster A104, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Elizabeth Olson[1,2], Gwenievere Birster[1], Scott Rauch[1,2], Isabelle Rosso[1,2]; [1]McLean Hospital, [2]Harvard Medical School

Introduction: Hyper-responsivity of fear- and extinction-related regions including the anterior insula (AI) in PTSD is well-documented. Dysregulation in reward-related circuitry in PTSD has received increasing attention, including reduced activity in the nucleus accumbens (NAcc). Recently, a white matter pathway connecting the right AI to the right NAcc was identified in the human brain; this pathway likely involves inhibitory control of the right AI over NAcc activity. We hypothesized that increased right AI-NAcc coherence would be associated with greater symptom severity in PTSD. Methods: 20 participants (13 female) with current DSM-IV PTSD were included. Probabilistic tractography was performed using FSL's bedpostx and probtrackx, from a seed in the right NAcc to the right AI. Tracts were masked and used to extract fractional anisotropy (FA) values. Age and gender were included as nuisance covariates. Results: Higher FA was associated with higher lifetime PTSD severity (CAPS scores, partial $r(16) = 0.542$, $p = 0.020$), driven by significant associations with avoidance and re-experiencing (but not hyperarousal) symptom clusters. In 11 participants who also had delay discounting data, higher FA was associated with steeper delay discounting, $r(9) = -0.635$, $p = 0.036$, but not with anhedonia, $r(16) = 0.084$. Conclusion: Increased FA between the right AI and right NAcc was associated with greater lifetime symptom severity. While hyperactivity in the AI and hypoactivity in the NAcc have been previously demonstrated, this finding suggests that altered white matter microstructure in the pathway connecting these regions may also be relevant to PTSD severity.

Topic Area: THINKING: Decision making

Information integration and endogenous control during exploration and exploitation

Poster A105, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Nathan Tardiff[1], Sharon L Thompson-Schill[1]; [1]University of Pennsylvania

Learning and decision-making in dynamic environments involve a fundamental challenge—whether to continue pursuing the current behavioral policy (exploitation), or to abandon it in favor of alternative and potentially more beneficial courses of action (exploration). In order to inform the decision to change control state between exploitation and exploration, learners must identify, track, and integrate relevant environmental variables, such as reward outcomes. Notably, both unexpected environmental changes and decisions to explore are associated with changes in arousal, which is thought to partly reflect activity of the locus coeruleus-norepinephrine system (LC-NE). This suggests that brain regions involved in changing control state may be ones that integrate information about decision-relevant environmental variables with information about the current control and arousal state. Here we sought to identify such integrative regions. Subjects underwent concurrent fMRI and pupillometry—an indirect measure of LC-NE activity—while completing a bandit task. As expected, pupil diameter increased following both changes in outcome value and decisions to explore. We then used an fMRI conjunction analysis to identify brain regions that showed greater activation to exploration than exploitation, greater activation to changes in outcome value than no change, and also were modulated by continuous pupil diameter. This analysis implicated several regions in joint or interdigitated coding of all three variables, including cingulate and paracingulate cortices, anterior insula, inferior frontal junction, and intraparietal sulcus, as well as some visual areas. These results shed light on regions involved in endogenously motivated (as opposed to cued) changes in control state in dynamic environments.

Topic Area: THINKING: Decision making

Dissecting the neural correlates of ambidextrous decision making

Poster A106, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Ting-Ting Chang[1], Carol Yeh-Yun Lin[1], Nai-Shing Yen[1], Danchi Tan[1], Ying-Ching Chen[1]; [1]National Chengchi University

Ambidextrous managers are good at switching between exploration and exploitation to achieve a balance for maximizing performance. Previous studies have shown that the two managing styles involve distinct decision making behavior. However, very limited is known about how the two styles differ in their brain responses, and how personality affects ambidexterity. Here we tackle this issue by conducting an fMRI study on thirty-nine adults while they played ‘four-armed bandit’ task. General linear model was conducted to model brain activation associated with exploitation and explorations, with the former was defined by participants choosing the bandit with the highest score of the four, whereas the latter referred to the rest of the options. We found that relative to exploration, exploitation behavior engaged strong activations in the striatum, inferior frontal gyrus and superior frontal gyrus in the prefrontal cortex as well as left middle temporal lobe in the temporal cortex. Exploration, in contrast, activated widespread fronto-parietal circuits, including insula, dorsal anterior cingulate cortex, middle frontal gyrus, and posterior parietal cortex. Interestingly, participants’ optimistic score was associated with reduced functional connectivity between prefrontal and parietal circuits during exploration trials. These results have suggested exploitation style require engagement of the neural circuits associating with self-reward system whereas exploration is involved in higher-level of cognitive control brain network. Moreover, these circuits were highly affected by optimistic personality. Our results have provided novel insights not only in uncovering the neural correlates of decision making but also into understanding of managing style in the organization.

Topic Area: THINKING: Decision making

Effects of video games on reward-processing; an fMRI study

Poster A107, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

David Raymond[1], Kelsey Prena[1], Josh Brown[1], Sharlene D. Newman[1]; [1]Indiana University Bloomington

There is some suggestion that heavy video game playing has a similar impact on the reward network and risk-taking behaviors as drug addiction (Gleich et al., 2017). The current study investigated the functional and behavioral performance of avid video gamers on a gambling task and contrasted those results with those of individuals who play little to no video games. This study used task-based functional magnetic resonance imaging with the Balloon Analogue Risk Task (BART). Participants were right-handed males (mean age=21.75). The fMRI data show that unlike in drug addiction, gamers have increased activation compared to controls in the anterior cingulate cortex (ACC) and in the ventral striatum, regions associated with risk-taking and reward processing. Increases in ventral striatum activation have been associated with learning how to manipulate behavior within video games (Erickson et al., 2010). This increase of activation in the reward network in gamers has been linked to players anticipating that their behavior will lead to reward. These findings suggest that neurological changes caused by gaming enable greater striatal response in anticipation of reward. Erikson, K. I., Boot, W. R., Basak, C., Neider, M. B., Prakash, R. S., Voss, M. W., …Kramer, A. F. (2010). Striatal volume predicts level of video game skill acquisition. Cerebral Cortex, 20, 2522-2530. doi:10.1093/cercor/bhp293 Gleich, T., Lorenz, R. C., Gallinat, J., & Kühn, S. (2017). Functional changes in the reward circuit in response to gaming-related cues after training with a commercial video game. NeuroImage, 152, 467-475. doi:10.1016/j.neuroimage.2017.03.032

Topic Area: THINKING: Decision making

Age-related differences in frontoparietal activity underlying creativity for convergent and divergent thinking

Poster A108, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Helena H. Lee[1], Ko-Jou Liu[1], Ya-Wen Fang[1,2], De-Jung Tseng[1], Ching-Po Lin[3], Ovid J.L. Tzeng[1,2,4,5,6], Hsu-Wen Huang[2,6], Chih-Mao Huang[1,2]; [1]National Chiao Tung University, [2]Academia Sinica, [3]National Yang Ming University, [4]Taipei Medical University, [5]National Taiwan Normal University, [6]City University of Hong Kong

Creativity represents the mental ability to require one single solution to a problem with insight experience (i.e., convergent thinking) or relate to generating unusual ideas or novel solutions to problems (i.e., divergent thinking). Creative ability involves convergent and divergent thinking appears to be associated with frontal and parieto-temporal regions in which show significant brain atrophy across the lifespan. We conducted an event-related fMRI study to investigate age-related differences in neural activity. Twenty-two young adults and 30 healthy older participants were instructed to perform two fMRI tasks during scanning: the Chinese-word remote associates test (CAT) to represent the processes of convergent thinking and the modified version of the alternative uses task (AUT) to measure the processes of divergent thinking. A whole brain analysis revealed that older adults exhibited greater and more distributed activation in superior parietal cortex and parahippocampal region compared to young adults during both convergent and divergent thinking, indicating the neural efforts for retrieval semantic knowledge. Moreover, older adults showed additional activation in bilateral inferior frontal region for convergent thinking and greater activation in superior occipital gyrus/precuneus during divergent thinking, suggesting the controlled retrieval of semantic knowledge and the process of mental imagery relevant to creative thinking, respectively. These findings demonstrate age-related differences in neurocognitive strategies during convergent and divergent thinking and provide evidence for an adaptive view of the human brain that functionally reorganizes and responds to neural aging.

Topic Area: THINKING: Development & aging

The role of sleep in memory and problem solving

Poster A109, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Kristin Grunewald[1], Ken A. Paller[1], Mark Beeman[1]; [1]Northwestern University

Numerous anecdotes and a few studies suggest a link between sleep and problem solving, showing improved puzzle solving or increased use of a hidden rule after sleep compared to an equal period awake. Capitalizing on similarities with memory processes, we applied the targeted memory reactivation technique to problem solving. During 2 evening sessions, participants attempted to solve puzzles while listening to unique sound cues arbitrarily paired with each puzzle. Each night, we presented half the sound cues during slow-wave sleep. In the morning, participants re-attempted previously unsolved puzzles, and solved reliably more of the puzzles cued during sleep, compared to uncued puzzles. In addition, the degree to which cueing increased participants' recall of puzzles correlated with increased solving of cued puzzles, but not with uncued puzzles. This suggests that sleep facilitates solving through the same mechanisms by which it facilitates memory. Furthermore, despite all the puzzles being classic insight puzzles, cue-enhanced solving was more often reported to come via analysis than via insight; and analytic- but not insight-solving was correlated with the memory cueing effect. This suggests that not only memory strengthening, but memory reorganization, occurs during sleep and is linked to improved problem solving. We further investigated this by examining puzzles that induced fixation (misdirection) versus those that did not. If memory reactivation during sleep enhances all puzzle memory, puzzles with fixation should be harder to solve; if reactivation helps reorganize memories, then puzzles with fixation should particularly benefit from cueing.

Topic Area: THINKING: Problem solving

Chain Free Association, Creativity, and the Default Mode Network

Poster A110, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Tali R. Marron[1], Yulia Lerner[2,3], Ety Berant[1], Sivan Kinreich[2], Irit Shapira-Lichter[2], Talma Hendler[2,3], Miriam Faust[1]; [1]Bar-Ilan University, [2]Tel Aviv Sourasky Medical Center, [3]Tel Aviv University

Research on creativity shows that creative thinking entails both executive (controlled) and associative (spontaneous) processes. Yet standard creativity tasks cannot reliably isolate these two types of cognitive processes, making it difficult to understand the relation between the two and the roles of their corresponding brain networks in creative cognition. In this study we attempted to establish chain free association (FA; verbalization of a "chain" of single-word associations, each association relating to the previous one) as a relevant method for directly investigating spontaneous associative thinking and its role in creative cognition. Participants completed common creativity tasks and then underwent functional magnetic resonance imaging (fMRI) scanning while producing FA chains. Instructions to participants that emphasized the spontaneous nature of the task, coupled with proper control conditions (balanced for difficulty), enabled us to uncover spontaneous (as opposed to controlled) processes. Behavioral measures from FA chains (flexibility, fluency, and semantic remoteness) were correlated with scores on creativity tasks and brain activity. We found that: (1) chain FA elicited spontaneous thinking, as reflected in Default Mode Network (DMN) activation, and activity in the left inferior frontal gyrus (IFG), superior frontal gyrus (SFG), middle frontal gyrus (MFG); (2) behavioral measures from FA chains were related to different creative abilities; (3) higher scores on different behavioral measures from FA chains were related to higher activation of the DMN, and reduced activation of the left IFG. These findings suggest that chain FA measures spontaneous associative abilities that are relevant for creative ideation and related to reduced cognitive control.

Topic Area: THINKING: Problem solving

Brain processes supporting the generation of new and original ideas

Poster A111, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Mathias Benedek[1], Emanuel Jauk[1], Roger Beaty[2]; [1]University of Graz, [2]Harvard University

One particularly remarkable capacity of our brain is the ability to create new mental representations that clearly go beyond what has been previously stored in memory. This imaginative capacity is considered central to creative thinking. A close inspection of creative idea generation performance shows, however, that it typically involves both newly generated ideas as well as original ideas that were actually retrieved from memory. Two fMRI studies capitalized on this observation by contrasting the brain activation between new and old ideas in the alternate uses task. The first study showed that the generation of new ideas is associated with increased activation in the left supramarginal gyrus. A second study extended this design by further distinguishing between the recall of original and common object uses. This study replicated the relevance of the supramarginal gyrus for the generation of new ideas. Moreover, the generation of new uses and the recall of original uses showed a similar activation pattern including activation of bilateral parahippocampal and medial prefrontal cortex regions, suggesting that the construction of new ideas builds on similar processes as the reconstruction of original ideas from episodic memory. Together, these findings shed further light on the crucial role of memory in creative cognition.

Topic Area: LONG-TERM MEMORY: Semantic

The Effect of Degree of Handedness and Gender Differences on White Matter

Poster A112, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Jordan Begay[1], Hu Cheng Ph. D.[1], Sharlene Newman Ph.D.[1]; [1]Indiana University of Bloomington

Gender differences in the size of the corpus callosum have been reported since the early 1980's (DeLacoste-Utamsing & Holloway, 1982; Driesen & Raz, 1995). In addition to examining the area or volume of the corpus callosum, Menzler et al., (2011) have recently used diffusion tensor imaging (DTI) to examine microstructural differences in the corpus callosum in male and female participants. They found that males had higher fractional anisotropy (FA) than females suggesting that differences in myelination account for the gender differences previously observed. However, these gender effects are not always observed with some researchers suggesting that the observed differences are due to brain size differences (Luders, Toga, & Thompson, 2014; Luders et al., 2006; Bishop & Wahlsten, 1997). In order to further explore sex differences in white matter 146 participants from the Human Connectome Project were examined (females: N=74, age=29.89±3.41; males: N=72, age=27.82±3.66). There was an equal number of left- and right-handed individuals with the handedness inventory scores for the right-handed group being 55.34± 28.33 and for the left-handed group being -58.46±30.46. Unlike in previous studies the females showed higher FA in a number of tracts including the corpus callosum and the corticospinal tract. No tracts showed increased FA for males compared to females. Further analyses are planned to investigate potential causes of these sex differences including how cognitive ability may impact these differences (Newman, 2015).

Topic Area: NEUROANATOMY

Auditory scene analysis in adolescents with and without language disorders: Neural indicators of maturation and auditory memory

Poster A113, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Elyse Sussman[1]; [1]Albert Einstein College of Medicine

Developmental language disorders, defined by an inability to use language with the same facility as age-matched peers in the absence of a clearly defined pathology, affect at least 7% of school-aged children in the United States. While intensive research has failed to identify specific etiologies of language disorders, it has spawned diverse hypotheses regarding the underlying causal factors. Impairments have been attributed to low-level deficits of auditory processing mechanisms, to linguistic-specific processes, and to attention deficits. We tested effects of bottom-up processing in adolescent children with language processing deficits compared to age-matched children with typical language. The goal was to evaluate neural indices of sound discrimination and memory in complex listening environments. We assessed auditory discrimination using simple tones presented in an auditory oddball paradigm and presented within a background of competing sounds. Event-related brain potentials (ERPs) elicited by the oddball sounds were measured and compared across groups. We found distinct differences in maturational features of the auditory evoked potentials in the language impaired group along with poorer memory for sound discrimination. These results indicate some processing deficits in children with language impairments, not explained by attentional factors.

Topic Area: ATTENTION: Auditory

Interactions between Age and Sex in Rhythmic Attention Networks

Poster A114, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Alex Wiesman[1], Tony W Wilson[1]; [1]University of Nebraska Medical Center

The capacity to dynamically allocate neural resources towards salient features in the visual space is integral to normative cognitive function, and has been found to be supported by a wide range of rhythmic neural networks. Further, visual attention function has been found to decline moderately with age and differ by sex, but the effects of these key demographic variables on the oscillatory dynamics supporting visual attention are not understood. In this study, we investigated the relationships between age, sex, and spectrally-specific visuospatial attention networks using spatially-resolved magnetoencephalography (MEG) in a large sample of healthy adults (N = 77; age range = 22-72 years). All MEG data were transformed into the time-frequency domain, imaged using a beamformer approach, and examined using whole-brain statistical methods. Our results showed that reaction time, frontal theta oscillations, beta activity in motor cortices, and temporo-parietal gamma oscillations were strongly correlated with age. Intriguingly, many of these responses also exhibited differential aging effects according to sex, indicating an interaction between these variables. In other words, our data support the notion that the neural coding of visuospatial attention function evolves across the lifespan, and that this evolution differs substantially according to biological sex. Quantifying the impact of basic demographic factors, such as age and biological sex, on the oscillatory components supporting visual attention is integral to achieving a more complete understanding of the diverse, dynamic patterns of population-level neural activity that supports attention function in the human brain.

Topic Area: ATTENTION: Development & aging

Seen and heard emotions of a crowd alter perception and state affect

Poster A115, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Sarah C. Izen[1], Xenia Leviyah[1], Vivian M. Ciaramitaro; [1]University of Massachusetts Boston

Being able to correctly interpret the emotional state of others is crucial for social interaction. In our daily lives, we are constantly exposed to emotional information conveyed by multiple sources, such as faces and voices, which must be successfully integrated. We used an adaptation paradigm to examine how hearing emotional crowd sounds (positive or negative) concurrent with a crowd of happy faces would bias judgements of facial emotion and state affect or mood. For each participant, we determined the face judged emotionally neutral before adaptation and quantified how judgments of this neutral face changed after adaptation. We predicted emotional sounds would change judgments of emotional faces and mood most when the valence of seen and heard emotions matched (congruent) than when it did not match (incongruent). We found no significant difference in perceptual biases between congruent and incongruent emotions. To confirm that our stimuli were emotionally salient we quantified changes in state affect, or mood, following the same emotional exposure (congruent, incongruent, as well as visual alone) under different attentional states: attention directed to the emotion of the faces or directed away to face gender. State affect was assessed before and after adaptation via the Positive and Negative Affect Schedule (PANAS). We found significant differences in mood post-adaptation for congruent compared to incongruent conditions only when attention was directed to the emotion, but not to the gender, of the faces. Our results suggest that emotional processing is not purely automatic and can be altered by attention.

Topic Area: ATTENTION: Multisensory

Investigating the relation between cognitive performance and brain activity associated with concentration in patients with a brain tumor

Poster A116, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Miek de Dreu[1], Irena Schouwenaars[1], Geert-Jan Rutten[1], Nick Ramsey[2], Martijn Jansma[1]; [1]Clinical Imaging Tilburg, Department of Neurosurgery, Elisabeth-TweeStedenHospital, Tilburg, The Netherlands, [2]Brain Center RudolfMagnus, Department of Neurology and Neurosurgery, UMC Utrecht, Utrecht, The Netherlands

Aim: To gain knowledge about the association between cognitive performance and neurophysiological correlates of concentration in brain tumor patients. Background: Brain tumor patients often show reduced cognitive performance and report concentration problems. We study if these complaints can be associated with abnormal activation in important brain networks using an fMRI task specifically designed to measure activation associated with concentration. Method: 32 brain tumor patients performed a cued visual attention task. Patients were asked to indicate the direction of the majority of nine arrows in a three by three layout. Each trial started with a cue indicating the presentation of a stimulus. A GLM-regression analysis was performed with a regressor for trials containing the activation related to the cue. 17 patients performed similar to previously studied healthy controls (HIGH; 86 % correct ± 10 (SD) in 1223 ms ± 141). 25 patients showed lower performance (LOW; 79 % correct ± 17 in 1584 ms ± 263). We tested for differences in the central executive network ('CEN'), the default mode network ('DMN'), and the visual network ('VN') using an independent-sample T test. Results: We found no significant differences in activation between HIGH and LOW (CEN: $p = 0.94$, DMN: $p = 0.95$, VN: $p = 0.50$). Conclusion: The height of activation related to concentration is not associated with the performance of the task. This study indicates that patients only have problems with the execution of the task, not with concentration. Alternatively, the concentration problems were too mild to sufficiently influence task performance.

Topic Area: ATTENTION: Nonspatial

Systematic non-stationarity of alpha rhythms in the human brain: Long term frequency sliding and power changes

Poster A117, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Christian Keitel[1], Christopher SY Benwell[1], Joachim Gross[1], Gregor Thut[1]; [1]University of Glasgow

An implicit assumption underlying current theories and the analysis techniques employed by many electro- & magnetoencephalographic (EEG/MEG) studies investigating neural oscillations is that, in the absence of experimental manipulation, the properties of a neural 'oscillator' measurable at the scalp remain approximately stationary over time. Here, across several EEG and MEG experiments, we show that these assumptions are false for one of the most prominent frequency bands, the alpha-band. Specifically, alpha power increases and instantaneous frequency decreases systematically over the course of a typical experimental session (~1-2 hours). Our results suggest the existence of two non-stationary endogenous processes inherent in alpha-band activity. Source-space analyses revealed that these processes may occur in partially overlapping cortical networks with a common right-lateralized focus along the ventral visual processing stream. As well as providing novel insight into the intrinsic properties of widespread neural networks, the findings are of fundamental importance for the analysis and interpretation of studies aimed at both identifying functionally relevant oscillatory networks, and also driving these networks through external entrainment.

Topic Area: ATTENTION: Other

Impaired sustained attention ability is associated with metabolic syndrome

Poster A118, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Thomas Wooten[1,2], Michael Esterman[2,3], Joe DeGutis[1,2], Victoria Poole[1,2], Elizabeth Leritz[1,2]; [1]Harvard Medical School, [2]VA Boston Healthcare System, [3]Boston University School of Medicine

Metabolic syndrome has been associated with subtle and diffuse neural compromise, but has not been consistently correlated with cognitive dysfunction. Sustained attention is a fundamental cognitive operation that relies on multiple brain networks and is sensitive to a broad array of psychiatric/neurologic dysfunction. We hypothesized that sustained attention would correlate with vascular risk, more so than executive function neuropsychological measures. We assessed metabolic function in 56 older adults based on standard guidelines. Participants also performed the gradual onset continuous performance task (gradCPT) to measure sustained attention. During the gradCPT, participants are instructed to respond via button press to each of the city images (90%) and to withhold response to rare mountains (10%) as the scenes gradually transition from one to the next. We focused our analyses on two measures of sustained attention ability: d', the ability to discriminate between targets (i.e., mountain scenes) and non-targets (i.e., city scenes), and reaction time variability (CV). Participants with no metabolic risk factors had more accurate performance and were less variable in their reaction time compared to participants who met criteria for metabolic syndrome (three or more risk factors). Furthermore, there was a linear correlation between number of risk factors and sustained attention ability. In contrast, no effect of metabolic syndrome was detected on standard neuropsychological tests. Our results demonstrate that the gradCPT is a sensitive diagnostic tool for assessing attention-related deficits in metabolic syndrome. This work also substantiates previous findings regarding metabolic syndrome's subtle negative effect on cognitive functioning.

Topic Area: ATTENTION: Other

Visual Field Representations in Human Cerebellum

Poster A119, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

James A. Brissenden[1], Sean M. Tobyne[1], David E. Osher[2], Emily J. Levin[3], Mark A. Halko[4], David C. Somers[1]; [1]Boston University, [2]Ohio State University, [3]Brown University, [4]Harvard Medical School and Beth Israel Deaconess Medical Center

Maps of the visual field have been identified throughout the cerebral cortex. Visual field maps located in higher-order association areas such as the intraparietal sulcus and frontal eye fields are of particular interest as maps in these regions may serve as a critical substrate for spatial cognition. Recently, we showed that cerebellar lobules VIIb/VIIIa, which exhibit intrinsic connectivity with cortical attention areas, are recruited in a load-dependent fashion by visual attention and visual working memory tasks (Brissenden et al., JNeurosci., 2016). While somatotopic maps in the cerebellum are well characterized, cerebellar visual field maps have not been reported. To investigate whether visual field representations exist in cerebellum we conducted two fMRI experiments. In the first experiment, subjects performed an attentionally demanding visual field mapping task. A population receptive field (pRF) analysis found representations of the ipsilateral visual hemifield within lobules VIIb/VIIIa, consistent with the crossing of cortico-cerebellar fiber tracts. In the second experiment, subjects performed a lateralized visual working memory task. Stimuli were presented bilaterally and subjects were asked to covertly attend items in one visual hemifield. To determine whether the cerebellum is sensitive to the locus of attention, we trained support vector machines on cerebellar activity patterns to discriminate between the two possible locations of attentional deployment (left or right hemifield). A multivariate feature weight mapping analysis revealed clusters of informative voxels within lobule VIIb bilaterally. These results demonstrate the existence of visual field representations in human cerebellum and indicate that cerebellar lobules VIIb/VIIIa participate in visuospatial cognition.

Topic Area: ATTENTION: Spatial

Separate Components of Attentional Bias to Reward Relate to Individual Differences in Impulsivity

Poster A120, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Kristin Meyer[1], Nelly Topa[1], Cheyenne Bricken[1], Margaret Sheridan[1], Joe Hopfinger[1]; [1]University of North Carolina at Chapel Hill

A growing body of research shows that reward-related distractors disrupt attentional control. Impulsivity, a construct linked with a broad range of psychopathology, is related to both heightened reward response and reduced cognitive control. However, findings regarding the relationship between attentional bias to reward and impulsivity have been mixed. This may be because most attentional bias paradigms do not parse apart key components of spatial attention: capture and disengagement. To address this gap, healthy adults completed a two phase attention task and the Barratt Impulsivity Scale (BIS-11). First, a colored circle stimulus was associated with monetary reward. Second, attentional bias to reward was assessed using a modified Posner cuing paradigm in which the non-predictive cues were either previously rewarded, previously trained-unrewarded, or neutral stimuli. Participants were significantly faster to respond to a target following a previously rewarded cue, demonstrating facilitated attentional capture to rewarding stimuli. Additionally, participants were significantly slower to disengage from a previously rewarded stimulus, as demonstrated by slowed reaction time when the target appeared in a location opposite the previously rewarded cue. These results are not due to training alone, as the trained-unrewarded stimuli showed no effect. Furthermore, these effects were strongly correlated with impulsivity as measured by the BIS-11. Whereas capture by reward history is more closely linked with motor and attention impulsivity, disengagement from previously rewarded stimuli predicts non-planning impulsivity. This study provides new evidence that the degree to which attention is captured and subsequently held by rewarding stimuli is linked with distinct components of impulsivity.

Topic Area: ATTENTION: Spatial

Socioeconomic status moderates age-related differences in brain anatomy and functional network organization across the adult lifespan

Poster A121, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Micaela Chan[1], Jinkyung Na[2], Phillip Agres[1], Neil Savalia[1], Denise Park[1,3], Gagan Wig[1,3]; [1]University of Texas at Dallas, [2]Sogang University, [3]University of Texas Southwestern Medical Center

An individual's environmental surroundings interact with the development and maturation of their brain structure and function. An important feature of an individual's environment is his or her socioeconomic status (SES), which estimates material resources and social prestige. Previous characterizations of the relation between SES and the brain have primarily focused on the earliest or latest epochs of an individual's lifespan (e.g., during childhood or older age). We broaden this work to examine how SES impacts brain anatomy and function across the adult lifespan, including individuals from the often-ignored middle-age range (20-89y; N=323). SES, as defined by education and occupation prestige, moderated age-related differences in whole brain structure and functional network organization defined at rest. Controlling for gender, race, physical health (e.g., smoking, alcohol usage, hypertension), depression and well-being, participants with lower SES exhibited reduced cortical gray matter thickness and lower resting-state system segregation (a measure of effective functional network organization) compared to higher SES participants in middle adulthood (35-64y). Interestingly, SES-related brain differences were minimal in younger and older adulthood, the latter of which may be due to selection effects. The SES-related brain observations were absent when participants were stratified using measures of their parental-SES. These findings provide evidence that SES relates to brain anatomy and function beyond the earliest years of life, and that higher SES may serve as a protective factor against early development of age-related brain decline.

Topic Area: EMOTION & SOCIAL: Development & aging

Age-related Differences in Selective Attention to Emotional Material: Does Task Relevance Matter?

Poster A122, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Didem Pehlivanoglu[1], Paul Verhaeghen[1]; [1]Georgia Institute of Technology

We investigated the effect of aging on ERP correlates of inhibition functioning by employing a selective attention task which required younger and older adults to selectively attend to either pictures of difference valence categories (positive, negative, and neutral) or line bars, concurrently presented on the screen. In the picture task, subjects decided whether the picture was presented in black and white; in the bar task, they indicated whether the orientation of the bars matched or not. To ensure that the bar task was equally cognitively demanding for all participants, the difficulty of the bar task was calibrated individually prior to the experiment. In the picture task, there was no evidence of emotional processing in the behavioral data but ERPs provided evidence of an emotion salience effect in both age groups, especially during later time window. More importantly, this effect was more pronounced for positively valenced stimuli in the old relative to the young, suggesting a shift toward processing positive material with age. In the bar task, for both age groups, neither accuracy nor magnitude of ERPs during early and later processing stages differed as a function of distractor picture valence, suggesting efficient inhibition of task irrelevant pictures in the bar task across age.

Topic Area: EMOTION & SOCIAL: Development & aging

Upregulating Empathy: An EEG Study in Undergraduates with Psychopathic Traits

Poster A123, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Danielle diFilipo[1,2], Alexandra Bueno[2], Lissete Gimenez-Arce[2], Kayla Talbot[2], Taylor Valentin[2], Denice Vidals[2], Jill Grose-Fifer[1,2]; [1]The Graduate Center - CUNY, [2]John Jay College of Criminal Justice - CUNY

Psychopathy is characterized by shallow emotion and a lack of empathy. We sought to determine whether deficiencies in the mirror neuron system are related to the empathy deficits found in psychopathy. We measured psychopathic traits using the Psychopathy Personality Inventory—Revised (PPI-R). In the first of two tasks, participants passively viewed happy, fearful, and sad faces from the NimStim set of emotional faces while completing a simple attention task. In the second task, participants were instructed to upregulate their emotional response to the same pictures. EEGs were recorded using 64 scalp electrodes in both tasks. We measured mu rhythm suppression, a marker of mirror neuron activity; the N170; and the LPP. All participants showed significantly increased mu suppression from the first to the second task. There was no relationship between psychopathic traits and mu suppression in either task. Participants with low and medium PPI-R Coldheartedness scores showed significantly more negative N170 amplitudes in the second task versus the first task, but those with high scores did not. Additionally, only participants with low Coldheartedness scores had significantly larger LPP amplitudes (400-600 ms) in the second task compared to first task for happy faces. These results suggest that people with higher levels of Coldheartedness have deficits in regulating their attention to emotionally salient information, even when explicitly instructed to do so. Yet, it appears that mirror neuron function is intact among those with psychopathic traits, at least in a non-forensic sample.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Orbitofrontal cortex integrates amygdala-hippocampal information and guides schema-based emotional categorization

Poster A124, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Jie Zheng[1], Jack J. Lin[1,2]; [1]University of California, Irvine, [2]Comprehensive Epilepsy Program, Irvine, CA

Repeated emotional experiences provide a cognitive map or mental “schema” to facilitate acquisition of new emotional information, shape individuals’ personalities, and guide interpersonal communications. The orbitofrontal cortex (OFC), hippocampus (HPC), and amygdala (AMY) are critical for schema formation, decision-making and emotional processing. However, despite anatomical links among these structures, the network oscillatory dynamics that support schema-based emotional processing in humans are unclear. We recorded intracranial electroencephalography from 7 pre-surgical epilepsy patients implanted with depth electrodes to characterize the OFC-HPC-AMY dynamics. During the task, participants were instructed to either categorize the face with the appropriate linguistic label of the emotion (e.g. sad, happy, afraid), which will elicit participants’ prior emotional knowledge (schema condition) or match the face with the one having the same emotional expression (non-schema condition). We observed faster reaction time (t-test, $P = 0.013$) and stronger low frequency synchrony (permutation test, $P < 0.01$) within the tripartite network for the schema compared to the non-schema condition. Moreover, the dimensionality of the network was reduced for the schema condition, with the OFC served as the hub modulating HPC and AMY high frequency activities at distinct theta phases for different emotional categories. For one patient with bilateral OFC lesions, impaired behavioral performance was observed only in the schema condition, with no dimensional reduction in the medial temporal lobe network. These findings provide causal evidence that the OFC serves to integrate new emotional information into existing schema by reducing the dimensionality of the space humans have to search to learn new information.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Genetic Contributions to Implicit Racial Bias: Does Race Matter?

Poster A125, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Brianna Pankey[1], Bethany C. Reeb-Sutherland[1], Melanie Stollstorff[1]; [1]Florida International University

Implicit racial bias (IRB) is the processing of racial stereotypes or attitudes at unconscious levels of awareness. Previous research suggests that individual differences in the serotonin transporter gene (5-HTTLPR), a gene involved in fear processing and emotional reactivity, are associated with IRB. Specifically, individuals with an S-allele (SS/SL), related to less efficient reuptake of serotonin, displayed higher IRB levels compared to those homozygous for the L-allele (LL). Given that measures of IRB are affected by an individual’s race/ethnicity, it is surprising no study to date has explored the moderating role of participant race/ethnicity on the relation between 5-HTTLPR and IRB. The current study examined whether race/ethnicity moderates the association between 5-HTTLPR and IRB in a diverse sample of 381 adult participants (49 African American, 80 White, and 252 Hispanic/Latino). Participants’ IRB was measured via the racial implicit association test (IAT) and 5-HTTLPR genotype status (SS/SL vs. LL) was measured via saliva samples. A significant interaction effect between 5-HTTLPR status and race/ethnicity was found. The SS/SL group displayed significantly greater IAT scores than the LL group in both Black and Hispanic/Latino participants. No significant difference in IAT scores were found among Whites. Results for the current study suggest that genetic risk and associated underlying neural mechanisms (i.e., amygdala) plays a significant role in implicit racial biases and that these effects are significantly impacted by an individual’s own race/ethnicity. The results from this study identifies a potential explanation for implicit race biases through intersectionality across multiple systems and dimensions in the individual.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Accessing General World Knowledge in Language Comprehension: The Case of Emotion

Poster A126, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Dorothee J. Chwilla[1]; [1]Donders Institute for Brain, Cognition, and Behaviour, Radboud University

Emotional context has been shown to influence semantic processing. A mood-related N400 modulation has been reported to different semantic mismatches. Recent work indicates that mood also impacts processing of more abstract script knowledge. In this study we ask whether mood affects the processing of general world knowledge. This was accomplished by studying the processing of words that fit people's general world knowledge or violate world knowledge (e.g., "The writer Shakespeare wrote many sonnets/melodies …." compared to a semantic violation (coats). Mood (happy vs. sad) was manipulated by presenting video clips. EEG was recorded while participants read sentences. The mood manipulation effectively induced a happy and sad mood. Across moods, N400 showed a graded pattern: its amplitude was largest for the semantic violation, reduced for world knowledge violations and smallest for words fitting world knowledge. While the ERPs in the standard N400 window (300-500 ms) were not modulated by mood, a mood by condition interaction occurred for the 200 to 300 ms window. The interaction reflected an early onset of the N400 effects for sad mood (larger amplitudes for the semantic and world knowledge violations relative to words fitting world knowledge) but absence of these effects for happy mood. This finding reveals that mood immediately affects processing of general world knowledge. In contrast with semantic knowledge and script knowledge, the effect of mood on general world knowledge was limited to the early N400 window. The implications of these findings for heuristic frameworks on the interplay between emotion and language are discussed.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Montessori Education Fosters Less Focal but Unwavering Attention After Errors: Hasty Slowly To Think Creatively.

Poster A127, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Solange Denervaud[1], Edouard Gentaz[1,2]; [1]The Swiss Center for Affective Sciences (CISA), University of Geneva, Switzerland, [2]Faculty of Psychology and Educational Sciences (FAPSE), University of Geneva, Switzerland

We aimed at studying interactions between academic outcomes, executive functions, emotional well-being at school and creativity in pupils enrolled in different learning environments (Montessori and traditional). Hundred and forty-three children from 4 to 12 years old underwent a complete assessment. Here we show that Montessori participants systematically achieved significantly higher scores in academic and creativity tasks, and reported higher well-being at school, reproducing existing data (Lillard & Else Quest, 2006). More originally, results unveil that even if executive functions are strongly impacting academic outcomes, creativity is a major significant predictor as well. Furthermore, creative thinking was found to take place in case of enlarged attention and minor post-error slowing. These findings are a first step towards understanding how creative thinking, which seems to results from creativity, executive competences and knowledge combined, can take place, with less focal but unwavering attention, even after mistakes. A follow-up study showed that individual strategies such as one's own affective relationship to mistakes and enabling time to think were shown to be shaped differently according to the learning environments in which pupils were enrolled. This sheds light on the importance of setting adequate school environments from early years on.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Translating cognitive neuroscience findings to benefits outside the lab: Promoting resilience in student veterans through a novel cognitive-emotional intervention

Poster A128, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Yifan Hu[1], Christian Williams[1], Howard Berenbaum[1], Florin Dolcos[1], Sanda Dolcos[1]; [1]University of Illinois at Urbana-Champaign

Despite recent progress in understanding the neural and behavioral mechanisms of instructed emotion regulation (ER), typically tested in an experimental setting, little is known about the long-term generalized benefits of systematic ER training. Such evidence-based interventions may be particularly useful for student veterans, who are confronted with a variety of unique challenges with reintegration, and experience high levels of psychological distress. Here, we tested a novel intervention designed to enhance student veterans' skills in using two ER strategies, focused attention (FA) and cognitive reappraisal (CR). Subjects participated in weekly training, for 5-8 weeks, and comprehensive assessments of psychological well-being, executive function, and resting-state fMRI were performed before and after the intervention. Preliminary results showed overall improvements in psychological well-being and executive function. These improvements were associated with decreased resting state functional connectivity between regions associated with cognitive control (lateral Prefrontal Cortex, PFC) and visual regions (occipital cortex). There was also increased connectivity between control regions and default mode network regions (medial PFC). These findings show that benefits of ER training can translate into increased general ability to deal with emotional challenges, and this positive effect is associated with both behavioral change and neuroplasticity in the resting state functional connectivity.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Gender Differences in Engaging with Negative Stimuli during Emotion Regulation and Processing Tasks related to Personality/Affective Style

Poster A129, Saturday, March 24, 1:30–3:30 pm, Exhibit Hall C

Teodora Stoica[1], Lindsay Knight[1], Naaz Farah[1], Depue Brendan[1]; [1]University of Louisville

Gender differences in emotional processes represent some of the most robust sex stereotypes and are supported by striking differences in the prevalence of emotional disorders, whereby women exhibit higher symptomatology than men. Therefore, we conducted functional activation (fMRI) and connectivity analyses (ICA) of men and women during an emotion-regulation task involving negative scenes and an emotion-processing task involving fearful human faces. The results of both analyses were regressed with personality/affective style questionnaires (NEO-FFI, BIS/BAS). Across tasks, fMRI results show marked differences in the way the two genders engage with negative stimuli. Women show a positive relationship between trait conscientiousness and regions associated with top-down dorsal attentional during negative stimuli and default mode networks (DMN) during baseline compared to men. In addition, women display a positive relationship between both BIS and BAS reward responsiveness (BAS-RR) scale and regions associated with the DMN in both tasks during baseline. Functional connectivity results show a similar pattern, whereby women indicate a positive relationship between both trait conscientiousness and BAS-RR with emotional processing networks involving the visual cortex, amygdala, somatosensory cortices (SMC) and orbitofrontal cortex (OFC). Conversely, men exhibit a negative relationship with both conscientiousness and BAS-RR with limbic and ventral attention networks. The results suggest that across tasks, women engage more with negative stimuli, finding them more salient than men. This in turn, leads to more top-down attentional processing during negative stimuli and more processing of emotion extending into baseline while men exhibit less processing of emotion, and more utilization of suppression mechanisms.

Topic Area: EMOTION & SOCIAL: Emotional responding

Impact of talker adaptation on speech processing and working memory

Poster B1, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Sung-Joo Lim[1], Jessica Tin[1], Barbara Shinn-Cunningham[1], Tyler Perrachione[1]; [1]Boston University

Perceptual adaptation to talkers is known to facilitate immediate recognition of speech. However, it is unclear whether and how talker adaptation also facilitates maintenance of speech information in working memory. Using electroencephalography (EEG) during a delayed recall of digit span task, we investigated whether talker adaptation facilitates working memory performance. We also investigated whether neural oscillatory power in the alpha frequency range (~10 Hz) reflects facilitatory effects of talker adaptation during both speech encoding and working memory retention. On each trial, listeners encoded a sequence of seven randomly ordered digits and recalled them in order after a 5-s retention delay. Digit sequences were spoken by either a single talker or multiple, random talkers, and were presented at either faster or slower speech rates (0-ms vs. 500-ms inter-digit intervals). Listeners responded faster and more accurately for sequences spoken by a single talker compared to multiple talkers at both presentation rates. Especially for the faster presentation rate, listeners were significantly more efficient (i.e., faster and more accurate) in recalling sequences spoken by a single talker than multiple talkers. Processing digit sequences spoken by a single vs. multiple talkers also elicited reduced parietal alpha power during both speech encoding and working memory retention, particularly for the faster presentation rate. These results suggest that talker adaptation reduces cognitive effort during both speech encoding and memory retention, thereby producing more efficient working memory for speech information, especially when listeners must process speech rapidly.

Topic Area: ATTENTION: Auditory

Age and sex modulate the variability of neural responses to engaging videos

Poster B2, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Samantha Cohen[1,2], Agustin Petroni[1], Nicolas Langer[1,3], Simon Henin[1], Tamara Vanderwal[5], Michael P. Milham[3,6], Lucas C. Parra[1]; [1]The City College of New York, [2]The Graduate Center of the City University of New York, [3]Child Mind Institute, [4]University of Zurich, [5]Yale Child Study Center, [6]Nathan Kline Institute for Psychiatric Research

Neural development is generally marked by an increase in the efficiency and diversity of neural processes. In a large sample (N = 114) of human children and adults with ages ranging from 5 - 44 years, we investigated the neural responses to naturalistic video stimuli. Videos from both real-life classroom settings and Hollywood feature films were used to probe different aspects of attention and engagement. For all stimuli, older ages were marked by more variable neural responses. Variability was assessed by the inter-subject correlation of evoked electroencephalographic (EEG) responses. Young males also had less variable responses than young females. These results were replicated in an independent cohort (N = 303). When interpreted in the context of neural maturation, we conclude that neural function becomes more variable with maturity, at least during the passive viewing of real-world stimuli.

Topic Area: ATTENTION: Development & aging

Cross-modal activation of visual cortices depends on auditory selective attention

Poster B3, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Chrysa Retsa[1], Pawel J. Matusz[1], Jan Schnupp[1,2], Micah Murray[1,3,4,5]; [1]1The Laboratory for Investigative Neurophysiology (The LINE), University Hospital Center and University of Lausanne, Lausanne, Switzerland, [2]Biomedical Sciences, City University of Hong Kong, Kowloon, Hong Kong SAR, [3]EEG Brain Mapping Core, Center for Biomedical Imaging (CIBM) of Lausanne and Geneva, Switzerland, [4]Vanderbilt University, Nashville, TN, USA, [5]University of Lausanne, Jules-Gonin Eye Hospital, Lausanne, Switzerland

Laterally-presented sounds can activate visual cortices, despite the sounds being task-irrelevant. An auditory-evoked contralateral occipital positivity (ACOP) at ~250ms post-sound onset is postulated as the event-related potential (ERP) correlate of this effect. It has been suggested that the cross-modal process indexed by ACOP is automatic. Our group has used a passive auditory paradigm to demonstrate that ACOP is context-contingent. The ACOP was observed only when the sound's location was unpredictable but was not present when location was predictable. As in prior studies the ACOP was elicited by task-irrelevant sounds, our present study examined to what extent task-relevance, and specifically, selective attention to a given feature of identical sounds modulates ACOP. To address this question, we employed an active auditory discrimination task and manipulated

which one of four possible stimulus attributes (location, pitch, speaker identity, syllable) was task relevant in each block. Sound acoustics were held constant, and their location was always equiprobable (50% left, 50% right). The only manipulation was which sound dimension participants attended to. 128-channel ERP data from healthy participants were analyzed within an electrical neuroimaging framework. We show that presence of sound-elicited activations of visual cortices depended on the to-be-discriminated dimension. An ACOP was elicited only when participants were required to discriminate sound location, but not when they attended to any of the non-spatial features. These results further indicate that the ACOP is not automatic. Moreover, we extend these findings to show the interplay between task-relevance and spatial unpredictability in producing the cross-modal activation of visual cortices.

Topic Area: ATTENTION: Multisensory

To what extent do spatial attention and expectation rely on 'amodal' or modality-specific mechanisms?

Poster B4, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Arianna Zuanazzi[1], Uta Noppeney[1]; [1]Computational Neuroscience and Cognitive Robotics Centre, University of Birmingham, UK

Attention and expectation are two critical mechanisms for guiding perceptual processes. Top-down attention favours efficient allocation of cognitive resources by prioritising relevant signals. Expectation facilitates perception by generating plausible templates of the forthcoming signals. Previous studies suggested that attention operates amodally, by similarly recruiting lower sensory areas and association cortices for signals in different sensory modalities. Yet, as these studies manipulated attention via stimulus probability, they confounded attention and expectation. Conversely, it is unknown whether expectations are formed via amodal or modality-specific mechanisms. To investigate whether spatial attention and expectation generalise across sensory modalities and rely on distinct mechanisms, the current functional magnetic resonance imaging (fMRI) study employed a novel multisensory approach that orthogonally manipulated spatial attention (i.e. task-relevance) and expectation (i.e. stimulus probability) selectively in audition and evaluated unisensory and multisensory effects on responses to auditory and visual signals. Presentation of stimuli in the unattended relative to attended hemifield increased the BOLD-response in the intraparietal sulcus (IPS) irrespective of stimulus modality suggesting that attentional shifts rely on largely amodal mechanisms in association cortices. By contrast, medial prefrontal cortices showed increased activations for expected relative to unexpected stimuli selectively for the auditory modality. Furthermore, low level visual and auditory areas showed increased activations indicating a prediction error signal selectively for unexpected auditory stimuli. In conclusion, our study showed that spatial attention and expectation rely on distinct neural systems. While attention relies on amodal mechanisms in IPS, expectation operates in a more modality-specific fashion leading to prediction errors in sensory areas.

Topic Area: ATTENTION: Multisensory

Attention and self-reported ADHD tendency modulate very early electrophysiological responses for visual words

Poster B5, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Tetsuko Kasai[1], Aiko Tanaka[2], Yasuko Okumura[3], Tomoki Uno[2]; [1]Faculty of Education, Hokkaido University, [2]Graduate School of Education, Hokkaido University, [3]National Center of Neurology and Psychiatry

Purpose. Previous behavioral studies suggest that visual words operate as perceptual units or “objects”, whereas early electrophysiological responses (e.g., N170) does not necessarily discriminate words from nonwords. The present study examined whether the activation of perceptual word representations involves attention and/or individual differences in attention, by indexing event-related potentials. Methods. Sixteen participants were presented with hiragana (2-letter words and nonwords) or symbol strings, overlapped with horizontal lines. They detected infrequent color changes of either the strings (attend-string) or the lines (attend-line) during their rapid presentations in given blocks. After recording sessions, participants filled the symptom checklist of

adult ADHD self-report scale (ASRS-v1.1). Results. Increased behavioral performance and letter-string-specific (words and nonwords vs. symbols) left-lateralized negativities (190-220 ms post-stimulus) were observed in the attend-string against attend-line condition. More importantly, P1 (130-160 ms) was enlarged for words compared to nonwords in the attend-line condition (i.e., when strings were ignored). Furthermore, an attention effect (attend-string minus attend-line) at an earlier range (70-100 ms) for words were positively correlated with ASRS scores. Conclusions. We found that visual cortex is organized to represent visual words, or learned combinations of letters, at very early stages of processing, the manifestations of which depend on the state of attention and attentional traits of individuals. These findings suggest a tight link between fluent reading and attention.

Topic Area: ATTENTION: Nonspatial

In Search of Mind Wandering: Dynamic Functional Connectivity during Rest and Task

Poster B6, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Ekaterina Denkova[1], Jason S. Nomi[1], Shruti Gopal Vij[1], Lucina Q. Uddin[1], Amishi P. Jha[1]; [1]University of Miami

Mind wandering (MW), defined as self-generated thinking disengaged from the external environment, has become a prominent topic in neuroscientific research. Emerging evidence suggests a critical role of three brain networks in MW: the default network (DN), the central executive network (CEN), and the salience network (SN). Advances in analytical methods for functional neuroimaging data (i.e., dynamic functional connectivity, DFC) demonstrate that the interactions among these networks are not static, but dynamically fluctuate over time. The majority of prior evidence comes from investigations focusing on the task-free resting state, which is often assumed to reflect unconstrained MW. Yet, it remains unclear if tasks characterized by fluctuations between attention and MW involve similar patterns of DFC. The present study applies the DFC method to neuroimaging data collected from 30 participants who completed a resting state scan followed by two sessions of a sustained attention to response task with embedded questions assessing MW. A DFC analysis revealed five dynamic network states common to both rest and task. Differences between rest and task appeared in the frequency of occurrence of two states. One state was more frequent during rest and characterized by weak connectivity between the three networks. The second state was more frequent during task and characterized by a negative correlation between the DN and CEN and SN, as well as a positive correlation between the CEN and SN. These findings suggest that some patterns of dynamic intercorrelations between networks may vary as a function of cognitive state.

Topic Area: ATTENTION: Other

Dynamic Fluctuations in Sustained Attention: Relating Neural Fluctuations to Individual Performance

Poster B7, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Francesca Fortenbaugh[1,2], David Rothlein[1,3], Joseph DeGutis[1,2], Regina McGlinchey[1,2], Michael Esterman[1,3]; [1]Department of Veterans Affairs, Boston Healthcare System, [2]Harvard Medical School, [3]Boston University School of Medicine

Recent work by Esterman and colleagues (2013) has shown that moment-to-moment fluctuations in sustained attention performance are related to corresponding dynamic fluctuations in large-scale neural networks including the dorsal attention network (DAN) and the default mode network (DMN). The present study completed both a robust replication and extension of the original findings related to these fluctuations using the gradual onset continuous performance (gradCPT) task. In this study, 140 participants completed the gradCPT during fMRI scanning. Analyses replicate the original findings demonstrating increases in BOLD activity in the DAN and decreases in the DMN when participants are “out of the zone”, periods of increased reaction time variability and greater error proneness. Results also show that BOLD activity in other task-positive regions, including the supplementary motor association area, ventral occipital cortex, and parahippocampal place area (PPA), track reaction time stability similarly to the DAN. Extending these findings, we performed dynamic functional connectivity analyses of DAN, DMN, and PPA using PPI, and found that being in the zone is associated with decreased PPA-DMN coupling. Additionally, we show that both the degree to which these ROIs’ activation couples with reaction time stability as well as their dynamic functional connectivity predict better individual differences in discrimination ability (d’) on the task using leave-one-subject-out cross-validation regression analyses ($r = 0.406$, p

< 0.001). These results demonstrate that behavioral and neural fluctuations are both related to intra-individual differences as well as inter-individual differences in sustained attention.

Topic Area: ATTENTION: Other

Dissociations Between Explicit Number Forms and Implicit SNARC Effects in Number-Form Synesthetes

Poster B8, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Elizabeth Y. Toomarian[1], Radhika S. Gosavi[1], Edward M. Hubbard[1]; [1]University of Wisconsin-Madison

In number-form (NF) synesthesia, people report vivid, automatic spatial layouts for numerical sequences. While these forms are consistent within individuals over time, the shape and direction of these forms differ across NF synesthetes. This phenomenon is similar to the implicit association between numbers and space demonstrated by the Spatial-Numerical Association of Response Codes (SNARC) effect, in which Western participants associate small numbers with the left side of space and large numbers with the right. Some researchers have suggested that explicit NFs and the implicit SNARC rely on shared mechanisms of co-activation, specifically in regions of parietal cortex underlying spatial and ordinal/numerical processing (Hubbard et al., 2005, Tang et al., 2008). To test this, previous research has examined single cases where SNARC effects corroborate subjective reports of NFs that go in non-canonical directions (e.g., right-to-left or bottom-to-top). We tested four NF synesthetes and compared the direction of their NF with the direction of their SNARC effects, for whole numbers and fractions. Contrary to our hypotheses, only one NF synesthete demonstrated SNARC effects congruent with her reported forms (both in the canonical left-to-right direction). One synesthete exhibited a canonical SNARC effect for whole numbers and no SNARC for fractions despite reporting a non-canonical number form direction for both. Two others showed no evidence of a SNARC for either stimulus type. These results demonstrate important dissociations between implicit measures of number processing and explicit reports, and challenge the hypothesis that NF synesthesia and implicit measures of spatial-numerical associations share a common unitary mechanism.

Topic Area: ATTENTION: Spatial

The functional architecture of endogenous and exogenous attention: a dynamic causal modeling study

Poster B9, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Jake Bowling[1], Kristin N. Meyer[1], Joseph B. Hopfinger[1]; [1]University of North Carolina at Chapel Hill

Behavioral and electrophysiological studies have consistently supported a dissociation between endogenous (voluntary) and exogenous (involuntary) attention, whereas functional magnetic resonance imaging (fMRI) studies have generally found highly similar patterns of activity in the dorsal fronto-parietal network across these types of attention. The sluggish nature of the hemodynamic response, however, may obscure important timing differences across regions when fMRI is used. Indeed, single-unit recordings in macaque monkeys (Buschman & Miller 2007) suggested critical differences in the temporal order of frontal and parietal activities when comparing endogenous and exogenous attention. Here, we use dynamic causal modeling (DCM; Friston et al. 2003) in healthy human participants who performed visual attention tasks to investigate potential differences in directed connectivity across frontal-parietal regions between attention types. A priori regions of interest were centered on the bilateral frontal eye fields and intraparietal sulci. Bayesian comparison of competing model architectures for each condition revealed a consistent winning model, supporting a common underlying network. However, the modulatory effects of attention differed significantly across conditions. For example, leftward-oriented attention increased connectivity in the right hemisphere in both directions, though frontal-to-parietal connectivity increased significantly more during endogenous attention while the reverse was true for parietal-to-frontal connectivity. Interestingly, differences between conditions were only consistently observed in the hemisphere contralateral to the direction of orienting, suggesting that differences in effective connectivity between the two types of attention were driven largely by activity in the contralateral hemisphere.

Topic Area: ATTENTION: Spatial

Aging Impairs Disengagement from Negative Words in a Dot Probe Task

Poster B10, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Christine E. Talbot[1], John C. Ksander[1], Angela Gutchess[1]; [1]Brandeis University

Age groups differ in how they attend to emotional information in a dot probe task, with emotionally valenced faces influencing older adults more than younger adults (Mather & Carstensen, 2003). Subsequent research on the dot probe with younger adults has demonstrated the importance of distinguishing between the processes of orienting to and disengaging from emotional stimuli (Salemink, 2007). In the present study, we examined the effects of aging as well as ability to orient to and disengage from emotional words in a dot probe task. Older and younger adults viewed word pairs (positive-neutral, negative-neutral, and neutral-neutral) and identified a probe that replaced one of the words in the pair as quickly as possible. Probes replaced either the emotional or neutral word. This design allowed for a test of whether effects of aging are larger for disengaging (identifying a probe that replaced a neutral word in an emotional-neutral trial), compared to orienting (identifying a probe that replaced an emotional word in an emotional-neutral trial), and whether the pattern is exaggerated for negative compared to positive stimuli. Attentional bias indices were calculated using mean reaction times for each trial type. Analyses revealed an interaction of age, valence, and trial type, with older adults showing a specific impairment in disengaging from negative words. These findings suggest that older adults have a reduced ability to disengage from negative stimuli, given increased inhibition requirements, and this impairment may influence how older adults perform in memory tasks in which negative stimuli are present.

Topic Area: EMOTION & SOCIAL: Development & aging

Developmental Trajectories of Functional Connectivity in Autism from Childhood to Adolescents during Face Processing

Poster B11, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Fahimeh Mamashli[1,2], Sheraz Khan[1,2,3], Hari Bharadwaj[1,2,3], Ainsley Losh[1], Matti Hamalainen[2,3,4], Tal Kenet[1,2]; [1]Department of Neurology, MGH, Harvard Medical School, Boston, MA, USA, [2]Athinoula A. Martinos Center for Biomedical Imaging, MGH/HST, Charlestown, MA, USA, [3]Department of Radiology, MGH, Harvard Medical School, Boston, MA, USA, [4]Department of Neuroscience and Biomedical Engineering, Aalto University School of Science, Espoo, Finland

Accumulating evidence suggests that functional connectivity abnormalities in ASD are not constant throughout maturation from childhood to adulthood. We have recently shown reduced local and long-range functional connectivity during face processing, in adolescents and young adults (14-22 years old) with ASD, estimated from magnetoencephalography (MEG) data. More specifically, we showed that local functional connectivity measured in fusiform face areas (FFA), estimated using phase amplitude coupling (PAC) was reduced in ASD. Long-range functional connectivity between the FFA and three higher order cortical areas was also reduced in ASD. None of the measures correlated with age. Here, we tested, using a similar paradigm, whether these findings extend to pre-adolescent children (8-13 years old). We found that both long-range and local functional connectivity in the same areas, using the same methods, were normal in ASD in this younger age group. Combining the two age groups, we found that the magnitudes of both local and long-range functional connectivity measures were positively correlated with age in TD, but negatively correlated with age in ASD, suggesting a divergence in the direction of the maturation trajectory itself in ASD. PAC was the most important feature in predicting age in ASD group, not in the TD group. Furthermore, the correlation between PAC and ASD severity strongly increased across development. These results suggest that direction of maturation should be a critical component to consider when examining ASD abnormalities, and that there are significant drawbacks to averaging over a wide age range in adolescence to increase power.

Topic Area: EMOTION & SOCIAL: Development & aging

Brain mechanisms by which emotional learning selectively and retroactively enhances memory for related information

Poster B12, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

David Clewett[1], Darren Yi[1], Joseph Dunsmoor[2], Elizabeth Phelps[1], Lila Davachi[1]; [1]New York University, [2]The University of Texas at Austin

Recent work in humans demonstrates that emotional learning can selectively and retroactively enhance memory for conceptually related neutral information that would otherwise be forgotten (Dunsmoor et al., 2015). However, the mechanisms underlying this retrograde memory enhancement are unclear. Because this effect only emerges after a delay, one possibility is that emotional learning biases post-encoding consolidation processes. Another possibility is that prior representations reactivate during new learning, enabling emotional events to facilitate memory for overlapping past and present information. Here, we tested these possibilities in humans using functional magnetic resonance imaging (fMRI). In a two-phase learning paradigm, participants first viewed images of neutral tools and animals intermixed with neutral scene images (pre-conditioning). Approximately 6 minutes later, participants viewed another stream of neutral tool and animal images, while one of the visual categories was conditioned with shock. Memory for all objects was tested 24 hours later. To examine learning-related changes in functional connectivity, resting-state scans were collected immediately before and after the conditioning phase. Across participants, learning-related changes in resting connectivity between hippocampus, VTA/SN, and shock-paired category-selective cortex were associated with greater emotion-biased retroactive memory enhancement. Furthermore, during conditioning, individuals who showed greater activity in scene-selective cortex while viewing shocked versus non-shocked objects, an index of pre-conditioning phase context reactivation, also exhibited greater emotion-related retroactive memory enhancement. These findings suggest that reinstating prior learning contexts during emotional experiences - along with increased selectivity in post-encoding dopaminergic neuromodulation - can determine the selection and storage of neutral experiences in long-term episodic memory.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Integration of spatio-temporal dynamics in emotion-cognition interactions: A simultaneous fMRI-ERP investigation using the emotional odd-ball task

Poster B13, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Matthew Moore[1], Andrea Shafer[2], Reyhaneh Bakhtiari[3], Florin Dolcos[1], Anthony Singhal[3]; [1]University of Illinois at Urbana-Champaign, [2]National Institute on Aging, [3]University of Alberta

Despite a corpus of evidence highlighting that emotion-cognition interactions elicit specific patterns of response in brain regions associated with major brain networks, it is unclear how the mechanisms by which emotion interfaces with cognition are linked to spatial and temporal dynamics in the associated neural correlates. Thus, there is a need to capitalize on multi-modal brain imaging approaches in order to elucidate the underlying mechanisms of these phenomena. The present study used simultaneous functional magnetic resonance imaging (fMRI) and event-related potential (ERP) recordings, in conjunction with an emotional odd-ball task, in a sample of 22 healthy young adults. As expected, fMRI captured greater response in dorsal system brain regions (e.g., dorsolateral prefrontal cortex, lateral parietal cortex) to targets compared to emotional distracters, while ventral system regions (e.g., ventrolateral prefrontal cortex, occipitotemporal cortex) showed greater response to emotional distracters. ERP responses to targets were associated with a prominent P300, and responses to distracters were associated with late positive potentials that showed greater amplitude for emotional compared to neutral distracters. Furthermore, ERP-informed fMRI analyses showed that ERP amplitude to targets was associated with blood-oxygen-level dependent (BOLD) signal in regions showing enhanced response to targets, and ERP amplitude to emotional distracters was associated with BOLD signal in regions showing enhanced response to distracters. Together, these results identify convergence and complementarity between measures of brain activity spanning different spatial and temporal resolutions, which supports the feasibility of using multi-modal brain imaging approaches to clarify the neural mechanisms associated with emotion-cognition interactions.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Measuring Empathic Influences on Perceptual and Motor Processing with ERPs, EEG Oscillations, and Response Force

Poster B14, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Sarah Fabi[1], Hartmut Leuthold[1]; [1]University of Tübingen, Germany

The time course and automaticity of processing components influenced by empathy for pain is still debated. For instance, it is unclear whether late motor processing stages are automatically influenced by empathy-related information, and if so, if they are facilitated or inhibited. Extending similar previous studies, it was the present aim to investigate within the same experiment automatic and controlled empathic influences on the different processing stages, from early encoding over later categorization to motor processing stages. To this end, participants performed either a pain judgment or a counting task to pictures of body parts that were depicted in painful or neutral situations. In addition to reaction time (RT), we analyzed event-related brain potentials (ERPs) to investigate empathic influences on perceptual and cognitive processing as well as oscillatory brain activity and response force (RF) as markers of motor processing. The Early Posterior Negativity (EPN; 200-300 ms) indicated an early automatic empathic influence on the perceptual encoding stage, whereas the late posterior positivity (P3) revealed a later and controlled influence on the categorization stage. RF and RT results revealed facilitated motor processing if participants attentively processed the pain dimension of the stimulus. EEG oscillations (mu and beta band) after response onset indicated an automatic and larger excitability of the motor cortex for painful than neutral stimuli. Together, empathy for pain seems to influence perceptual, cognitive categorization and motor processing stages.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Rewarded extinction diminishes enhancement of episodic fear memory

Poster B15, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Nicole Keller[1], Joseph Dunsmoor[1]; [1]Universirty of Texas at Austin

Defensive behaviors that result from fear conditioning can be extinguished by repeatedly presenting a conditioned stimulus (CS) without its previously paired aversive unconditioned stimulus (US). However, extinction is often followed by the re-emergence of extinguished behavior suggesting that extinction forms a secondary memory of safety that competes with the original fear memory. Previous studies using category-based fear conditioning in humans show that conditioning selectively enhances long-term episodic memory for conditioned exemplars (Dunsmoor et al., 2015; Dunsmoor et al., 2012). In the present study, we examined what happens to episodic fear memory when fear conditioning is followed by a competing experience of reward. Participants were presented with a heterogeneous collection of pictures of animals and tools, and exemplars from one category (CS+; animals or tools, counterbalanced) were reinforced with an electrical shock, whereas objects from another other category (CS-; tools or animals, respectively) were never reinforced. Immediately after fear conditioning, subjects underwent reward extinction (i.e., counterconditioning), in which the shock was unexpectedly replaced with a monetary reward. Subjects returned 24-hours later for a surprise recognition memory test. Preliminary results reveal that a competing reward memory diminishes selective episodic memory enhancement for CS+ items encoded during fear conditioning. This result is stark contrast to past studies (e.g., Dunsmoor et al., 2015), which showed a selective enhancement of fear memory for CS+ objects encoded during fear conditioning. We suggest that rewarded fear extinction may engage an opponent and competing reward system that competes with and inhibits emotional episodic memory enhancements for negative events.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Temporal dissociation in how stress enhances subjective valuation in the presence versus absence of explicit temptation

Poster B16, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Nidhi Banavar[1], Candace Raio[1], Anna Konova[1], Paul Glimcher[1]; [1]New York University

Stress and craving are well-established drivers of reward-seeking behavior in health and psychopathology. Despite this, we still lack a basic empirical characterization of how these states affect reward valuation to bias behavior. Here, we developed an economic decision-making task designed to capture dynamic changes in subjective value (SV) for food rewards over time. Specifically, after a baseline period and before returning to the SV task, healthy non-dieters either underwent an acute stress induction (Cold-Pressor Test; 'Stress'), this same stress test paired with craving induction (brief multi-sensory food exposure; 'Stress+Craving'), or control procedures ('Control'). Results revealed an increase relative to baseline in the SV of food rewards in both the 'Stress' and 'Stress+Craving' groups compared to 'Control'. Interestingly, this increase peaked at different times: peak SV was observed immediately after induction in the 'Stress+Craving' group (+10 minutes), while peak SV was observed with delay in the 'Stress' group (+60 minutes). Individual differences in self-reported craving experience and perceived stress mirrored these distinct temporal profiles, suggesting that these SV changes might underlie the psychological experience of craving and stress, respectively. Additionally, for the 'Stress' group, effects were enhanced for foods rated as most desirable prior to the study suggesting that, in the absence of explicit cue-exposure (as in 'Stress+Craving'), an individual's reward history guides the degree to which stress increases reward-seeking. Our results provide important insights into the mechanisms by which stress exposure and cue-induced craving influence SV and highlight differences in when individuals may be most susceptible to maladaptive choice behavior.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Generalization of Conditioned Appetitive Responses in Humans

Poster B17, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Marta Andreatta[1], Paul Pauli[1]; [1]Department of Psychology, University of Wuerzburg

Aversive conditioned responses (CR) can be generalized to stimuli, which have not been associated with an aversive unconditioned stimulus (US, e.g. painful electric shock), but which share properties with the threat-signaling conditioned stimulus (CS). We investigated here, whether similar processes underline generalization of appetitive CR. Twenty-eight healthy participants underwent an appetitive classical conditioning during which a circle (CS+) was paired with an appetitive US (i.e., chocolate or salty pretzel), while another circle (CS-) with different diameter was never paired with the US. During the test phase, CS+ and CS- were presented again as well as four additional circles (generalization stimuli, GS) with gradual diameter from CS+ to CS-. We found successful appetitive conditioning as positive valence, higher appealing and contingency ratings as well as larger skin conductance response (SCR) to CS+ than to CS- indicate. Interestingly, we confirmed for appetitive CRs a positive gradient from CS+ to CS- in all responses. In summary, we found successful appetitive conditioning and generalization of appetitive CRs. Importantly, these mechanisms might be involved in the etiology and maintenance of substance-related disorders or eating disorders.

Topic Area: EMOTION & SOCIAL: Emotional responding

ERP probe technique without probe stimulus: Heartbeat-evoked potentials reflect physical attractiveness

Poster B18, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Kohei Fuseda[1], Jun'ichi Katayama[1]; [1]Department of Psychological Science, Kwansei Gakuin University,

The ERP probe technique is useful method to evaluate the amount of interest in video clips. Although task-irrelevant probe stimuli do not require any action, it might become a distractor during a passive viewing of video clips. Then, the purpose of this study is to establish a new method without probe stimuli to evaluate the degree of physical attractiveness using a heartbeat-evoked brain potential (HEP). Twelve males and twelve females were received both probe and no-probe conditions during watching the 7 minutes video clips of attractive or unattractive models. In the no-probe condition, instead of the probe stimulus, R-waves of the electrocardiogram were used as a trigger, i.e., the HEP was measured. In the probe condition, the electrical stimuli as probe stimuli were presented in an oddball sequence: frequent (80%) and infrequent stimuli (20%) were presented at each wrist every 1000 ms. P2 amplitude to both the frequent and infrequent probe stimuli during watching attractive models was significantly smaller than watching unattractive ones. In contrast, HEP amplitude in the no-probe condition was larger for attractive models. Results in the probe condition indicated that attentional resource was more allocated to attractive models. Larger HEP for the attractive models in the no-probe condition shows that we can evaluate the degree of physical attractiveness without probe stimuli, i.e., without distraction for the watching video clips.

Topic Area: EMOTION & SOCIAL: Emotional responding

Frontal alpha asymmetry and hart rate synchronized during emotional experience when people show facial expression

Poster B19, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Motoyuki Sanada[1], Masanori Kobayashi[1], Keiko Otake[1], Jun'ichi Katayama[1]; [1]Kwansei Gakuin University

The purpose of the current study was to unveil temporal dynamics of physiological state during emotional experience. It has been widely accepted that emotion arise from interaction between cerebral processing and bodily response (e.g., Seth, 2013). Therefore, we measured indices of both the activities; frontal alpha asymmetry for cerebral processing and heart rate for bodily response. Frontal alpha asymmetry of EEG reflects emotional state; negative emotion induces larger alpha power in left frontal site than right, and positive emotion evokes the opposite pattern (Davidson et al., 1990). Emotional state also changes heart rate; this modulation reflects valance of autonomic nerves system (Kreibig, 2010). Twenty participants watched six video clips (two for each negative, neutral, and positive), during which EEG and electrocardiogram (ECG) were recorded. In order to track the time course of frontal alpha asymmetry, we extracted alpha wave (8-13 Hz) from their EEG by FIR filter, and then, calculated the power value per one second. Heart rate per one second was computed from ECG as well. These analyses showed that time course of frontal alpha asymmetry synchronized with heart rate fluctuation when they watched one of the positive video clips. Post-hoc observation of participant's face during the experiment unfolded that the video clip most often induced their facial expression. These results submitted a possibility that cerebral area which has responsibility for frontal alpha asymmetry and the center for controlling autonomic nerves system are connected, and their activity synchronize when expression is exposed.

Topic Area: EMOTION & SOCIAL: Other

Increased response to facial attractiveness in visual areas reflects saliency, not reward

Poster B20, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Franziska Hartung[1], Anja Jamrozik, Geoffrey Aguerri[1], Miriam Esther Rosen[1], David B. Sarwer[2], Anjan Chatterjee[1]; [1]University of Pennsylvania, [2]Temple University

Attractive faces are found to evoke larger neural responses within ventral occipito-temporal cortical areas (such as the fusiform face area) as compared to faces of average attractiveness. Whether this activity represents reward or saliency is unclear. We addressed this question by measuring neural responses to photographs of people taken before and after surgical treatment of facial disfigurement. While undergoing fMRI, participants (N=34) viewed pre and post-treatment faces. During 168 acquisitions of 5 mins 36 secs, pre and post treatment faces were presented randomly interleaved (6 seconds per face). Only the pre or post treatment image of any particular face was presented to a participant, with this assignment randomized across participants. Participants indicated by button press for each stimulus if the photograph depicted a male or female face. We found that images of facial disfigurement, as compared to images of the same faces after surgical treatment, evoked significantly greater neural responses within ventral occipito-temporal cortex, consistent with the hypothesis that face processing areas respond automatically to the salience of faces, rather than attractiveness per se. A relative decrease in neural response to disfigured faces was found in the medial prefrontal cortex, an area associated with social cognition. We speculate that this response reflects inhibition of mentalizing and emotional processing. Given the behavioral finding that people with facial disfigurement are perceived to have less positive personality characteristics we plan to investigate if the suppression of medial prefrontal cortex represents a neural marker of mechanisms underlying the dehumanization of people with disfigured faces.

Topic Area: EMOTION & SOCIAL: Person perception

EEG Responses to Unexpected Outcomes of Own or Partner's Actions in a Turn-Taking Game

Poster B21, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Gedeon Deák[1], Kevin Jenson[1], Alvin Li[1], Scott Makeig[1]; [1]University of California, San Diego

To investigate real-time, naturalistic social decision-making, we collected EEG within a turn-taking game. Adult dyads took turns touching one of two animated bubbles on a touchscreen table, with the goal of eliciting a “big pop” (high reward) instead of a less-interesting (i.e., low reward) outcome. Subjects had to learn feedback contingencies by trial and error. Each session consisted of a 64-trial rule-learning block followed by two unpredictable blocks (totaling 400 trials) in which outcome contingencies were reversed in 20% of the trials (random), and finally a block of 48 trials with the original contingencies. Late Positive Complex (P3) features of scalp ERPs were modulated by reward size, and by expectancy-violation. We used adaptive-mixture independent component analysis (AMICA) to unmix EEG signals, and clustered the resulting independent components (ICs) using k-means. We then analyzed two IC clusters that accounted for the most ERP variance from 200 to 700ms. ERP amplitudes of the more centro-medial-ACC cluster were larger for high-reward outcomes, whereas amplitudes of the more rostral-ACC cluster were larger following unexpected outcomes. Notably, both of these effects were significant for own-trial ERPs, but were qualitatively similar but non-significant in observation trials (i.e., watching the partner's actions). These results suggest that (1) reward and uncertainty processing exhibit unique dynamics in distinguishable cortical networks; (2) the LPC/P3 consists of multiple spatially, temporally and functionally distinct processes (converging evidence); and (3) cortical outcome-evaluation processes are attenuated in observation relative to “first person” action, even in a cooperative, shared activity.

Topic Area: EMOTION & SOCIAL: Person perception

Exploring the effects of speed of processing training on brain activity and connectivity

Poster B22, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Christina Webb[1], Christine Whitaker[2], Jarrod Hicks[2], Erica Schmidt[2], Shaadee Samimy[1], Nancy Dennis[1], Kristina Visscher[2], Lesley Ross[1]; [1]The Pennsylvania State University, [2]The University of Alabama at Birmingham

Speed of Processing Training (SPT) is an adaptive cognitive intervention that transfers to maintained health, reduced depression, and maintained driving safety and mobility in older adults. While its efficacy is well documented, the neural mechanisms underlying this intervention are unknown. This study used fMRI to explore neural changes following SPT. Task-based and resting-state fMRI were used to examine changes in brain activity and connectivity in healthy older adults randomized to 10 hours of SPT (n=13), 10 hours of cognitively stimulating activities (CSA; n=11), or a no contact control (n=10). SPT, but not CSA, resulted in improved performance on the speed of processing task. Relative to no-contact controls, SPT resulted in reduced activity in the anterior insula and supplementary motor area, two areas shown to be involved in effortful processing of sensory inputs. Furthermore, resting-state functional connectivity between brain regions involved in executive function and visual attention were strengthened following SPT. These results suggest that SPT enhances neuronal connections needed for task performance, thus decreasing the effort needed to process visual stimuli and execute the task. Together with prior behavioral, neural, and physiological work, this study provides evidence that one mechanism of SPT is to improve the brain's efficiency for processing visual stimuli.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Functional segregation loss over time is moderated by APOE genotype in healthy elderly

Poster B23, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Eric Kwun Kei Ng[1], Yingwei Qiu[1,2], June C Lo[1], Evelyn SC Koay[3,4], Woon-Puay Koh[1,5], Michael WL Chee[1], Juan Zhou[1,6]; [1]Duke-NUS Medical School Singapore, [2]Third Affiliated Hospital of Guangzhou Medical University, China, [3]Yong Loo Lin School of Medicine, National University of Singapore, [4]National University Hospital Singapore, [5]Saw Swee Hock School of Public Health, National University of Singapore, [6]Clinical Imaging Research Centre, A*Star-NUS

Evidence from cross-sectional functional connectivity (FC) studies on the effects of the apolipoprotein E-e4 allele (APOE-e4) on the brain functional organization in cognitively normal elderly is mixed. The possible synergistic effect of brain ageing and genetic risk factor on cognitive decline is also largely unknown. To investigate the longitudinal influence of APOE-e4 allele on age-related changes in brain FC and cognitive decline, 122 healthy older adults (aged 58-79; 42 APOE-e4 carriers) underwent task-free fMRI at baseline. 78 of them (16 carriers) had follow-ups every two years (over 2-4 years). Intra- and inter-network FCs were evaluated in the default mode network (DMN), the executive control network (ECN), and the salience network (SN). Linear mixed models were used to estimate the cross-sectional and longitudinal changes in brain function and cognition. Cross-sectionally, FC or cognitive did not differ significantly between APOE-e4 carriers and non-carriers. In contrast, longitudinally, APOE-e4 carriers had greater loss of functional segregation than non-carriers, evidenced by a steeper increase in FC between the DMN and the ECN. The brain-cognition association was also affected by APOE genotype. In younger elderly, higher FC between the DMN and the ECN was associated with greater decline in processing speed in both carriers and non-carriers. In contrast, in older elderly, the non-carriers continued to have the same negative correlation but carriers had the opposite trend. Therefore, APOE-e4 may alter biological ageing by accelerating the reduction of the segregation between high-level cognitive functional systems. The brain-cognition relationship is modulated by APOE genotype in an age-dependent manner.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Aging effects on the neural connectivity underlying the arithmetic confusion effects.

Poster B24, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Thomas Hinault[1], Kevin Larcher[2], Louis Bherer[3], Alain Dagher[4], Susan Courtney[5]; [1]Johns Hopkins University, [2]McGill University, [3]Montreal Geriatric Institute, [4]McGill University, [5]Johns Hopkins University

This aimed to better understand aging effects on cognitive control processes. To this end, we investigated the arithmetic confusion effect (i.e., poorer performance to correctly reject a false proposed solution when it is the correct product of another operation type; e.g., 8 + 4 = 32), previously demonstrated to involve inhibitory processes. Maintenance and updating of operation types were also studied. We analyzed DTI and fMRI data to investigate how structural and functional connectivity measures are associated with behavioral cognitive control performance and individual differences therein. Thirty-four young (18-35 years) and 34 older adults (above 65 years) performed an arithmetic verification task in a MRI scanner. Results highlighted the cognitive control network involved during the arithmetic confusion effect. Activations and connectivity (evaluated with generalized psychophysiological interactions) between ACC, IFG, DLPFC, and angular gyrus were found during confusion problems. These activations were larger when the cued operation type was previously actively maintained in working memory. With age, larger confusion effects were associated with larger frontal and posterior activations. Moreover, white matter integrity of the IFO and SLF tracts was quantified in each individual and was negatively correlated with behavioral confusion effects. This study contributes to better understand the structural and functional connectivity of cognitive control processes, together with the determinants of individual variability of cognitive control performance during aging. Results could help identify biomarkers of the level of alterations of the cognitive control connectivity in each individual.

Topic Area: EXECUTIVE PROCESSES: Development & aging

The impact of deprivation and threatening experiences on behavior in early childhood

Poster B25, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Laura Machlin[1], Adam B. Miller[1], Jenna Snyder[2], Katie A. McLaughlin[3], Margaret A. Sheridan[1]; [1]University of North Carolina at Chapel Hill, [2]Cooper Medical School, [3]University of Washington

Early adversity is strongly associated with risk for psychopathology (McLaughlin et al., 2012). Deprivation, defined as the absence of expected cognitive and social inputs, is associated with lower performance on complex cognitive tasks (Sheridan et al., 2017). Threatening experiences, defined as the presence of atypical traumatic learning experiences, are associated with impaired fear learning processes (Sheridan et al., 2017). Depriving and threatening experiences have not previously been studied together in early childhood when experience profoundly impacts neural development. The present study examines how depriving and threatening experiences are associated with behavioral performance in early childhood. Children 4-7 years old (N=56) completed interviews assessing threatening experiences (Violence Exposure Scale for Children-Revised), deprivation (Multidimensional Neglectful Behavior Scale), and behavioral tasks assessing working memory and cognitive control. Children also completed a fear conditioning and extinction paradigm. Parents completed questionnaires assessing deprivation (Home Screening Questionnaire) and threat (UCLA PTSD Reaction Index). Children with high self-reported deprivation had significantly worse cognitive control ($B=.18$, $t=2.17$, $p<.05$) and working memory ($B=-.43$, $t=-2.48$, $p<.05$) as indexed by reaction time and accuracy respectively. Parent-reported threat was significantly associated with greater attentional bias towards threat-related cues during a fear conditioning paradigm as indexed by behavioral responses ($B=.32$, $t=2.89$, $p<.01$). All analyses controlled for age, gender, IQ, and other experiences (deprivation or threat). Results suggest that deprivation results in impaired cognitive control and working memory while threatening experiences are associated with increased attention to threatening stimuli. Future work should examine physiological and neural mechanisms underlying behavioral changes associated with early adversity.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Dissociating Proactive and Reactive Control in Adolescents and Young Adults with Autism Spectrum Disorder

Poster B26, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Marie K. Krug[1], Jeremy Hogeveen[1], Cory C. Coleman[1], Matthew V. Elliott[1], Seoyoung Gam[1], Cameron S. Carter[1], Marjorie Solomon[1]; [1]University of California, Davis

According to the dual mechanisms of control framework, there are two types of cognitive control: proactive control, which is preparatory and sustained, and reactive control, which is implemented after interference has already occurred (Braver, 2012; Braver, Gray, & Burgess, 2007). Although individuals with autism spectrum disorder (ASD) have impaired cognitive control, previously used paradigms have not been able to dissociate proactive and reactive control. Adolescents and young adults with ASD (N=20) or typical development (TYP: N=20) performed baseline, proactive (list-wide manipulation of proportion congruency; LWPC) and reactive (item-specific manipulation of proportion congruency; ISPC) versions of an auditory Stroop paradigm developed to measure various indices of proactive and reactive control (Gonthier, Braver, & Bugg, 2016). TYP and ASD showed similar reliance on proactive control in the LWPC task. In ASD, proactive control was associated with both a clinical benefit–reduced attention problems–as well as a clinical cost–increased repetitive behaviors–suggesting that high levels of proactive control may confer advantages and disadvantages in individuals with ASD. TYP participants showed a trend toward utilization of reactive control on the ISPC version of the task, while ASD did not. Performance of the ISPC was always after the LWPC, and therefore individuals with ASD may have difficulty switching to a reactive control strategy following performance of a proactive control task. Data collection is ongoing and future analyses will look at the implementation of reactive control over time, as well as age effects on the development of proactive and reactive control in our groups.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Creating Structured Task-sets from Categorical Stimuli

Poster B27, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Christina Bejjani[1], Tobias Egner[1]; [1]Duke University

Adaptive behavior is facilitated by our ability to discover and leverage rules for classifying stimuli and linking them to appropriate actions. Previous studies have shown that when humans learn stimulus-response associations for a small set of multi-dimensional stimuli (e.g., colored shapes), they will spontaneously form and generalize abstract rule structures, even in the absence of inherent structure and performance benefit. Here, we tested some determinants and boundary conditions of such spontaneous task-set building. Specifically, we tested whether this effect could also be observed at the level of stimulus categories (trial-unique face stimuli), the degree to which it is biased by how stimulus categories map onto responses (random vs. grouped by dimension), and whether the order in which these biases are introduced affects task-set structure. Participants performed a feedback-based learning task that allowed for hierarchical clustering of stimulus-action rules according to face stimulus dimensions (age, gender). In "flat learning" blocks, the stimulus-response mapping was arbitrary; in "hierarchical learning" blocks, the choice was "motor-biased" such that the buttons assigned to each image category were clustered according to a particular higher-level dimension (e.g., gender). We found dimensional switch-costs in both blocks, but costs were increased in the hierarchical learning condition, regardless of the order in which the conditions were introduced. These results document that humans generate hierarchical task-sets for grouping trial-unique stimuli into categories, even in the absence of inherent structure and performance advantages, and this tendency is robustly enhanced when stimulus-response mappings encourage dimensional grouping.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Understanding the Effect of Media Multitasking on the Mind

Poster B28, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Jesus J. Lopez[1], Madison M. Liggett[1], Joseph M. Orr[1]; [1]Texas A&M University

Given the prevalence of multitasking in today's society, it is critical to understand how multitasking affects the mind. Decades of cognitive research suggest that a 'central bottleneck' requires higher level cognitive functions to proceed serially; however, efficient multitasking requires parallel processing of multiple tasks. Moreover, neuroimaging results suggest that multiple goals can be held concurrently in the brain. It is unclear if frequent multitasking has led to an improvement of parallel processing abilities, perhaps at the expense of serial processing.This study examined whether the degree to which a person engages in media multitasking affects the balance between serial and parallel processing styles. Our hypothesis was that more frequent multitasking would lead to more efficient parallel processing at the expense of serial processing. Parallel processing was indexed by the classic divergent thinking paradigm, the AUT (Alternative Uses Task), and serial processing by the classic convergent thinking paradigm, the RAT (Remote Associates Test). 537 participants completed the Media Multitasking Index (MMI) as well as the RAT and AUT. Participants were randomly assigned to an online or in-person condition. Contrary to our predictions, MMI scores were found to be negatively associated with AUT scores, indicating that more time spent media multitasking is associated with less divergent thinking. There was no association between MMI and RAT scores. Online participants performed significantly worse on the AUT versus their in person counterparts, which may have profound implications for online data collection. Ongoing work is focused on using more direct measures of parallel and serial processing.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Enhancement of action inhibition by accidental rewards preceding the stop signals

Poster B29, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Hsin-Ju Lee[1], Fa-Hsuan Lin[2], Wen-Jui Kuo[1]; [1]National Yang-Ming University, [2]National Taiwan University

In this study, we were interested in the effects of accidental rewards, both positive and negative, on the implementation of action inhibition and their neural underpinnings. For the purpose, a stop-signal task was used together with fMRI, and there were three accidental rewards arranged to match the stop trials of the task, including monetary gain (positive), monetary loss (negative), and neutral feedback. We found that the stop signal reaction time (SSRT) was shorter in both positive and negative reward conditions, as compared to the neutral one. It appears that emotional fluctuation perturbed by the positive and negative rewards might facilitate action inhibition control. For the imaging results, we discovered that positive reward was encoded in the ventral striatum and negative reward elicited higher activity in the lateral orbitofrontal cortex. We also found that the brain regions associated with inhibitory control were enhanced, echoing the improved efficiency of stopping processes. Pre-SMA showed higher activation when participants were receiving both reward feedbacks, whereas right posterior inferior frontal cortex showed an interaction of reward feedback and inhibitory control. Strikingly, the striatum activity revealed a functional dorsal-ventral gradient. While the dorsal

striatum displayed more substantial activation when participants were perturbed by the positive and negative rewards, the ventral striatum activity was only higher for the positive reward.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Cycling as an effective modality for improving inhibitory control and maintaining brain function and academic performance in 9- to 10-year-old children

Poster B30, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Caroline C. Meadows[1], Charles H. Hillman[2], Eric S. Drollette[1]; [1]University of North Carolina at Greensboro, [2]Northeastern University

Acute aerobic exercise has demonstrated positive effects on inhibitory control in children. However, regarding academic performance and underlying neural mechanisms during and following acute exercise, the evidence is not well established. The aim of the present investigation was to examine the effects of moderate stationary cycling on academic achievement and event-related potentials (ERPs) during an inhibitory control task in 9- to 10-year-old children. Children (n = 34) completed a standardized math and reading test (WRAT3) and a hybrid no-go/flanker task (assess attentional and motor inhibition) on two separate counterbalanced days (i.e., cycling, seated rest). Math and reading were assessed during cycling and seated rest while task performance and the P3 ERP component were assessed during and after both conditions. Although results revealed no change in math and reading during cycling, greater overall no-go/flanker accuracy was observed during and after cycling compared to seated rest. Additionally, a decrease in P3 amplitude was observed during cycling and after seated rest compared to during seated rest, suggesting greater temporal reductions in P3 amplitude across the rest condition compared to the cycling condition. Collectively, results demonstrate improvements in inhibitory control during and after cycling without decrements in neuroelectrical underpinnings of attention and performance on math and reading tests. Together, acute moderate bouts of cycling may be an effective exercise modality for improving aspects of inhibitory control that facilitate behavior in children. Such findings have implications for promoting acute bouts of aerobic physical activity in the classroom by improving behavior without interfering with academic endeavors.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Body Mass Correlates Inversely with Inhibitory Control in Go/NoGo Task: an ERP Study

Poster B31, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Siqi Chen[1], Yajun Jia[1], Steven Woltering[1], Diana Guerra[1], Johanna Song[1]; [1]Texas A&M University

Inhibitory control is defined as the ability to suppress prepotent responses and resist irrelevant stimuli, which is thought to play a critical role in the manifestation and maintenance of obesity in adolescents. Adolescence is a unique developmental stage characterized by significant maturational changes in cortical structures (i.e., prefrontal cortex: PFC) that relate to inhibitory control processes. The current study investigated the behavioral and neurophysiological correlates of inhibitory control in adolescents (18 normal-weight and 24 obese adolescents) using electroencephalography (EEG)-based measures during a Go/NoGo task. We compared the N2 and P3 event-related potential (ERP) components, which are believed to be derived from PFC activity. For task performance, results indicated that obese adolescents showed lower accuracy compared to their normal-weight peers in NoGo trials where greater amounts of inhibitory control effort were required. For the ERP components, a larger NoGo N2 amplitude and smaller NoGo P3 amplitude were observed in obese adolescents compared to normal-weight group. Furthermore, a lower self-efficacy of individual's ability to control eating behaviors in challenging situations (as measured by the Weight Efficacy Lifestyle-Short Form) directly correlated with larger NoGo N2 amplitudes for both groups. These findings suggested that obesity in adolescence is negatively and selectively associated with prefrontal inhibitory control. The results contribute to the growing literature of obesity in adolescents and increase our understanding of the neural correlates of inhibitory control associated with obesity.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Computational modeling as a tool for detecting medication response in ADHD

Poster B32, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Mads Pedersen[1,2], Michael J. Frank[1], Sigurd Ziegler[2], Mats Fredriksen[3], Guido Biele[4]; [1]Brown University, [2]University of Oslo, [3]Vestfold Hospital Trust, [4]Norwegian Institute of Public Health

Stimulant medication reduces symptoms in ADHD, but response rates are only around 60-70%, and non-responders are typically identified only after several months. Recent studies have examined the influence of patients' neurobiological, clinical, and social characteristics on medication response, but no clinically useful predictors have been identified. Cognitive processes captured by computational modeling are likely closer to adaptive functioning than neurobiological variables and can thus potentially provide a bridge between less specific global measures of functioning and fine-grained neurobiological characteristics. To test the potential benefit of using computational modeling for predicting medication response we applied a modified drift diffusion model to data on Conners' Continuous Performance Test (CPT) II collected in a prospective open-label study on adult ADHD-patients. 250 patients followed during their first year of medication treatment were tested on the CPT before starting medication treatment, and at multiple time points during treatment. At the end of the study, 160 patients (70%) continued on medication. To measure potential differential effects of medication we retrospectively grouped patients based on medication status at the one-year endpoint. After 6 weeks of treatment, patients who at end-of treatment responded to medication showed substantially stronger positive effects of medication on performance in the CPT compared to non-responders. Specifically, performance improved more for responders through an increased rate of evidence accumulation (Bayes Factor: 32.99) and extended decision threshold (Bayes Factor: 25.49). The results reported here show the potential benefit of using computational modeling as a tool for predicting medication response in ADHD.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Feedback-related ERPs during value-learning foreshadow how participants later handle reversal learning

Poster B33, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Sucheta Chakravarty[1], Isha Ober[1], Christopher R. Madan[2], Yvonne Y. Chen[3], Jeremy B. Caplan[1]; [1]University of Alberta, [2]University of Nottingham, [3]Baylor College of Medicine

How do people handle the situation in which previously known item-values change? We used a feedback driven learning paradigm where participants learned, through trial and error, the values associated with a set of 48 words, divided equally in high-value (10 points for choosing, 1 point for not choosing) and low-value (1 point for choosing, 10 points for not choosing) words. After 16 blocks of value learning, the values of half of the words reversed without warning. Some of our participants (N=19, “exploratory”) guessed at new values, while some other (N=21, “conservative”) responded based on previous knowledge of values (presented at CNS 2017). We wondered if participants who applied these strategies had, in fact, learned item values differently. Behavioural measures failed to distinguish the two strategy groups during the 16 blocks of value learning (i.e., prior to the value reversal). However, ERPs in response to feedback stimuli, during value learning, were strikingly different. Strategy interacted significantly with latency at electrode FCz, with conservative participants showing a greater deviation from baseline at earlier latencies (negative voltage) and exploratory participants showing a greater deviation from baseline at later latencies (positive voltage). These findings suggest that the participants that were conservative incorporated feedback-information proactively, anticipating feedback and updating value knowledge earlier. In contrast, participants that were exploratory waited until feedback arrived, updating value knowledge in reaction to feedback cues. In sum, two equivalently effective approaches to learning item-values may reflect different ways of processing feedback and updating value knowledge.

Topic Area: EXECUTIVE PROCESSES: Other

ERP Components Related to Proactive Interference in Visual Working Memory

Poster B34, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Li Zhou[1], Thomas Farnbacher[2], Robin Thomas[2]; [1]Bemidji State University, [2]Miami University

Previous studies have showed that visual working memory (VWM) likes verbal working memory is subject to proactive interference (PI). A small set of ERP research have investigated ERP activities for PI in verbal working memory, however few have studied that in VWM. In our study, we adopted recent-probe paradigm with colored squares as stimuli, and recorded twenty-three college students' ERP activities when the size of memory array was below and around VWM capacity. The response time difference between recent and non-recent negative probe suggested that participants experienced proactive interferences during the task. The ERP results showed that late positive component (LPC) reflected the difference between recent and non-recent negative probe, which suggested LPC is the ERP signature related to proactive interference resolution in VWM. In addition, we observed different scalp distributions of LPC difference related to recency manipulation for the two memory load conditions. When memory load was below VWM capacity, LPC difference distributed at parietal lobe, whereas, it moved to frontal-central area when memory load was up to VWM capacity. The results suggested that we may have different control mechanism for PI resolution corresponding to different memory conditions.

Topic Area: EXECUTIVE PROCESSES: Other

Vascular Risk Factors for Diabetes in Late Adolescents and Young Adults, an Assessment of Working Memory

Poster B35, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Alexandra Roach[1], Heather Nall[1], Juliette Seremak[1]; [1]University of South Carolina Aiken

Older adults diagnosed with diabetes are at a greater risk for developing cognitive deficit than normal age-related cognitive decline. Given that diabetes is a progressive disease, it is important to understand whether its effects are detectable prior to a formal diagnosis. We investigated whether a relationship between vascular risk factors for diabetes and cognition exist even in healthy young adults. We collected blood pressure (BPs = systolic, BPd = diastolic), blood glucose levels (BGL), and calculated body mass index (BMI) for 55 undergraduate volunteers, and analyzed their effects on working memory. We used an n-back task to assess working memory with 3 levels of cognitive load. Stimuli included letters appearing in succession, and participants were asked to respond when the current stimulus was a target (i.e., matched the item 0-, 1-, or 2-back). Accuracy data were subjected to a repeated-measures ANCOVA on log-normalized d' where cognitive load was the within-subjects factor, and BPs, BPd, BGL, and BMI were covariates. We found a main effect of cognitive load, $F(1.52, 71.43) = 8.9$ ($p = .001$), and a trend towards significance for BGL, $F(1.52, 71.43) = 3.07$ ($p = .066$) and BPs, $F(1.52, 71.43) = 2.58$ ($p = .097$). These results demonstrate that, while vascular risk factors in young adults are not significant predictors of working memory performance, there is a degree of influence on performance indicating that, even in healthy young adults, these vascular risk factors may initiate systemic neurological changes much earlier in disease progression than previously thought.

Topic Area: EXECUTIVE PROCESSES: Working memory

Neural mechanisms of precision in visual working memory

Poster B36, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Elizabeth Lorenc[1], Mark D'Esposito[1]; [1]University of California, Berkeley

There is considerable variability, both between and within individuals, in the precision with which complex images are maintained in visual working memory (VWM). We hypothesize that precise VWM relies upon the continued maintenance of perception-related activity in stimulus-selective regions like the fusiform face area (FFA). To test this hypothesis, we collected fMRI data while participants performed a delayed-estimation task for faces. On each trial, participants were presented with a face from a continuous face space, followed by a post-cue which indicated whether to store the item through a 10s delay period ('store") or discard it from

memory (“drop”). “Store” trials ended with a method-of-adjustment response in which a probe face was morphed to match the remembered face, and on “drop” trials, participants morphed a probe face to match a simultaneously-presented test face. We used an inverted encoding model approach to examine VWM representations in the FFA. After training an encoding model on perception-related activity patterns, we inverted this model and applied it to held-out fMRI data. First, we found that faces could reliably be reconstructed during perception, before the “store” or “drop” post-cue. Second, this model trained on perception-related activity patterns allowed successful reconstruction of faces maintained in VWM. Finally, “store” delay patterns more closely resembled perception than did “drop” delay patterns. These results indicate that the FFA is involved in maintaining the precise details of a face in VWM, and suggest that a common coding scheme underlies both perception/encoding and VWM maintenance.

Topic Area: EXECUTIVE PROCESSES: Working memory

Reduced interference in working memory following mindfulness training is associated with increases in hippocampal volume

Poster B37, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Jonathan Greenberg[1,2], Victoria L Romero[3], Seth Elkin-Frankston[3], Matthew A Bezdek[4], Eric H Schumacher[4], Sara W Lazar[1,2]; [1]Department of Psychiatry, Massachusetts General Hospital, [2]Harvard Medical School, [3]Charles River Analytics, [4]Georgia Institute of Technology

Proactive interference occurs when previously relevant information interferes with retaining newer material. Overcoming proactive interference has been linked to the hippocampus and deemed critical for cognitive functioning. However, little is known about how this ability can be improved or about the neural correlates of such improvement. Mindfulness training emphasizes focusing on the present moment and minimizing distraction from competing thoughts and memories. It improves working memory and increases hippocampal density. The current study examined whether mindfulness training reduces proactive interference in working memory and whether such improvements are associated with changes in hippocampal volume. 75 participants were randomized to a four-week web-based mindfulness training program or a similarly structured creative writing active control program. The mindfulness group exhibited lower proactive interference error rates compared to the active control group following training, and these improvements significantly associated with volume increases in the left hippocampus. These results provide the first evidence suggesting that mindfulness training can protect against proactive interference, and that these benefits are related to hippocampal volumetric increases. Clinical implications regarding the application of mindfulness training in conditions characterized by impairments to working memory and reduced hippocampal volume such as aging, depression, PTSD, and childhood adversity are discussed.

Topic Area: EXECUTIVE PROCESSES: Working memory

Distinct influence of value-driven attentional capture when maintaining locations and spatial relations in working memory: An EEG study

Poster B38, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Myranda Gormley[1], Thomas Hinault[1], Kara J. Blacker[2], Brian A. Anderson[3], Susan M. Courtney[1]; [1]Johns Hopkins University, [2]The Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc., [3]Texas A&M University

Previous work has demonstrated distinct neural correlates for maintenance of abstract and sensory information in working memory (WM). These results suggest that sensory regions are suppressed during the maintenance of abstract information in WM. In the current study, we used electroencephalography to evaluate whether value-driven attentional capture (i.e., allocation of attention to a task-irrelevant feature previously associated with a reward) is modulated by the type of information maintained in WM. In a training phase, 19 participants learned to associate a color with reward. In the subsequent test phase, participants were presented squares and encoded their locations into WM. Participants were instructed to convert the spatial information either to another sensory representation (i.e., draw an imaginary line linking the squares) or to an abstract, relational representation (i.e., maintain which square was above the other one). During the WM delay period, task-irrelevant distractors in the previously-rewarded and

non-rewarded colors were presented. Results revealed that after presentation of the distractors alpha power was greater over posterior electrode sides contralateral to the previously rewarded color compared to ipsilateral. In addition, we observed an N2pc component with more negative potential contralateral to the distractor in the previously rewarded color. These effects were found only during relational WM, but not during sensory WM, and only for the previously rewarded distractor color. These results likely reflect suppression of previously rewarded sensory information during maintenance of abstract information, and suggest that value-driven attentional capture differs as a function of the type of information maintained in WM.

Topic Area: EXECUTIVE PROCESSES: Working memory

Examination of phase-amplitude coupling during working memory updating and interactions with goal-directed attention ability

Poster B39, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Timothy K. Gray[1], Araya Lacy[1], Robert S. Ross[1]; [1]University of New Hampshire

Working memory updating ability may be related to attention. Working memory updating involves continuingly changing the contents of working memory. Oscillations in theta (4-8 Hz), alpha (9-14 Hz), and beta (15-25 Hz) ranges are associated with goal-directed attention and working memory. Interactions between alpha and beta bands supports working memory maintenance and is impacted by attention ability. However, it is unclear whether alpha and beta interact and/or theta and alpha interact during working memory updating. This study sought to identify how changes in phase-amplitude coupling (PAC), which measures how different oscillations interact, during working memory updating change with variations in goal-directed attention ability. Participants completed a Posner attention task where participants covertly shift attention to one side of a screen in anticipation of a stimulus. Reaction time was used to make high and low attention ability groups via a median split. After the Posner task, participants completed a 0-back, 1-back, and 2-back working memory updating task while undergoing EEG. PAC in the n-back tasks was analyzed using FieldTrip and compared across high and low attention groups using ANOVA. PAC between predefined regions in left and right frontal and left and right parietal regions showed that theta-alpha and alpha-beta PAC during working memory updating increased with load. Theta-alpha PAC between contralateral parietal regions during the 0-back task was greater for participants with higher goal-directed attention ability. No difference in alpha-beta PAC was seen based upon attention group. These results imply that goal-directed attention ability may not impact working memory updating ability.

Topic Area: EXECUTIVE PROCESSES: Working memory

Neural oscillations in the prefrontal and superior temporal cortices predict spatial working memory performance

Poster B40, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Amy L Proskovec[1,2], Alex I Wiesman[2], Elizabeth Heinrichs-Graham[2], Tony W Wilson[1,2]; [1]University of Nebraska Omaha, [2]University of Nebraska Medical Center

The oscillatory dynamics serving spatial working memory (SWM), and how such dynamics relate to performance, are poorly understood. The goal of this study was to identify the oscillatory dynamics underlying SWM encoding and maintenance processes, and probe the relationship between oscillatory responses and SWM performance. Thus, 22 healthy adults performed a SWM task during magnetoencephalography (MEG). The resulting MEG data were transformed into the time-frequency domain, and significant oscillatory responses were imaged using a beamformer. To quantify the dynamics, voxel time series data were extracted from the cluster peaks. Additionally, whole-brain partial correlation maps using the beamformer output images and accuracy on the SWM task were computed. The results indicated transient theta oscillations in spatially distinct subregions of the prefrontal cortices at the onset of encoding and maintenance, as well as strong and sustained decreases in alpha and beta throughout most of encoding and maintenance in parietal, temporal, and occipital regions. The neuro-behavioral correlations suggested that beta oscillations within the left dorsolateral prefrontal cortex and bilateral superior temporal gyri was negatively correlated with SWM accuracy. We propose that the prefrontal theta oscillations may play a role in the selection and integration of goal-relevant information, while the

posterior alpha and beta oscillations may serve sustained attention and maintenance processes during SWM performance. Notably, this is the first study to significantly link neural oscillations to behavioral performance in the context of SWM, and our results indicated that superior temporal integration and prefrontal central executive control regions may be critical to SWM performance.

Topic Area: EXECUTIVE PROCESSES: Working memory

Relationships between white matter in infancy and subsequent language abilities in preschool

Poster B41, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Jennifer Zuk[1,2], Michael Figuccio[1], Xi Yu[1], Joseph Sanfilippo[1], Jade Dunstan[1], Clarisa Carruthers[1], Ellen Grant[1,2], Nadine Gaab[1,2,3]; [1]Boston Children's Hospital, [2]Harvard Medical School, [3]Harvard Graduate School of Education

A rich body of evidence has identified the neural basis for language that is already present before birth, and longitudinal studies have found that behavioral and neural responses to language-related stimuli in infancy predict language abilities in preschool. To date, neuroimaging studies have predominantly employed electrophysiological methods with infants to characterize brain activity, whereas brain structure and its relation to subsequent language development remains understudied. Therefore, the present study investigates how brain structure in infancy relates to emerging language abilities in preschool. This study draws from an ongoing longitudinal investigation of infants with and without familial risk for dyslexia. Initially, structural neuroimaging was successfully acquired with infants (ages 4-18 months) using a natural sleep technique. Automated Fiber Quantification was employed to estimate white matter properties of language-related tracts from diffusion weighted images. Infants were then longitudinally enrolled and reinvited for follow-up assessment in preschool. To date, 25 follow-ups (mean age: 5.5 yrs, age range: 4–6.5 yrs) have completed a comprehensive language evaluation. Longitudinal analyses establish significant relationships between (i) the left arcuate fasciculus in infancy and vocabulary knowledge in preschool, and (ii) the posterior corpus callosum in infancy and phonological awareness abilities in preschool. Preliminary findings suggest that properties of white matter in language-related tracts predict language abilities in preschool. This research has the potential to uncover white matter properties in infancy that underlie the developmental trajectory of typical and atypical language development in early childhood, and further consider the role of early brain structure in shaping subsequent language outcomes.

Topic Area: LANGUAGE: Development & aging

Right lateralization of white matter tracts in infants with a genetic risk of developmental dyslexia

Poster B42, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Clarisa Carruthers[1], Xi Yu[1,2], Jennifer Zuk[1,2], Jade Dunstan[1], Joseph Sanfilippo[1], P. Ellen Grant[1,2], Nadine Gaab[1,2,3]; [1]Boston Children's Hospital, [2]Harvard Medical School, [3]Harvard Graduate School of Education

Dyslexia is highly heritable and several dyslexia susceptibility genes have been identified to date. These have been shown to be important for early brain development in utero. Previous studies have revealed atypical structural and functional characteristics in the left-hemispheric reading network in individuals with developmental dyslexia (DD) and/or family history of DD as early as infancy. It has been suggested that possible compensatory pathways could form in the right hemisphere in dyslexic readers, which might be driven by genetic and environmental factors. However, the emerging process of this alternative network is largely unknown. Here, we investigated the association between right-hemispheric white matter structure and genetic risk of DD in early development in 47 infants (ages 4-18 months), 24 with a family history of DD (FHD+) and 23 without (FHD-). Fractional anisotropy (FA) in the right superior longitudinal fasciculus (RSLF), right arcuate fasciculus (RAF), and right inferior longitudinal fasciculus (RILF) were quantified at various nodes using an automated fiber quantification (AFQ) method. Two-sample t-tests were conducted to compare white matter density between FHD+ and FHD- infants at every node in the RSLF, RAF, and RILF. Higher FA was observed in the RILF and RSLF in FHD+ infants compared to FHD- infants, whereas the RAF did not show significant differences between these

two groups. The present findings demonstrated higher white matter integrity in the right hemisphere in infants at risk for DD, suggesting that a right lateralized network for language/reading might start to emerge as early as infancy.

Topic Area: LANGUAGE: Development & aging

Brain Activity During Executive Tasks Predicts Individual Differences in Reading Ability

Poster B43, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Kai Wang[1], Marie Banich[1], Daniel Leopold[1], Andrew Reineberg[1], Laurie Cutting[2], Lee Thompson[3], Erik Willcutt[1], Stephen Petrill[4]; [1]University of Colorado Boulder, [2]Vanderbilt University, [3]Case Western Reserve University, [4]Ohio State University

Previous evidence suggests that reading ability may be influenced, in part, by domain-general aspects of executive function (EF). Yet little is known about how individual differences in brain mechanisms supporting EF might influence individual differences in reading, a question we investigated here in a sample of adolescents in their late teens. We acquired fMRI data in an overlapping sample of individuals on two tasks: an N-back task (N=249, mean age=17.06, SD=1.57), which assesses executive aspects of working memory, and a reading comprehension task (N=234, mean age=17.13). An individual's level of ability in each domain was determined by measures obtained outside the magnet. GLM covariate analyses were performed for each task to isolate those brain regions whose activation is associated with level of ability. Three methods were used to determine which regions associated with reading ability are also associated with EF. First, we masked our reading covariate map by brain regions that consistently activate during EF tasks across individuals as indicated by Neurosynth (neurosynth.org), a meta-analytic tool of brain activation across studies. Next, we masked our reading covariate map by regions associated with individual differences in EF as determined by our covariate EF analysis. Finally, we isolated regions that are associated with individual variation both in reading as well as in EF through a whole-brain corrected conjunction analysis of the two covariate maps. These analyses suggested that EF regions predicting reading ability are mainly observed in the parietal cortex and suggest that EF contributes to individual differences in reading ability.

Topic Area: LANGUAGE: Other

A functional magnetic resonance imaging investigation of the overlap between voluntary and reflexive spatial attention and lexical and sublexical reading

Poster B44, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Chelsea Ekstrand[1], Josh Neudorf[1], Marla Mickleborough[1], Layla Gould[1], Ron Borowsky[1]; [1]University of Saskatchewan

Spatial attention and reading processes have long been investigated in isolation, however there has recently been a shift to investigate their potential interactive effects behaviorally (e.g., Franceschini et al., 2012). Neuroanatomically, both reading and attentional processes have been shown to dissociate along dorsal and ventral streams- lexical reading engaging a left ventral occipito-temporal circuit and sublexical reading engaging a left dorsal temporo-parietal circuit. Similarly, voluntary attention engages a dorsal attentional system (frontal eye fields; superior parietal lobule, SPL; and intraparietal sulcus, IPS), whereas reflexive attention engages a ventral attentional system (temporo-parietal junction, TPJ; intraparietal sulcus, IPS; and inferior and middle frontal gyri). However, the overlapping neural correlates of attention and reading have yet to be explored. Therefore, we sought to investigate the overlapping neural mechanisms of spatial attention and reading using fMRI. Participants performed two attentional orienting tasks (reflexive and voluntary) and two reading tasks (lexical and sublexical). We hypothesized that sublexical reading would show greater overlap with the voluntary attention task in dorsal attentional areas, whereas lexical reading would show greater overlap with the reflexive attention task in ventral attentional areas. Results showed unique overlap between reflexive attention and lexical reading in the right TPJ, right frontal operculum (rFO), and right putamen. Sublexical reading showed unique overlap with voluntary attention in the right SPL and the right IPS, whereas lexical reading showed overlap in the rTPJ and rFO. These results elucidate several neuroanatomical regions of overlap between attentional and single-word reading processes that underlie their interactive effects.

Topic Area: LANGUAGE: Other

Effects of polyglotism on functioning of the language, MD, and DMN networks.

Poster B45, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Olessia Jouravlev[1,2], Zachary Mineroff[1], Evelina Fedorenko[1,3,4]; [1]Massachusetts Institute of Technology, [2]Carleton University, [3]Harvard Medical School, [4]Massachusetts General Hospital

Research on neurocognitive mechanisms of exceptional language processing is lacking. We report the first fMRI investigation of seventeen polyglots (M(languages)=11.6; range(languages)=5-55). In Study 1, we explored whether the language network of polyglots was different from that of non-polyglots. The language network was defined individually using the Sentences>Nonwords contrast of the language localizer task (Fedorenko et al., 2010). The polyglots showed both less extensive activation and a smaller Sentences>Nonwords effect than non-polyglots. No group differences were observed in two control brain networks (Multiple Demand and DMN), arguing against ubiquitous group differences in information processing. This finding suggests that language processing is more efficient in individuals speaking multiple languages compared to monolinguals. In Study 2, we examined how different languages (i.e., native language (L1), non-native languages (L2-L4), cognates languages (L5-L6), and unfamiliar languages (L7-L8)) are represented in the polyglots' brains. Participants listened to intact passages in different languages and to a control scrambled-speech condition. The Intact>Scrambled contrasts for the different languages activated highly overlapping areas within the language network. The Intact>Scrambled effect was reliable in all languages (ps<0.03), but its size generally scaled with proficiency, decreasing from L2 to L8, except for the response to L1, which was relatively low. Thus, the ability to extract high-level linguistic information from the speech signal leads to stronger responses in the language regions. However, one's native language constituted an exception: the response was lower than to familiar non-native languages, perhaps reflecting greater efficiency.

Topic Area: LANGUAGE: Other

Modulatory Effects of Emotional Prosody on Neural Sensitivity to Speech Discrimination in Second Language Learners

Poster B46, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Chieh Kao[1], Yang Zhang[1]; [1]University of Minnesota

Basic emotional signals in speech are thought to be universal whereas phonetic processing is language-specific. Our event-related potential (ERP) data showed that emotional prosody modulates phonetic processing at the early pre-attentive level and the later stages. This follow-up study used the same multi-feature oddball paradigm to investigate whether English-as-a-second-language (ESL) learners' neural responses to English stimuli with phonetic and prosodic contrasts would show similar modulation effects. Participants were sixteen adult ESL learners. The monosyllable /bab/ in a neutral tone was the standard. The deviants differed from standard in prosody (happy and sad), phoneme (/gab/), or both dimensions (happy-/gab/ and sad-/gab/). For the /b-g/ phonetic contrast and neutral-sad contrast, the ESL learners showed mismatch negativity (MMN) responses similar to the native English speakers. While happy prosody also elicited a similar positive mismatch response at about 250 ms, it did not produce a later negativity in the ESL learners. For deviants with changes in both phonetic and prosodic dimensions, the early MMN response (prior to 150 ms) that was found in native English speakers was missing in the ESL group and there were also differences in later stages of processing. These results demonstrate similarities and differences between first and second language speakers in their neural sensitivity to basic emotional signals in speech. Moreover, the modulatory effects of emotional prosody on phonetic discrimination are shaped by language experience.

Topic Area: LANGUAGE: Other

Phoneme learning in a musical context

Poster B47, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Mihye Choi[1], Ertugrul Uysal[1], Mohinish Shukla[1]; [1]University of Massachusetts Boston

Phoneme learning has been described as a narrowing process – while 6-mo-olds are universalists in their phoneme discrimination patterns, they lose discrimination capacities for non-native contrasts and begin strengthening native contrasts by their first birthday. A sensitivity to distributional properties of phonetic tokens has been hypothesized to lead learners to induce the appropriate underlying phonemic categories. In babies and adults, exposure to a continuum from [da] to [ta] with highest frequencies at the ends of the distribution (i.e., a bimodal distribution) leads to better discrimination of [da] and [ta] tokens compared to exposure to a unimodal distribution with a peak centered on the [da]-[ta] continuum. Separately, musical experience has been shown to influence linguistic abilities (the OPERA model). In this study, we bring these disparate observations together and ask if distributional learning can be enhanced by musical presentation. English speakers were exposed to an eight-step continuum from Hindi [ba] to [pa], with a unimodal or bimodal distribution. Additionally, half the participants were trained with monotonous presentation of the tokens, while for the other half the pitch of the tokens was manipulated to approximate a melody (Vivaldi's Winter). Data collection is underway. Preliminary results suggest that, in the absence of music, participants are better at discriminating the non-native contrasts in the bimodal, compared to the unimodal condition. However, there are no differences between unimodal and bimodal presentations in the musical context groups. If this pattern of results remains, it would suggest a positive effect of language training in a musical context.

Topic Area: LANGUAGE: Other

Predicting Reading Comprehension from Eye Movement Features using Deep Neural Network

Poster B48, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Xiaochuan Lindsey Ma[1], Jinlong Hu[2], Xiaowei Zhao[3], Ping Li[1]; [1]Pennsylvania State University, [2]South China University of Technology, [3]Emmanuel College

Eye movements have been utilized as an index of attention and comprehension during reading from a wide range of literature. Highly skilled readers are found to show shorter fixations, more skips, and fewer regressions as compared with less skilled readers (Ashby, Rayner, & Clifton, 2005). In this study, participants read five science texts in the MRI, while their eye movements were recorded. By combining readers' real-time eye movements with neuroimaging, we could identify lexical access and semantic integration processes on the basis of moment-by-moment information processing. Readers' reading comprehension ability was also assessed by the Gray Silent Reading Test (Wiederholt & Blalock, 2000), which allowed us to classify readers' comprehension into two levels (High vs. Low). We hypothesized that these two levels could be predicted given their eye movement features (word-level fixation duration, skip rate, and regression rate, etc.) during reading. A Deep Neural Network (DNN) model (Bengio, 2009) with three hidden layers was trained on the eye-movement features to learn to predict the two groups of participants. After applying L1 & L2 regularization as well as dropout layer to reduce over-fitting, the DNN model reached a 70% accuracy on classifying high vs. low reading comprehension groups. A similar DNN with three hidden layers was applied on participants' fMRI images. However, due to the high dimensionality of the fMRI data (34200 voxels), the model failed to classify the images into appropriate groups. Future studies need to consider feature selection methods to improve the model's performance based on fMRI data .

Topic Area: LANGUAGE: Other

Two late positivities during sentence comprehension: The influence of wrap-up and cognitive control

Poster B49, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Trevor Brothers[1,2], Eddie Wlotko[3], Simone Riley[1], Margarita Zeitlin[1], Connie Choi[1], Gina Kuperberg[1,2]; [1]Tufts University, [2]Massachusetts General Hospital, [3]Moss Rehabilitation Research Institute

During sentence comprehension, context can influence both the initial access of word meanings (300-500ms) and more prolonged, re-interpretive processes (500-1200ms). Here, we investigated the cognitive mechanisms underlying two late post-N400 positivities, which are known to vary as a function of plausibility and lexical constraint. In this study (N = 70), we measured ERPs as participants read sentences with predictable, unpredictable, or anomalous critical words ("Father carved the turkey with a knife/smile/beach…"). For 33 participants, critical words appeared in the sentence-final position, where "wrap-up" effects are maximal. For 37 participants, a few words were added to each sentence to delay sentence wrap-up. Finally, to probe the role of cognitive control in generating these late ERP components, we used the AX Continuous Performance Task (AX-CPT) to assess individual differences in cognitive control abilities. Unpredicted words produced a larger late anterior positivity, and anomalous words produced a larger late posterior positivity, relative to predictable words. Critically, the amplitude of the anterior positivity was larger for critical words appearing in sentence-final positions. This pattern was reversed for the late posterior positivity, with larger anomaly responses occurring in sentence-medial positions. Finally, improved performance on the AX-CPT appeared to selectively enhance the magnitude of the late anterior positivity, suggesting that the re-interpretation of unexpected (but plausible) events may depend on frontally-mediated cognitive control abilities.

Topic Area: LANGUAGE: Semantic

Effective Connectivity of Aphasic Bilingual Semantic Processing

Poster B50, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Robert Buckshaw II[1], Erin Meier[1], Swathi Kiran[1]; [1]Boston University

In a world becoming increasingly bilingual, it is essential to understand how bilingual individuals process meaning. Bilingual adults with aphasia (BAA) who have semantic deficits secondary to stroke can experience impairments that leave them unable to communicate in either language. As such, the current study aimed to characterize connectivity between two key regions implicated in semantic control: inferior frontal gyrus, pars triangularis (IFGtri) and posterior middle temporal gyrus (pMTG), during a semantic association task in four BAA and four age-matched, healthy bilingual controls (BHC). We used fMRI and dynamic causal modeling (DCM) and created a model space to test hypotheses regarding the nature of semantic processing in term of directionality (i.e., feedforward [MTG-IFG] vs. feedback [IFG-MTG]) and laterality (i.e., left, right, or bilateral lateralization). The best fit model for the majority of participants was represented by a bilateral feedback connectivity model. However, as some participants favored other models, parameter analysis was done using data from single subject best fit models. The results showed that BHC have stronger intrinsic connections (i.e., in the absence of task) than BAA. By contrast, BAA have stronger task-driven connections than BHC. These results suggest that patients experience more functional disconnect between IFGtri and pMTG than controls at rest but must rely on the connectivity between these regions to a greater extent during a task requiring semantic control. Ultimately, knowing how left hemisphere damage impacts semantic network connectivity will allow for better therapeutic treatment for those suffering from aphasia.

Topic Area: LANGUAGE: Semantic

Semantic processing of self-adaptors, emblems, and iconic gestures: An ERP study

Poster B51, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Kawai Chui[1], Chia-Ying Lee[2,3], Kanyu Yeh[1], Pei-Chun Chao[3]; [1]National Chengchi University, Taiwan, [2]Academia Sinica, Taiwan, [3]National Yang-Ming University, Taiwan

The study investigates how the brain processes self-adaptors, emblems, and iconic gestures along with speech. The three types of gestures give rise to a continuum of semantic distinctions in relation to the accompanying speech. The overall N400 component occurred between 500 and 800 msec after the simultaneous gesture and speech onsets. In comparison to the speech-only condition, the reduced N400 evidenced the facilitation effect of iconic gestures at the centro-parietal sites. The meaningful yet non-speech-related emblems elicited enhanced N400s at the left frontal-parietal sites; the meaningless self-adaptors produced the largest N400 effect over the scalp at the frontal-parietal sites. Self-adaptors had a larger negativity of N400 than emblems did at the centro-parietal regions. The results evidence the automatic integration of gesture and speech, and the diverse influence of gesture on processing. Only iconic gestures facilitate the semantic integration with speech. For a linguistic meaning to integrate with a speech-unrelated emblem is less effortful than with a meaningless self-adaptor, as pragmatic or world knowledge would be needed for the processing of self-adaptors.

Topic Area: LANGUAGE: Semantic

University students with a history of reading difficulty show reduced neural effects of word expectancy

Poster B52, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Suzanne Welcome[1]; [1]University of Missouri - St Louis

It is known that some individuals identified as having severe reading problems in childhood have no apparent reading comprehension deficits in adulthood. What is not fully understood is how individuals with compensated dyslexia read. One possible compensatory mechanism is greater reliance on meaningful relationships between words. We used event-related potential (ERP) data to explore the idea that individuals with a history of reading difficulty make more use of sentence context to support word identification. University students with and without a self-reported history of reading difficulty completed a battery of standardized tests of reading and read a series of strongly or weakly constraining sentences ending in expected or unexpected words. We compared amplitude differences in the N400 (275-450 ms post stimulus onset) between expected and unexpected sentence-final words. Individuals with a history of reading difficulty showed smaller expectancy effects in the N400 window than their peers without such a history over parietal sites, particularly for weakly constraining sentence frames. Further, scores on the self-report measure of reading difficulty were significantly associated with the magnitude of expectancy effects across the whole sample of university students. Contrary to the prediction that individuals with a history of reading difficulty would show stronger effects of expectancy as a result of more reliance on meaningful relationships between words, individuals with a history of reading difficulty showed less difference between expected and unexpected sentence-final words. However, these results suggest that neural processing of sentence context differs between university students with different reading histories.

Topic Area: LANGUAGE: Semantic

A noisy channel account of ERP differences in sentence comprehension

Poster B53, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Veena D. Dwivedi[1], Janahan Selvanayagam[1], Victoria Witte[2], Harmonie Chan[1], Ted Gibson[3]; [1]Brock University, [2]Heidelberg University, [3]MIT

We used event-related brain potentials (ERPs) in order to investigate the interpretation of sentences that contained errors of deletion vs. errors of insertion. We investigated plausible (ditransitive) such as (i) The aunt mailed the letter to her niece by post as compared to sentences that deleted the preposition to, resulting in (double object) implausible sentences such as (ii) #The aunt mailed the letter_ her niece by post. In addition, related plausible (double object) sentences such as (iii) The aunt mailed her niece the letter by post were modified with the insertion of to resulting in an implausible (ditransitive) sentence such as (iv) The aunt mailed her niece #to the letter by post. All sentences were followed by yes/no comprehension questions such as Did the niece receive something? /Did the letter receive someone? Given that noisy channel models propose that deletion errors are more likely to occur than insertions, perceivers should be more likely to revise sentences with deletion vs. insertion errors. Thus, we further explored the ERP components elicited by these sentence types, based on previous work (Dwivedi et al., 2017). Previously, both sentence types exhibited a slow-going negativity, which might have been due to sentence length. These were shortened in this study. Deletion sentences still did elicit negative-going waveforms, insertion sentences did not. Instead, these elicited a late positivity. These effects were interpreted in terms of likelihood of revision; a corrected deletion sentence taxes working memory resources, whereas less likely correction at insertion sentences results in perceived ungrammaticality.

Topic Area: LANGUAGE: Syntax

Mechanisms of neural plasticity during recovery from sentence processing deficits in chronic stroke-induced aphasia: an fMRI study

Poster B54, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Elena Barbieri[1], Jennifer E. Mack[1], Brianne M. Dougherty[1], Eduardo Europa[1], Cynthia K. Thompson[1]; [1]Northwestern University, Evanston, IL

The role of the right hemisphere (RH) in aphasia recovery is still debated. While studies using repetitive transcranial magnetic stimulation (rTMS) have supported theories assigning the RH a maladaptive role in aphasia recovery, recent neuroimaging studies have suggested that changes in the RH neural activation or in functional connectivity may be associated with recovery of language functions (Kiran et al., 2015). The present study investigated the role of the RH in recovery of sentence processing in 11 participants with chronic stroke-induced aphasia who underwent a 3-month sentence comprehension/production treatment protocol focused on passive sentences (Treatment of Underlying Forms, Thompson & Shapiro, 2005) and 4 non-treated participants. At both timepoints, all participants underwent a block-design fMRI task employing a picture-verification task, in which comprehension of active and passive sentences was alternated with blocks of a control condition (scrambled picture presented with reversed speech). Increased activation (upregulation, $p<.001$ unc.) from pre (T0) to post-treatment (T1) was observed in the treatment group only. Region-of-interest (ROI) analyses showed significant upregulation ($p<.01$) in 'good responders' (i.e., participants exhibiting significant gains in comprehension and/or production), within the RH homologues of regions associated with sentence processing. Laterality indices computed for good responders at both timepoints indicated a shift from bilateral activation for passive>control at T0 to a right-lateralized activation at T1 within the sentence processing ROIs, and no shift within a subset of domain-general ROIs (dorsal attention network) The study demonstrates that the RH contributes to the restoration of normal-like sentence processing patterns in chronic aphasia.

Topic Area: LANGUAGE: Syntax

Testing associations between peri-adolescent differences in declarative memory abilities, intrinsic brain networks, and regional cortical thickness in a cross-sectional sample

Poster B55, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

David Warren[1], Nicholas Christopher-Hayes[1], Anthony Rangel[1], Julia Stephen[2], Vince Calhoun[2], Yu-Ping Wang[3], Tony Wilson[1]; [1]University of Nebraska Medical Center, [2]Mind Research Network, [3]Tulane University

Childhood and adolescent development are associated with cognitive changes including improvements in declarative memory abilities, but the brain changes supporting memory development are not well understood. Brain variables potentially related to memory development include structural measures (cortical thickness) and functional measures (resting-state functional connectivity [rs-FC]). To address whether these brain variables are associated with age-related changes in memory abilities, we drew on cross-sectional data from the Developmental Chronnecto-Genomics project (Dev-CoG). This project is currently collecting longitudinal cognitive and neuroimaging data from approximately 230 children and adolescents. Here, we used Dev-CoG Year 1 data from children and adolescents ($n=109$, age=9-15) in a cross-sectional analysis to test whether measures of intrinsic brain function (rs-FC) and brain structure (cortical thickness) were related to age, memory performance, and their interaction. Measures of rs-FC were based on ten minutes of resting-state fMRI data and a hippocampal seed region; cortical thickness was estimated from structural MRI data with FreeSurfer; and memory was assessed with the NIH Toolbox Picture Sequence Memory Test. For rs-FC measures, we observed an overall pattern that broadly resembled the default mode network with significant local differences related to age (widespread), memory performance (lateral parietal), and their interaction (cuneus). Similarly, cortical thickness showed robust, widespread differences with age and some evidence for local differences related to memory performance. Our results support the hypothesis that age-related differences in peri-adolescent memory abilities are related to unique changes in brain structure and brain function.

Topic Area: LONG-TERM MEMORY: Development & aging

Age-related Differences in the Effects of Lying on Cognitive Control and Memory

Poster B56, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Laura Paige[1], Angela Gutchess[1]; [1]Brandeis University

Misinformation alters memory and lying could have similar implications. Lying requires cognitive control to inhibit truthful information, processes that decline with age. However, if older adults cannot reconcile competing information, lying may not impair their memory. In the present study, younger and older adults completed a questionnaire in which they lied or told the truth while EEG data was collected. After a delay, participants completed the same questionnaire answering all items truthfully, which served as a recognition test. Medial frontal negativity (MFN) is an event related potential (ERP) component associated with cognitive control, occurring ~70 ms post-response. Prior work suggests it is greater for deceptive relative to truthful responses. We predicted that lying would increase MFN response relative to the truth, due to increased cognitive control, and would impair correct memory at later test. Because older adults have difficulty with cognitive control, we predicted they would exhibit a smaller MFN response for lies and that lying would not impair correct memory relative to younger adults. Contrary to our predictions, older adults had worse memory for items to which one lied relative to younger adults, and the two groups did not differ in memory performance for truth items. Further, MFN response was greater for items to which one told the truth relative to lies and there were no age differences. Taken together, this suggests that processes other than cognitive control are involved in lying, and perhaps that reinforcing truthful information necessitates additional executive functioning.

Topic Area: LONG-TERM MEMORY: Development & aging

Age Differences in Emotional Integrative Memory

Poster B57, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Shaina L. Garrison[1], Kelly S. Giovanello[1]; [1]University of North Carolina at Chapel Hill

Past research has suggested the presence of an age-related deficit in binding together separate components of an episodic memory (Naveh-Benjamin, 2000). Furthermore, these deficits have been shown to be ameliorated by the presence of emotional information in the episode (Murray & Kensinger, 2013). The present study examined cognitive processes contributing to age-related differences in associative recognition memory for emotional and neutral integrated information. Older and younger adults studied word pairs consisting of either two neutral words or one neutral and one emotional (positive or negative) word, under integrative encoding instructions. While all older adults encoded under full attention (OA-FA), younger adults either encoded under full attention (YA-FA), speeded (YA-DA-Item-Hard) or normal-speed item-processing divided attention (YA-DA-Item), or integration-processing divided attention (YA-DA-Integration). Participants then completed item memory (IM) and relational memory (RM) tests. Results indicate that YA-FA participants perform better on the RM test than the IM test for neutral and positive integrations. However, dividing attention at encoding with the YA-DA-Item and YA-DA-Item-Hard conditions eliminated this RM advantage. Critically, both OA-FA and YA-DA-Integration participants demonstrated worse RM than IM performance for negative integrations. The similarity in the pattern of results between these conditions suggests that aging leads to a selective reduction in integrative processing during integrative encoding. This age-related integration deficit may yield a specific deficit in retrieving bound negative and neutral information. The results are interpreted in the context of prominent theories of cognitive and neural changes associated with aging.

Topic Area: LONG-TERM MEMORY: Development & aging

A trade-off in category- and item-level learning: implications for development

Poster B58, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Erika Wharton-Shukster[1], Amy S. Finn[1]; [1]University of Toronto

During the process of learning, we gather information at multiple levels of analysis. For instance, when observing an object, we learn item-level features that are unique to that object as well as patterns that stretch across multiple objects, how they are similar and different. The latter is an abstraction of our knowledge, allowing us to create categorical representations. However, it is not fully understood how these forms of learning occur in parallel. In particular, could learning specific items well impair similarity abstraction? Given that children have been shown to recall specific items better than adults in certain conditions (Sloutsky & Fisher, 2004), this question is even more pressing for understanding developmental shifts in the nature of learning. To investigate this tradeoff in adults, we used a conceptual learning task consisting of stimuli varied at the categorical and individual level. The categories were defined by distortions of two prototypical checkerboard patterns, and each item varied by color and shape unique to them. Participants learned to categorize the exemplars via response feedback. They were then given a recognition memory posttest to assess item-level learning. The conceptual learning scores showed category learning in half the sample. Using a median split, participants were grouped into Good Learners and Poor Learners. A difference in memory accuracy was found, with Poor Learners performing more accurately than Good Learners. This suggests a trade-off between learning at the category- and item-level; adults who learn the categories well also don't recall the specific exemplars that led to this learning.

Topic Area: LONG-TERM MEMORY: Development & aging

Modeling the dynamic content, encoding, and retrieval of naturalistic stimuli

Poster B59, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Andrew Heusser[1], Jeremy Manning[1]; [1]Dartmouth College

The dynamic content of naturalistic stimuli is much more richly structured than traditional (highly controlled, but impoverished) stimuli, interweaving many simultaneous interacting information streams. This presents a substantial challenge to studying naturalistic cognitive phenomena. For example, to study how participants encode and retrieve information contained in a video, one needs to formally define (a) the dynamic informational content of the video (b) a means of assessing the participant's memory, and (c) a means of matching up the participant's responses with specific moments of the viewed video. We present a methodological advance for studying naturalistic learning and memory. Specifically, we develop an automated pipeline that uses machine learning algorithms to extracting a text description of each frame of video and moment of audio. We then apply topic models (Blei et al., 2003) to the extracted text (treating each moment of video as a "document"). This yields topic vectors (i.e. a mix of themes) for each moment of video. We apply the same pipeline to spoken responses from participants, and we use the match between the topic vectors of the video and participant's responses as an indication of which moments of video each response is about. We apply our approach to data collected as participants viewed and verbally recalled an episode of Sherlock (Chen et al., 2017). Our automated approach replicates behavioral results from the original study that previously required manually matching up each moment of video and response.

Topic Area: LONG-TERM MEMORY: Episodic

Map-like coding of personal preferences facilitates social learning.

Poster B60, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Raphael Kaplan[1], Karl Friston[1]; [1]University College London

Spatial cognition relies on transitioning between personal and external frames of reference in order to navigate our everyday world, yet how we switch between different reference frames during other behaviors like social decision-making is less clear. Here, we ask whether the functional anatomy of spatial navigation in extrapersonal space is also used when making abstract decisions about others and their social preferences. We had healthy volunteers give likelihood ratings for the personal preferences of a close friend, a typical person, and themselves for 100 different everyday scenarios (e.g., eating spicy food). Afterwards, during fMRI scanning, participants learned a novel agent's personal preference for each previously rated scenario relative to themselves, their friend, or the typical person and then had to choose which of the two remaining individuals was closer to that novel agent's preference. This enabled us to test for a main effect of changing the frame of reference, parametric effects of choice discriminability, and interactions between these two factors. We found that medial orbitofrontal cortex responded to choice discriminability differently depending on

which reference frame was initially used to learn the novel agent's personal preference. Notably, hippocampal and retrosplenial cortex responded to reference frames differently depending on how much allocentric translation was necessary to learn a novel agent's personal preference for a given scenario. Taken together, these results provide evidence of distinct reference frame calculations in orbitofrontal cortex, hippocampus, and retrosplenial cortex during a social decision-making task that requires autobiographical memory.

Topic Area: LONG-TERM MEMORY: Episodic

The role of the prefrontal cortex in accuracy of judgments of learning

Poster B61, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Alexandra M. Gaynor[1], Elizabeth F. Chua[1,2]; [1]The Graduate Center, The City University of New York, [2]Brooklyn College, The City University of New York

Accurate awareness of one's memory is crucial for effective control of learning. When individuals make confidence judgments at study about their ability to remember information at later test, known as Judgments of Learning (JOLs), they often base JOLs on cues that are not predictive of memory accuracy, such as encoding fluency, while disregarding cues such as depth of encoding, which do influence memory accuracy. Neuroimaging studies suggest the anterior prefrontal cortex (aPFC) is involved in JOL accuracy, and the dorsolateral prefrontal cortex (DLPFC) is associated with the magnitude of JOL ratings; however, no studies have tested the roles of these regions in JOLs that are based on different cues. We applied high-definition transcranial direct current stimulation (HD-tDCS) over the aPFC, DLPFC, and sham stimulation while participants studied and gave JOLs to high-frequency and low-frequency words, presented upright or inverted 180°. Participants took an old/new recognition test 24 hours later. Results demonstrated that participants gave higher JOLs to high-frequency words ($p<0.01$) but had better memory for low-frequency words ($p<0.001$). They gave marginally higher JOLs to upright words ($p=0.08$) but had better memory for inverted words ($p<0.001$). There was a marginally significant interaction ($p=0.07$) between the effects of stimulation and frequency on JOL accuracy: while JOL accuracy was similar for high- and low-frequency words under both sham and DLPFC stimulation, aPFC stimulation significantly improved JOL accuracy for low-frequency words. Results suggest the role of the aPFC in JOL accuracy may vary with the cues on which JOLs are based.

Topic Area: LONG-TERM MEMORY: Episodic

Familiarity and Retrieval Monitoring Effects on Dorsal Striatum Connectivity across the Adult Lifespan

Poster B62, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Paul F Hill[1,2], Marianne de Chastelaine[1,2], Eleanor S Liu[1,2], Michael D Rugg[1,2]; [1]University of Texas at Dallas, [2]Center for Vital Longevity

Recollection and familiarity-based memory judgments elicit activity in bilateral dorsal striatum. Despite striatal dopamine loss and atrophy with advancing age, the stability of striatal recognition memory effects across the adult lifespan is unknown. We used fMRI to investigate familiarity- and retrieval-monitoring related changes in dorsal striatal connectivity across three age groups. Young, middle-aged, and older adults were scanned as they made associative recognition judgments about previously encoded word pairs. Familiarity and monitoring effects were operationalized as contrasts between studied test pairs incorrectly endorsed as rearranged vs (1) correctly rejected new pairs, or (2) studied test pairs correctly endorsed as intact, respectively. Psychophysiological interaction analyses identified increased familiarity- and monitoring-related functional connectivity with separate bilateral caudate seeds. Familiarity related connectivity changes were observed in left intraparietal sulcus (IPS), right dorsolateral prefrontal cortex (DLPFC), and pre-supplementary motor cortex. Retrieval monitoring connectivity changes were observed in left IPS, left DLPFC, and dorsomedial prefrontal cortex. A region of interest analysis revealed additional monitoring related dorsal striatal coupling with left anterior hippocampus and parahippocampal gyrus. Regression analyses tested the independent contributions of age, recollection performance, and age by recollection interactions on connectivity change. Across all regions, the magnitude of connectivity change was age-invariant after controlling for recollection, with one exception. Compared

to young and middle aged adults, the relationship between recollection and monitoring-related striatal-hippocampal coupling among older adults was significantly attenuated. These results suggest a network for tracking familiarity strength during associative recognition memory as well as a potential source of age related memory impairment.

Topic Area: LONG-TERM MEMORY: Episodic

Event boundaries modulate neural representations of temporal context

Poster B63, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Lynn Lohnas[1], M. Karl Healey[2], Lila Davachi[1]; [1]New York University, [2]Michigan State University

Although we experience everyday life as a continuous stream of information, we generally perceive and remember this information as discretized events. It has been hypothesized that as experiences are segmented, they are separated by event boundaries (Zacks et al., 2001). Interestingly, recent work has shown that segmenting experiences also influences how those experiences are remembered. Critically, stimuli presented in different events are more weakly associated than stimuli presented in the same event (DuBrow & Davachi, 2013, 2014, 2016; Ezzyat & Davachi, 2011, 2014). Here we examined how boundaries may weaken associations by modulating context representations. We examined a slowly changing neural representation used to query temporal context (Manning et al., 2011) and the implications for behavior. We recorded scalp electroencephalography while participants (N=147) performed a free recall task, with events operationalized as 2-6 words studied with the same encoding task. Each studied or recalled word was associated with a temporal context vector, defined as an autocorrelated vector of power values across electrodes and frequencies. Our results were motivated by predictions of the Context Maintenance and Retrieval model (CMR; Polyn et al., 2009), which assumes that boundaries disrupt temporal representations. Thus, CMR predicts that, controlling for objective time, the similarity in temporal context should be greater between two words from the same event than two words presented in different events. We found the neural data were consistent with CMR's prediction. Further, across participants, behavioral performance correlated with the extent of the decrease in neural similarity for items within versus across events.

Topic Area: LONG-TERM MEMORY: Episodic

Representational similarity patterns predict subsequent source memory but are disrupted by task switching in temporo-occipital regions

Poster B64, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Carolin Sievers[1], Fraser W. Smith[1], Janak Saada[1], Louis Renoult[1]; [1]University of East Anglia, UK

The present experiment used functional magnetic resonance imaging to investigate representational similarity patterns across repeated stimulus encoding in either a same task or a task switching condition. Twenty adult participants performed categorization tasks during the encoding phase, followed by an unexpected recognition-source memory task. During encoding, each stimulus was presented four times and participants either performed the same task repeatedly or a different task at each of the four encoding presentations. We hypothesized subsequent correct source memory judgements to be associated with higher neural pattern similarity between encoding episodes compared to incorrect source memory judgements. Furthermore, we predicted pattern similarity to be lowered when different tasks were performed. In line with these hypotheses, neural similarity was found to be higher for correct compared to incorrect subsequent source memory judgements. Moreover, pattern similarity in frontal regions, including the superior frontal gyrus predicted source memory performance irrespective of encoding task condition, while temporo-occipital regions only predicted source memory outcome when the same task was performed repeatedly. These results suggest that frontal regions represent source information regardless of associated encoding operations, consistent with their implications in task switching. Pattern similarity in posterior regions did not discriminate between subsequent correct and incorrect source judgements when stimuli were incidentally encoded in different tasks highlighting the need for consistent encoding and task-related reactivation in order to predict subsequent source memory.

Topic Area: LONG-TERM MEMORY: Episodic

Pattern separation and integration in hippocampus are the result of memory reactivation during learning

Poster B65, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Robert Molitor[1], Katherine Sherrill[1], Neal Morton[1], Alison Preston[1]; [1]University of Texas at Austin

Efficient learning requires encoding of both detailed information from individual events and generalities across experiences. In service of these goals, it is hypothesized that hippocampus can create orthogonal memories through pattern separation or form integrated representations that code common features across memories. To optimize learning, it is critical to identify how these neural codes come to coexist within hippocampus. One factor that may influence whether related memories become integrated or separated is memory reactivation during learning. Recent evidence indicates that memories are reactivated in neocortex when learning overlaps with past experience. Although reactivation is thought to promote integration of new information into existing memories, reactivation may also lead to competition between memories, requiring pattern separation. Here, we used fMRI to test the hypothesis that the strength of reactivation during learning influences whether hippocampus separates or integrates related memories. Participants learned initial picture associations (AB pairs) and overlapping associations (BC pairs). Before and after learning, participants viewed individual images (A and C). We used pattern analysis to assess whether hippocampal activation patterns for indirectly related images (A and C) became less similar (separated) or more similar (integrated) after learning. Additionally, we used pattern classification to measure reactivation of related memories (A items) in ventral temporal cortex during overlapping event (BC) learning. Consistent with our hypothesis, we found that the strength of memory reactivation predicted whether indirectly related memories were separated or integrated in hippocampal subfields. These findings provide insight into the basis of the different neural codes formed by hippocampus.

Topic Area: LONG-TERM MEMORY: Episodic

What happens in the human brain when explicit warnings reduce false memories?

Poster B66, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Sara Cadavid[1], M. Soledad Beato[2], Mar Suarez[2]; [1]Universidad del Rosario, Colombia, [2]Universidad de Salamanca, Spain

We analyzed the effects of warnings on false recognition (FR) employing Deese/Roediger-McDermott paradigm. In this paradigm, words associated to a non-presented critical lure are studied and, subsequently, critical lures are often falsely remembered/recognized. We collected behavioral data, and, furthermore, we used event-related potentials (ERPs) to understand what happens in the human brain when this memory task is performed with warnings. ERPs were obtained to study frontal FN400 (300-500 ms), left-parietal (500-800 ms), and late right-frontal (1000-1500 ms) old/new effects (associated with familiarity, recollection, and monitoring processes, respectively). First, at the behavioral level, although it was not possible to eliminate FR in Warning condition, as expected, FR was higher in the No-Warning condition. Second, the ERP results regarding the FN400 old/new effect showed similar patterns for true recognition and FR. Therefore, true recognition and FR seemed to share common underlying familiarity-based processes. Differences between Warning and No-Warning conditions were only observed on true recognition patterns, and only in this particular epoch: Warning-condition participants presented a more pronounced familiarity-related effect. This outcome suggests that warnings actually led to strategic encoding. ERP similarities between true recognition and FR disappeared when recollection processes were examined, because only true recognition presented a left-parietal old/new effect. Later, with the onset of monitoring processes, true recognition and FR waveforms presented, again, clearly similar patterns, showing both a late right-frontal old/new effect associated with post-retrieval monitoring processes. Together, findings suggest that, even when participants are provided with warning instructions, true recognition and FR share some common underlying processes.

Topic Area: LONG-TERM MEMORY: Episodic

Ultra-high resolution functional magnetic resonance imaging of hippocampal subfield networks during pattern separation

Poster B67, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Stephanie Langella[1], Shaina Garrison[1], Wei-Tang Chang[1], Weili Lin[1], Kelly Giovanello[1]; [1]University of North Carolina at Chapel Hill

The dynamic interaction between the hippocampus and neocortical regions is known to be critical for memory functions. The hippocampal formation consists of several distinct subfields, including CA1, CA3, subiculum, and dentate gyrus (DG), each contributing in unique ways to different aspects of memory. Prior ultra-high resolution (e.g., voxel size = 1mm3) functional magnetic resonance imaging (fMRI) studies have been limited to the hippocampus due to technical constraints associated with whole-brain investigations. In the current project, we examined hippocampal subfield-neocortical functional connectivity using a novel ultrahigh-resolution imaging sequence at 7T. Participants completed a continuous recognition version of the Mnemonic Similarity Task while task-based fMRI data were acquired. Preliminary results show increased DG activity, as compared to other hippocampal subfields, when viewing lure stimuli relative to repeated stimuli. Functional connectivity analyses of the task-based data suggest that the visual association cortex has stronger connections with DG, rather than with CA1. These results highlight the utility of using whole-brain ultra-high resolution fMRI to detect differences in hippocampal subfield connectivity beyond the medial temporal lobe. Such investigations may provide critical insight into hippocampal subfield network differences that occur as a function of age and neurodegenerative disease.

Topic Area: LONG-TERM MEMORY: Episodic

Does aging influence the use of episodic memory in decision making?

Poster B68, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Hannah Tarder-Stoll[1], Azara Lalla[1], Lynn Hasher[1], Katherine Duncan[1]; [1]University of Toronto

There is a well-documented decline in episodic memory function in healthy aging (Nyberg et al., 2012). However, older adults still perform well on decision making tasks that utilize past experiences (Flores et al., 2017). This apparent incongruity may be due to the arbitrary nature of most memory tasks with minimal motivational elements. In the current study, we investigated how younger and older adults use memory to make optimal decisions. Participants completed a card game in which they used object-point associations learned during a single event (episodic memory) to win as many points as possible. Older adults reliably used their episodic memories to guide their decisions, but did so significantly less than younger adults ($β=-0.692$, $p=0.024$). But do these age-related shifts in decisions reflect a reduced use of memories or an increased reliance on other types of memories? To answer this question, we also asked how aging influences the use of semantic memories (each object's value in the real world) and task irrelevant associations (changes to the card's location). Older adults' choices were significantly more biased by the semantic value of objects as compared to younger adults ($β=-.026$, $p=.037$). Additionally, older adults' preferences were significantly more influenced by memories of cards' previous spatial location as compared to younger adults ($β=.242$, $p=.043$). Together these findings suggest that older adults incorporate many types of memories, but younger adults selectively utilize what in this instance is the most relevant information, memories, pointing to an age-related shift in cognitive strategies used to make optimal decisions.

Topic Area: LONG-TERM MEMORY: Episodic

Prestimulus subsequent memory effects differ as a result of informative or uninformative cues

Poster B69, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Eleanor Liu[1,2], Paul F Hill[1,2], Marianne de Chastelaine[1,2], Michael D Rugg[1,2]; [1]University of Texas at Dallas, [2]Center for Vital Longevity

Neural activity elicited by a pre-stimulus cue that signals the task to perform on an upcoming stimulus event is predictive of subsequent event memory. Such 'pre-stimulus subsequent memory effects' (PSMEs) are found in, among other regions, the medial

temporal lobe, especially in the hippocampus, as well as in regions comprising the default mode network. Here we contrasted PSMEs according to whether the pre-stimulus cue was informative (signaling the nature of the upcoming task) or uninformative (task neutral). In two separate experiments, participants made one of two study judgments – animacy or syllabic– on visually presented words. Experiment 1 used the informative cue whereas experiment 2 used the uninformative cue. In both cases the subsequent memory task comprised a recognition memory test incorporating 'Remember/Know/New' judgments. PSMEs were operationalized by a 'Remember' versus 'Know' contrast. A 2x2 full factorial analysis revealed a significant main effect of task type in bilateral parahippocampal cortex, which was driven by greater PSMEs for the animacy compared to the syllable tasks. Parahippocampal PSMEs were more robust in response to informative than uninformative cues. We also observed a cue by task interaction in the right anterior hippocampus, which was driven by informative cues signaling the animacy task (as reported previously for experiment 1). This effect partially overlapped with the parahippocampal PSMEs. These results suggest that hippocampal PSMEs are dependent on task informative cue and may reflect the anticipation of the nature of an upcoming task.

Topic Area: LONG-TERM MEMORY: Episodic

Hippocampal-Thalamic Contributions to Associative Memory.

Poster B70, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Kirk T. Geier[1], Rosanna K. Olsen[1,2]; [1]Rotman Research Institute, [2]University of Toronto

Damage to anterodorsal thalamic subregions in rodents and humans can result in memory impairments or even amnesia (Aggleton et al., 2011). fMRI can determine the extent to which these thalamic subregions are involved in different memory processes. To our knowledge, only one previous fMRI study has specifically examined thalamic subregion activity during associative memory (Pergola et al., 2013). The current study uses fMRI (n=28) with concurrent eye-tracking to test the involvement of medial temporal lobe (MTL) and thalamic structures during associative memory (task adapted from Hannula and Ranganath, 2009). Face-scene pairs are encoded during the study phase and then during test trials, a studied scene appears and prompts the participant to retrieve the associated face and hold it in mind. After a brief delay, the scene reappears and participants select among three studied faces the face previously associated with the scene. Faces which were previously associated with the current scene (called "match" faces) were visually sampled significantly more than lure faces, even during incorrect trials, replicating previous results. However, we failed to observe heightened signal in the MTL associated with disproportionate viewing of match faces. During the delay phase (following the scene retrieval cue), significant activations were observed ($p<0.05$ FDR corrected) within the thalamus, dorsal striatum and ventral visual processing stream. These initial results, however, indicated activity in the thalamic subregions was not strongly associated with memory performance. Further research is thus needed to determine the exact contributions of thalamic subregions along with the MTL to distinct types of memory.

Topic Area: LONG-TERM MEMORY: Episodic

The Effect of Incentives on Pupil Dilation During Recognition Memory

Poster B71, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Lisa Solinger[1], Ian Dobbins[1]; [1]Washington University in St. Louis

A robust finding in eye tracking studies of recognition memory is that correctly recognized studied (i.e., old) items yield greater pupillary dilation (PD) than do correctly identified unstudied (i.e., new) items. Termed the pupil old/new effect, it is generally thought to reflect the cognitive effort involved in retrieving content from memory. However, there is evidence suggesting that the PD response reflects the attentional salience of retrieval, and not retrieval processes per se (Mill, O'Connor, & Dobbins, 2016). To adjudicate between these two accounts, we crossed performance-based incentives with "new" and "old" conclusions—systematically controlling whether the detection of new or old items was more motivationally salient. During baseline, subjects demonstrated the classic pupil old/new effect. However, when "new" conclusions were incentivized the old/new effect was eliminated, and when "old" conclusions were incentivized the effect was amplified relative to baseline. Thus, the early amplitude PD response does not track memory strength or retrieval per se. Instead, it captures a recognition orienting component that can be modulated via incentives. In addition to this early pupillary component, there are sequential dependencies in the pupil dilation

response. The findings support the attentional salience account of the pupil old/new effect and reveal additional distinct psychological contributors to the PD response during recognition memory.

Topic Area: LONG-TERM MEMORY: Other

Neural interactions between memory and language: The role of language profile on semantic processing leading to true and false memories

Poster B72, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Eugenia Marin-Garcia[1], Pedro M. Paz-Alonso[2]; [1]University of the Basque Country, [2]BCBL

Consequences of linguistic profile of the speaker in how semantic information is encoded and recovered from memory remain not well understood. We used the Deese/Roediger-McDermott (DRM) paradigm to investigate semantic relational processing leading to veridical and false memories in monolinguals and bilinguals. Spanish monolinguals and Spanish/Basque bilinguals were compared while performing DRM paradigm in a MRI. Their linguistic profile was defined by language age of acquisition, language proficiency and language use/exposure in their every day life. Participants were instructed to study word lists for a memory test. Materials consisted in Spanish DRM word lists that converge on a semantic theme captured in a critical word (critical lure) never presented in the list. After encoding, participants performed an old/new recognition test that included studied words, critical lures, and unrelated lures. Associative strength, the tendency of DRM lists to elicit false memories, was manipulated including lists with high and low associative strength. Behavioral results showed that monolinguals exhibited significantly more true memories relative to bilinguals, in both, high and low associative strength conditions. fMRI results revealed that left Inferior Frontal Gyrus (IFG), specifically pars triangularis, was significantly more activated in bilinguals than monolinguals for both, true and false memories. And this area was more activated for low than high associative strength conditions. These results are consistent with previous evidence showing that the IFG is engaged in semantic tasks requiring active strategies and effortful processing. And this suggests a less automatized or more effortful semantic access in bilinguals than in monolinguals.

Topic Area: LONG-TERM MEMORY: Semantic

Probing the transition of novel information towards familiarity

Poster B73, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Amnon Yacoby[1], Anat Maril[1]; [1]Hebrew University of Jerusalem

In daily life, humans are exposed to new information which could be consistent (familiar) or inconsistent (novel) with prior knowledge. Over time, the once-novel information becomes integrated into our knowledge base, shifting its mental status from novelty to familiarity. In this study, we investigated the processes by which this transition takes place. Our assumption was that over the course of recurrent presentations of novel objects, their neural representations gradually change, expressing a transition towards familiarity. We further assumed that this shift is tractable by neural patterns using fMRI. While being scanned, participants were presented with noun-adjective word pairs that were either consistent or inconsistent with their prior knowledge. The stimuli were repeated 3-6 times within the scans. Employing univariate and multivariate analyses we show that neural representations of familiar and novel objects differ upon first presentation in lateral frontal and temporal regions, as well as in medial prefrontal cortex and the precuneus. Importantly, the neural representations of novel stimuli were gradually altered over the course of repetitions such that they became indistinguishable from those of the respective familiar items in these regions. Our findings suggest that the transition from novelty to familiarity is gradual, and is completed within a few repetitions.

Topic Area: LONG-TERM MEMORY: Semantic

Encoding of episodic context in abstract and concrete concepts

Poster B74, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Charles P. Davis[1,2], Pedro M. Paz-Alonso[3], Gerry T. M. Altmann[1,2], Eiling Yee[1,2]; [1]University of Connecticut, [2]Connecticut Institute for the Brain and Cognitive Sciences, [3]Basque Center on Cognition, Brain, and Language

Grounded cognition theories suggest that in lieu of the primarily sensorimotor-based representations that form concrete concepts, the representations of abstract concepts are derived from situational context. Hypothesizing therefore that when encountering abstract concepts people should be more sensitive to context than when encountering concrete concepts, we utilized the source memory paradigm, which presents study items with an arbitrary context, tests recall of the items and corresponding contexts, and shows hippocampal activation as a function of the amount of contextual detail recalled. In Experiment 1, the arbitrary context was the color of the box that enclosed words referring to abstract or concrete concepts. Contrary to our predictions, box color was better recalled for concrete than abstract concepts. These findings suggested two possibilities: the general concreteness advantage in language processing extends to encoding of episodic detail, or the task promoted memory unitization—that is, box color and concrete concepts can be unitized into a single percept (e.g., red table), while this is not the case for abstract concepts. Experiment 2 tested this by using voice source, which should not facilitate unitization with concrete or abstract concepts, as the to-be-encoded context. The same pattern emerged: voice source was more accurately recalled for concrete than for abstract concepts. The findings suggest that simple episodic associations are not particularly well encoded when encountering abstract concepts. Thus, if representations of abstract concepts are indeed derived from situational context, the contexts may need to be more elaborate and/or temporally extended than the simple associations examined here.

Topic Area: LONG-TERM MEMORY: Semantic

Investigating the efficacy of digital simulations for procedural learning.

Poster B75, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Wen Qian Zhang[1], Victoria A Roach[2], Rebecca M Todd[1], James H Kryklywy[1]; [1]University of British Columbia, [2]Oakland University

With the ubiquitous nature of mobile devices in our daily lives, their use is expanding beyond traditional communication. Simulated environments are beginning to be used as tools for training skilled behaviours in lieu of real world interaction. For example, be nurses and surgeons can now practice complicated procedures prior to entering the operating room. Before the integration of simulated environments into medical training, however, there is a critical need to assess the validity and efficacy of these cutting-edge teaching methods. In the current study, participants learned to identify toolsets via either booklet-based studying, tablet-based simulation, or real-world handling. Each 30-minute training condition was immediately followed by a test procedure (T1) to assess retention of item names and procedural order. One week following initial training, participants completed an additional testing session (T2). Accuracy and reaction time during testing sessions were analyzed with respect to training condition and test-delay. While training condition did not impact accuracy of tool identification at T1 or T2, there was a significant decrease in overall accuracy from T1 to T2. Of note, identification and action on tools learned through both simulation and real-world action were significantly faster than when learned through booklet-based studying. No significant differences were identified between the simulated and real-world conditions. This suggests that while semantic learning of tool names and ordering procedure may be equivalent irrespective of acquisition methods, the ability to interact efficiently with an object may depend on the association of that object with action and behaviour.

Topic Area: LONG-TERM MEMORY: Skill learning

Frequent-dependent temporal fluctuations of functional connectivity within intrinsic networks in human cortex

Poster B76, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Aaron Kucyi[1], Josef Parvizi[1]; [1]Stanford University

Intrinsic brain networks are comprised of remote regions that have correlated spontaneous activity seen in functional imaging, known as intrinsic functional connectivity (FC), that is remarkably persistent across distinct consciousness states. Given the limited temporal resolution of imaging methods, little is known about fluctuations of FC on the scale of tens of seconds (known as "dynamic FC"), and controversy remains over the potential behavioral and neural relevance of dynamic FC. Here we aimed to identify electrophysiological correlates of intrinsic BOLD FC in canonical cortical networks and to clarify how electrophysiological FC within those networks fluctuates across frequencies on short time scales. We studied neurosurgical patients with intracranial electrodes directly implanted simultaneously within individually-localized nodes of the default, dorsal attention and frontoparietal control networks. Within these networks in both wakeful rest and sleep states, we found that electrophysiological functional connectivity of both high-frequency broadband (HFB, or high gamma; 70-170 Hz) and alpha (8-12 Hz) power amplitudes were reproducibly correlated spatially with functional connectivity in separately recorded resting-state fMRI within the same subjects. Although there were modest negative correlations between HFB and alpha local activity within each network, spatial connectivity patterns showed similarities between these frequency ranges. In contrast, within-network HFB and alpha coupling often diverged from one another temporally across short windows (on the order of seconds). These results suggest that temporal fluctuations of functional connectivity within widely studied human brain networks are shaped by multiple, dissociable neurophysiological processes that potentially have distinct behavioral relevance.

Topic Area: METHODS: Electrophysiology

The effects of obesity on olfactory and visual event-related potentials

Poster B77, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Andrew J. Fiscella[1], Claire Murphy[1]; [1]San Diego State University

Alzheimer's disease (AD) is a form of dementia marked by the presence of Aβ-plaques, neurofibrillary tangles (NFTs) and cognitive decline. There is evidence that the pathophysiological symptoms of AD may begin decades before cognitive decline appears. The formation of NFTs in the Alzheimer's brain may begin in the olfactory cortices and studies examining APOE-ε4 carriers have shown deficits in odor processing before the development of AD. Additionally, as obesity serves as a risk factor for AD, it is crucial to understand the link between obesity and olfaction. The goal of this study was to examine the effects of obesity on olfactory and visual event-related potential components, specifically N1, P2, N2 and P3. Participants were 13 young adults and 12 older adults recruited from San Diego State University and the San Diego community. Odor discrimination was tested with a pairwise task in which participants were presented with pairs of odors and indicated whether odors in a pair were the "same" or "different". An analogous color discrimination task was also presented. Results of repeated-measures ANOVAs indicated that when odors were different there was a significant effect of BMI on the amplitudes of N2 $F(1,12) = 9.218$, $p < .05$ and P3 $F(1,12) = 5.626$, $p < .05$ as well as a significant effect of BMI $F(1,12) = 6.501$, $p < .05$ and waist circumference $F(1,12) = 15.439$, $p < .05$ on the latency of N1. These results suggest that being overweight or obese may negatively impact olfactory and visual brain function.

Topic Area: METHODS: Electrophysiology

NIH Funded NITRC's Triad of Services: Software, Data, Compute

Poster B78, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Christian Haselgrove[1,2], Robert Buccigrossi[3], Albert Crowley[3], David Kennedy[2], Abby Paulson[3], Nina Preuss[3], Matt Travers[3]; [1]Neuromorphometrics, Inc, [2]University of Massachusetts Medical School, [3]TCG, Inc

Aim: The Neuroimaging Informatics Tools and Resources Clearinghouse (NITRC) is a neuroinformatics knowledge environment for MR, PET/SPECT, CT, EEG/MEG, optical imaging, clinical neuroinformatics, computational neuroscience, and imaging genomics tools and resources. Methods: Initiated in 2006 through the NIH Blueprint for Neuroscience Research, NITRC's mission is to foster a user-friendly knowledge environment for the neuroinformatics community. By identifying existing software tools and other resources, NITRC supports researchers dedicated to enhancing, adopting, distributing, and contributing to the evolution of analysis software, data, and compute resources. Results: Located on the web at www.nitrc.org, the Resources Registry (NITRC-R) promotes software tools and resources, vocabularies, test data, and databases, extending the impact of previously funded contributions to a broader community. NITRC-R gives researchers greater and more efficient access to the tools and resources they need, better categorizing and organizing existing resources, facilitating interactions between researchers and developers, and promoting better use through enhanced documentation and tutorials. the NITRC Image Repository (NITRC-IR) makes thousands of imaging sessions publicly available at no charge, and the NITRC Computational Environment (NITRC-CE) provides cloud-based computation services. Conclusions: NITRC is now an established knowledge environment for the neuroimaging community where tools and resources are presented in a coherent and synergistic environment. NITRC is a trusted source for the identification of resources in this global community. We encourage the neuroinformatics community to continue providing valuable resources, design and content feedback, and to utilize these resources in support of data sharing requirements, software dissemination, and cost-effective computational performance.

Topic Area: METHODS: Neuroimaging

The specificity and robustness of long-distance connections in weighted inter-areal structural brain networks

Poster B79, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Richard Betzel[1], Danielle Bassett[1]; [1]University of Pennsylvania

The functional repertoire of a brain area depends upon the configuration of its incoming and outgoing connections. The complete set of these connections defines a connectome, which can be represented as a network and analyzed using tools from network science. Among the most salient features of brain networks is their cost efficient spatial embedding, which results in disproportionately many short-range connections. Nonetheless, brain networks exhibit a small number of costly long-distance connections, which are thought to confer functionality to neural systems by enabling efficient signaling and transfer of information by reducing the average number of processing steps separating any two brain areas. However, in real-world networks connection weights are log-normally distributed and weaken monotonically as a function of distance. This observation implies that long-distance connections play a minor role in the network's shortest path structure, suggesting a diminished capacity for promoting efficient inter-areal communication. What then is the functional role of long-distance connections? Using a network analytic framework, we provide evidence suggesting that long-distance connections confer connectional specificity to brain areas and in the process define its functionality. Using four network datasets (human, macaque, drosophila, and mouse), we show that long-distance connections are also highly reinforced and redundant, suggesting that long-distance connections are resilient to most perturbations. However, using dynamical simulations, we show that in their absence the complexity of spontaneous neural activity is dramatically reduced. These findings help clarify the functional roles of costly long-distance architectural features and inform future studies of inter-areal network structure and function.

Topic Area: METHODS: Neuroimaging

Early stage brain topology alterations in low functioning autism

Poster B80, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Aditya Jayashankar[1], Sowmyashree Kaku[1], Satish Girimaji[1], Sonia Bansal[1], Suril Gohel[2], Rose Dawn Bharath[1], Shoba Srinath[1]; [1]National Institute of Mental Health and Neuro Sciences (NIMHANS), Bangalore, India, [2]School of Health Professions, Rutgers University

Objective – To examine the changes in whole brain topology and regional connectivity in 17 children of the ages 3 to 8 years with autism spectrum disorder (ASD), we used resting state fMRI data scans in a 3T MRI scanner. Methodology– Patients were divided into two groups based on the severity of ASD, determined by the Childhood Autism Rating Scale (CARS) scores (Mild, 30-36; Severe, >36). Data was preprocessed using the standard pipeline and independent component analysis (ICA) was used to extract regions of interest (ROI) to construct a correlation matrix representing the brain network. Following which, graph theory measures were calculated at sparsity 6% - 35% and statistically analyzed, and corrected for significance (FDR $p<0.05$). Clustering coefficient of the ROIs which revealed significant between-group (mild vs. severe) differences were used for correlation with clinical scores (CARS). Results – Children with severe ASD revealed significantly increased clustering coefficient and small-worldness compared to those with mild or moderate ASD. Regional analysis showed the Heschl's gyrus exhibited altered clustering coefficient which significantly correlated with CARS scores. Conclusion – The findings from the current study provide early stage evidence of aberrant brain connectivity appearing in low-functioning ASD, prior to pruning mechanisms and environmental bias. Heschl's gyrus clustering correlated to the severity of ASD symptoms and agrees with current literature on cortical changes associated with autism, reflecting nascent changes to language processing regions.

Topic Area: METHODS: Neuroimaging

Increased Default Mode Network Functional Connectivity in Individuals with Greater Meditative Experience

Poster B81, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Lauren Goodes[1], Yush Kukreja[2], Jeffrey Rouse M.D[2], Jeremy D. Cohen Ph.D.[1]; [1]Xavier University of Louisiana, New Orelans, LA, USA, [2]Tulane University, New Orleans, LA, USA

In those that have practiced mindfulness meditation over a long period of time, research suggests increased functional connectivity within the default mode network (DMN) between dorsomedial prefrontal cortex and right inferior parietal lobule. The current study examined the relationship between resting-state functional connectivity of the DMN and meditation experience in 40 subjects (M=20; F=20) from the Nathan Kline Institute Rockland-Sample. Subjects ranged in age from 20-40 (M=30.1 SD=5.5) who provided a self report measure of their experience with meditation. SPM12 and the CONN toolbox were used to preprocess subject brain data and conduct functional connectivity analyses, using self report scores of meditation experience as a covariate across subjects. DMN regions were selected as seed regions. Results from this study indicate that increased meditative experience is correlated with an increase in functional connectivity of the right superior parietal lobule with both the right and left nucleus accumbens. Previous research of persons in the meditative state has identified alterations in activity of the superior parietal lobule, potentially related to its function of awareness of the self in spatial relation to one's surroundings. Nucleus accumbens involvement may be a novel finding associated with meditation and is intriguing in light of its associating with reward processing. Data here supports that more experienced meditators show greater functional connectivity between brain regions that are involved in reward and self-awareness. Future work will seek to replicate these results in a larger sample and investigate potential similar correlations with various reward-related regions.

Topic Area: METHODS: Neuroimaging

Local Heterogeneity Regression Analysis: A Novel Measure of Representational Sparseness in Reading

Poster B82, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Jeremy Purcell[1], Brenda Rapp[1]; [1]Johns Hopkins University

Orthographic representations become sparser after learning (i.e. strong activation in a relatively small set of neurons), and that differences in the mean neural response does not capture this relative sparseness (Glezer et al., 2009). Instead more advanced measures that quantify the local neural heterogeneity are required. Here we introduce a novel Local Heterogeneity Regression (Hreg) Analysis that quantifies the relative heterogeneity of the local neural responses. This approach relies on the premise that well-learned sparse representations will have heterogeneous local responses across voxels. We apply this approach to block design fMRI reading data (N=30) which included well-learned words (i.e. high frequency-HFW) and relatively less well-learned words (i.e. low frequency-LFW and pseudowords-PW). Local-Hreg is a search-light analysis where, for each search-light, a general psychophysiological interaction analysis (McLaren et al., 2012) is performed using the center voxel to make pair-wise predictions of each surrounding voxel. The Local-Hreg value is the median condition-specific pairwise interactions within a searchlight. Lower average condition-specific cross-voxel interactions indicate higher local heterogeneity. Results reveal a significant left vOTC cluster with higher heterogeneity for the well-learned words (HFW) relative to the less well-learned stimuli (LFW or PW). We compare Local-Hreg to another measure of heterogeneity (heterogeneity correlation-Hcorr), and confirm that it is a more robust method for detecting local heterogeneity. Here we introduce a novel approach for examining the relative sparseness of orthographic representations. We argue that it can be used as a general analysis tool for probing neural dynamics of representation and learning in various cognitive domains.

Topic Area: METHODS: Neuroimaging

Effects of Prefrontal tDCS on Executive Function: Methodological Considerations Revealed by Meta-Analysis

Poster B83, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Michael Imburgio[1], Madison Parks[1], Lane Bannwart[1], Joseph Orr[1]; [1]Texas A&M University

Transcranial direct current stimulation (tDCS) has rapidly gained in popularity for the treatment of various psychopathologies (e.g., depression, addiction, PTSD). A common target for stimulation is the dorsolateral prefrontal cortex (DLPFC), a region that is often impacted by these diseases. As the DLPFC is often associated with executive function (EF), DLPFC tDCS treatment could act, at least in part, through effects on EF. While several meta-analyses have now examined the effects of DLFPC tDCS on cognition in general, there are no analyses which focus specifically on EF. A meta-analysis of studies using single-session transcranial direct current stimulation (tDCS) to target the dorsolateral prefrontal cortex (DLPFC) was undertaken to examine the effect of stimulation on executive function (EF) in healthy samples. In line with the Unity-Diversity model of EF, we looked for studies with tasks targeting working memory updating, set-shifting, and inhibition. 30 studies were included in analyses, yielding 71 effect sizes. Analyses revealed a significant effect of anodal unilateral tDCS on updating tasks, but no effect of anodal unilateral stimulation on inhibition or set-shifting tasks. Further, extracranial cathodes yielded a significant effect on EF while cranial cathodes yielded no effect, and smaller electrodes were more effective than larger electrodes. The current work has implications for possible cognitive mechanisms in the treatment of disorders such as schizophrenia and depression with DLPFC tDCS. Additionally, moderator analyses provide important insight into methodological considerations for future studies attempting to modulate EF in healthy samples with single-session DLPFC tDCS.

Topic Area: METHODS: Other

Evidence of Non-reciprocal Topological Connections between Frontal Association Cortex and Temporal Cortex in the Rat

Poster B84, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Stacey Bedwell[1], Chris Tinsley[2]; [1]Birmingham City University, [2]Nottingham Trent University

The prefrontal cortex (PFC) is known to be important in a wide range of high order and complex cognitive processes. The most frontal aspect, Frontal association cortex (FrA) remains to be a relatively little understood cortical region, both in terms of function and underlying anatomical structure. We investigated the anatomical organisation of connections from FrA to regions of temporal cortex in the rat. Retrograde (Fluoro-Gold) and anterograde (Fluoro-Ruby) neuroanatomical tracers were injected into equally spaced regions of FrA and the locations of their projections to temporal cortex (PRh, Ent) studied in three axes of orientation. Statistical analyses revealed significant evidence of topological ordering in the dorsal-ventral, anterior-posterior and medial- lateral axes ($p<.001$). Labelled afferent and efferent connections showed evidence of similar patterns of ordering, however were not found in the same columnar regions of temporal cortex. Little evidence of reciprocal connectivity i.e. inputs and outputs occurring in the same region was found in the FrA – temporal cortex pathway. Taken with previous observations of prefrontal cortex structural organisation, the findings presented here provide evidence to support a gradient of connectivity from anterior to posterior PFC.

Topic Area: NEUROANATOMY

Frontal Cortex and Executive Functions in Healthy and Neuropsychiatric Samples: A Meta-Analysis of Structural Neuroimaging Studies

Poster B85, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Valeria Vilomar[1,2], Abigail B. Waters[1], Lance P. Swenson[1], David A. Gansler[1]; [1]Suffolk University, [2]University of Puerto Rico

Previous meta-analyses have shown the link between the prefrontal cortex (PFC) and performance on tasks of executive function in healthy adults (Yuan & Raz, 2014). Given certain regions and tasks, the range of the strength of association is .08 - .23. However, the strength of this relationship in neuropsychiatric populations is unknown via meta-analysis. We conducted a meta-analysis of published studies (k = 30) that assessed the relationship between executive functions and frontal regions in vivo (N = 1935) for both healthy (20 samples) and neuropsychiatric (21 samples) adults. Random effects modeling was used to calculate mean effect sizes and CIs. Neuropsychiatric samples were classified as psychiatric disorders, MCI/Alzheimer's, lowered vascular health, neurodegenerative disorders, or acute brain injuries. Brains regions were classified as lateral, medial, and/or ventral due to variance in study region operationalization. Larger volumes and thickness were associated with better executive functioning in both healthy (r = .32, 95% CI = .22 - .42) and neuropsychiatric populations (r = .47, 95% CI = .29 - .62). Although, the mean effect size was larger for the neuropsychiatric populations (Zobserved = 3.90, p < .001), the overlapping CIs imply that the effect sizes are not significantly different due to the increased variability of effects in neuropsychiatric patient groups. Focal brain regions (single brain surfaces) had similar effects (r = .40, 95% CI [.16 - .60]) compared to more diffuse brain regions (three brain surfaces; r =.35, 95% CI [.17-.53]). Results suggest that brain-behavior relationships are more variable in neuropsychiatric populations.

Topic Area: NEUROANATOMY

In vivo manganese tract tracing of macaque saccadic eye movement circuitry: a comparison with diffusion tensor imaging

Poster B86, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

David J Schaeffer[1], Kevin Johnston[1], Joseph S Gati[1], Ravi S Menon[1], Stefan Everling[1]; [1]Robarts Research Institute, University of Western Ontario, London, Ontario, Canada

The saccadic eye movement system has emerged as a valuable model in the neurosciences for studying neural circuitry related to flexible control of behavior. Although connections of the saccade circuit are well documented via histochemical tracers, these methods require fixed tissue and thus cannot provide longitudinal assessments of connectivity. To circumvent this, diffusion tensor imaging (DTI) is often used as a proxy for connectivity in vivo, allowing researchers to trace connections longitudinally and noninvasively. As an indirect measure of connectivity, however, DTI is limited by the ability to accurately estimate connections based on water diffusion. Here, we demonstrate the use of ionized manganese as an MRI-based in vivo labelling technique that allows for direct tract tracing without the need for fixed tissue. Manganese (Mn^{2+}) is a strong paramagnetic contrast agent used for MRI. Mn^{2+} is taken up by excitable cells via voltage-gated calcium channels and transsynaptically propagates, resulting in anterograde-like tracing that is MRI visible. Here, we directly injected $MnCl_2$ into a key saccadic node (frontal eye fields; FEF) of two rhesus macaques and collected ultra-high field MRI data (7T; T1, DTI). The results demonstrate that $MnCl_2$-traced FEF connections parallel those established by histochemical tracing (albeit at a lower spatial resolution) and suggest that DTI underestimates FEF connectivity, with false negatives across the network, likely due to crossing fibers and small tract size. These results highlight the lack of DTI sensitivity for tracing FEF fibers, but also suggest $MnCl_2$-based tracing as a powerful alternative for assessing these connections in vivo.

Topic Area: NEUROANATOMY

The subtle impact of oscillatory phase on auditory detection

Poster B87, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Yue Sun[1], Oded Ghitza[1,2], David Poeppel[1,3]; [1]Max Planck Institute for Empirical Aesthetics, Frankfurt am Main, Germany, [2]Boston University, Boston, USA, [3]New York University, New York, USA

Acoustic rhythms are a fundamental feature in our acoustic environment, including in speech and music (Ding et al., 2017). It has been proposed that auditory processing profits from the entrainment of cortical neural oscillations to the rhythmicity of the acoustic input, which aligns optimal oscillatory phase with critical auditory events (Schroeder & Lakatos., 2009). However, to what extent oscillatory phase influences the efficiency of auditory processing is still a subject of controversy (VanRullen, 2014). Here we examined the robustness of phase-modulated decoding, using an auditory detection paradigm adapted from a recent study (Hickok et al., 2015). Participants were asked to detect a 1-kHz tone embedded in background noise following an acoustic entrainment signal modulated at 3 Hz. The target tone was presented at various positions aligned with different phases of the preceding entrainment. While the original study showed that the detectability of the tone, presented at a near-threshold intensity, was strongly modulated at the frequency of preceding entrainment and consistently aligned with its phase, a similar effect was found in our study only when the tone was presented 6 dB above participants' individual thresholds. Meanwhile, when the tone was presented at a near-threshold intensity, the detection accuracy was no longer modulated at the frequency of the entrainment signal but at a lower frequency, around 1.5 Hz. Our findings demonstrate the subtlety of phase-modulated detection in audition and its sensitivity to experimental protocol and task difficulty.

Topic Area: PERCEPTION & ACTION: Audition

Neural Responses to Narrative Speech Differentiate Patients with Disordered Consciousness

Poster B88, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Ivan Iotzov[1], Brian C Fidali[2], Agustin Petroni[1], Mary M Conte[2], Nicholas D Schiff[2], Lucas C Parra[1]; [1]City College of New York, [2]Laboratory of Cognitive Neuromodulation, The Feil Family Brain and Mind Research Institute, Weill Cornell Medicine

Clinical assessment of auditory attention in patients with disorders of consciousness is often limited by motor impairment. Here, we employ inter-subject correlations among electroencephalographic responses to naturalistic speech in order to assay auditory attention among patients and healthy controls. Electroencephalographic data were recorded from 20 subjects with disorders of consciousness and 14 healthy controls during of two narrative audio stimuli, presented both forwards and time-reversed. Inter-subject correlation of evoked electroencephalography signals were calculated, comparing responses of both groups to those of the healthy control subjects. This analysis was performed blinded and subsequently compared to the diagnostic status of each patient based on the Coma Recovery Scale-Revised. Subjects with disorders of consciousness exhibit significantly lower inter-subject correlation than healthy controls during narrative speech. Additionally, while healthy subjects had higher inter-subject correlation values in forward vs. backwards presentation, neural responses did not vary significantly with the direction of playback in subjects with disorders of consciousness. Increased inter-subject correlation values in the backward speech condition were noted with improving disorder of consciousness diagnosis, both in cross-sectional analysis and in a subset of patients with longitudinal data. Inter-subject correlation of neural responses to narrative speech audition differentiates healthy controls from patients and appears to index clinical diagnoses in disorders of consciousness.

Topic Area: PERCEPTION & ACTION: Audition

Low-Frequency Oscillations Mediate Cortical-Subcortical Communication During Auditory Novelty Processing

Poster B89, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Marc Recasens[1], Joachim Gross[1], Peter Uhlhaas[1]; [1]University of Glasgow

Emerging evidence supports the role of neural oscillations as a mechanism for predictive information processing across large-scale networks. However, the oscillatory mechanisms underlying auditory novelty detection and information flow between brain regions remain unclear. To address this issue, we examined the contribution of oscillatory activity at theta/alpha-bands (4-8/8-13 Hz) and assessed directed connectivity in magnetoencephalographic data while 17 human participants were presented with sound sequences containing predictable repetitions and order manipulations that elicited prediction-error responses. We characterized the spectro-temporal properties of neural generators using a minimum-norm approach and assessed directed connectivity using Granger Causality analysis. Novel sequences elicited increased theta power and phase-locking in auditory, hippocampal and prefrontal cortices, suggesting that theta-band oscillations underlie prediction-error generation in cortical-subcortical networks. Furthermore, enhanced feedforward theta-band connectivity was observed in auditory-prefrontal networks during novel sequences, while increased feedback connectivity in the alpha-band was observed between hippocampus-auditory regions during predictable sounds. Our findings highlight the involvement of hippocampal theta/alpha-band oscillations towards auditory prediction-error generation and suggest a spectral dissociation between inter-areal feedforward vs. feedback signalling, thus providing novel insights into the oscillatory mechanisms underlying auditory predictive processing.

Topic Area: PERCEPTION & ACTION: Audition

Group Drumming Communication Program, Effects on Cognitive and Motor Functions in Older Adults with Dementia at a Special Elderly Nursing Home

Poster B90, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Atsuko Miyazaki[1], Rui Nouchi[2], Takashi Okuyama[3], Hayato Mori[1], Kazuhisa Sato[4], Naoyuki Miyajima[5], Masahiko Ichiki[6], Shinichiro Nakamura[1]; [1]RIKEN, Saitama, Japan., [2]Tohoku University, Sendai, Japan., [3]Kobe University School of Medicine, Kobe, Japan (part-time lecturer)., [4]Care 21 Co., Ltd., Tokyo, Japan., [5]Social Welfare Corporation Tenyu, Saitama, Japan., [6]Tokyo Medical University, Tokyo, Japan.

The rhythm response function is maintained even in patients with severe dementia. Drum playing is an entertaining exercise where the beat of music has a stimulating effect on motor circuits at the neuronal functioning level. Because of its high correlation with cognitive function, rhythm response may help improve cognitive function in patients with dementia. Thus, our aim is to construct a new active group drumming program to prevent dementia to become more severe. In this study, we conducted Randomized Controlled Trial to assess the effect of “Drumming Communication Program” we developed for improving and preventing dementia at a special elderly nursing home. Forty-six participants were divided into two groups by random assignment based on their cognitive function scores. The intervention group, consisting of 22 people, took part in the program for 30 minutes three times a week for three months. They sat in a circle and played with the drum freely, as well as listened to others perform. The group which didn’t participate in the program consisted of 17 persons. The intervention group showed an improvement in their cognitive function score in the Mini-Mental State Examination and Frontal Assessment Battery. As for motor functions, significant differences were seen between the two groups for an Active Range of Motion, the intervention group showed improvement in their shoulder and wrist flexion. We propose a new rehabilitation program based on group drum playing to improve cognitive and motor functions, for patients with dementia and other debilitating diseases who have rhythm response capability.

Topic Area: PERCEPTION & ACTION: Development & aging

Kids don’t see what we see: Young children are less likely to experience an illusion that requires perceptual integration

Poster B91, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Kay Otsubo[1], Danielle Lim[1], Asaf Gilboa[2], Morgan Barense[1], Amy Finn[1]; [1]University of Toronto, [2]Rotman Research Institute at Baycrest

Previous work has shown that children are less susceptible than adults to the Ebbinghaus illusion (Doherty et al., 2010). That is, children are better at correctly identifying the larger of two target circles when presented with surrounding circles that make the

target circle appear misleadingly larger or smaller. In the current study, we investigated the hypothesis that children do not experience this powerful illusion because perceptual integration is less "automatic" due to ongoing hippocampal development (Lee et al., 2014). Here, 43 children (aged 4-10 years) were asked to identify the larger or longer item of two targets for three different illusions – Ebbinghaus, Sander's, and Vertical-Horizontal. In the Ebbinghaus illusion, the target circles are visually disconnected from their surroundings. However, in the Sander's and Vertical-Horizontal illusion, the target lines are either connected with their surroundings or with each other, respectively. The younger aged children (4-6 years) did not perceive the Ebbinghaus illusion, correctly identifying the larger circle more often in misleading contexts than the older children (7-10 years). For the Sander's and Vertical-Horizontal illusion, however, the younger children were equivalently susceptible as older children. Younger children are therefore immune to an illusion when the target items are visually disconnected from surrounding perceptual information. These findings suggest that children younger than 7 years do not automatically integrate spatially disconnected visual information. This could be a result of ongoing maturation of neural structures central to these processes, such as the medial temporal lobe and hippocampus (Barense et al., 2010).

Topic Area: PERCEPTION & ACTION: Development & aging

White matter microstructure in sensorimotor cortices and tracts predicts motor imagery ability in young adults

Poster B92, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Christian Hyde[1], Ian Fuelscher[1], Peter Enticott[1], Jarrad Lum[1], Karen Caeyenberghs[2]; [1]Cognitive Neuroscience Unit, School of Psychology, Deakin University, Geelong, Australia., [2]School of Psychology, Faculty of Health Sciences, Australian Catholic University, Melbourne, Australia.

There is compelling evidence suggesting that motor imagery (MI) activates similar cortical regions to real movement. This study aimed to be the first, to our knowledge, to investigate the degree to which microstructural properties of sensory-motor cortices previously implicated in MI, and those tracts that support communication between them, predict individual differences in MI performance. 12 healthy adults (18-46 years) have performed the hand laterality task (HLT), a well-validated MI measure. Diffusion MRI metrics of white matter microstructure were generated for the posterior parietal cortex (PPC), cerebellum, primary sensory cortex, and putamen based on a recent meta-analysis of fMRI studies indicating that these regions are active in HLT performance. Sensorimotor tracts including the corticospinal tract (CST) and superior longitudinal fasciculus (SLF) were reconstructed for each participant using constrained spherical deconvolution tractography (CSD). Quantitative diffusion metrics were then correlated with HLT performance efficiency. We observed significant correlations between HLT efficiency and diffusion metrics in the PPC (i.e. left inferior parietal, and left and right supramarginal parietal cortices), mean fractional anisotropy of the left SLF and mean diffusivity of the right SLF and HLT efficiency. These preliminary analyses are the first to provide evidence suggesting that the white matter organization in those cortices known be active during MI, and those tracts that support communication between these cortices, may predict individual differences in MI ability. These findings compliment functional data from fMRI and provide critical insight into the neural substrate of MI and factors that contribute to individual performance differences.

Topic Area: PERCEPTION & ACTION: Motor control

No-movement awareness induces ERP modulations after long-term limb immobilization in a Go/Nogo task

Poster B93, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Valentina Bruno[1], Irene Ronga[1], Carlotta Fossataro[1], Francesca Garbarini[1]; [1]SAMBA – SpAtial, Motor & Bodily Awareness – Research Group, Psychology Department, University of Turin, Turin, Italy

This EEG study focused on electrophysiological processes underlying no-movement awareness (the conscious detection of the impossibility of accomplishing self-generated actions). We contrasted conditions in which participants were free to perform a Go/Nogo task with conditions in which left-hand movements were prevented by a cast. Immobilization effects were tested after the cast-positioning and after one week of immobilization. We predicted a modulation of event-related potentials in blocked-conditions, when subjects tried to perform the task, but movements were precluded. In nogo trials, a modulation of the inhibition-related P300 was found. Only in left (manipulated) side, P300 was reduced in blocked-conditions, suggesting that, when the system “knows” that no-movement can be performed, inhibitory responses are not implemented. In go trials, a modulation of N400, related to semantic/conceptual violations, was found. In our study, the motor-monitoring system could detect a violation when, according to go-signals, motor response was planned but no-movement was performed (due to immobilization). In left side, N400 was oppositely modulated by blocked- and free-conditions, depending on the day. In blocked-conditions, an enhanced N400 at day1 suggests that motor-monitoring system suddenly detects a mismatch between intended but not executed response. At day2, when motor-monitoring system changed its predictions about the “learned block”, no incongruence is detected. Contrariwise, in free-conditions, a larger N400 at day2 was elicited by the detection of new incongruence between no-movement predictions and the evidence of being able to move again. These findings show that mechanical limb-immobilization is a good model to investigate EEG-activity changes related to no-movement awareness.

Topic Area: PERCEPTION & ACTION: Motor control

Cognitive tuning of the defensive peripersonal space is influenced by postural adjustment ability

Poster B94, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Marco Bove[1], Monica Biggio[1], Ambra Bisio[1], Piero Ruggeri[1]; [1]University of Genoa, Italy

The hand blink reflex (HBR) is a subcortical defensive response, known to dramatically increase when the stimulated hand is statically positioned inside the defensive peripersonal space (DPPS) of the face. DPPS has a crucial role for survival, and its modulation is fundamental when we interact with the surrounding environment. A fine cortical tuning of HBR was observed when a thin wooden screen was placed between the participants' face and their hand. Thus, the screen reduces the extension of the DPPS so that the hand is never inside the defensive peripersonal space of the face. We hypothesized that this “screen effect” can automatically manifest as consequence of experience in those athletes who use hands as a shield to protect the face from an external threatening stimulus, as it occurs when boxers assume the guard position. Thirteen boxers and 13 age-matched controls were enrolled. Electromyographic activity was recorded from the orbicularis oculi muscles. HBR response was elicited in three static hand positions from the face: far, intermediate and near positions. HBR enhancement in the near position was present only in the control group, while no significant difference was found in the three positions in the boxer group. Also, the higher years of practice in boxing the higher suppression occurred. These observations suggest that, as a result of sensorimotor experience, the brain can shape the DPPS by evaluating the harm probability through the assessment of the ability to set an accurate defensive postural adjustment able to cope with possible dangerous stimuli.

Topic Area: PERCEPTION & ACTION: Motor control

Exercise impacts information processing and neural activity under varying cognitive demands in children treated for brain tumours

Poster B95, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Elizabeth Cox[1,2], Sonya Bells[1], Janine Piscione[1], Brian W. Timmons[3,4], Ute Bartels[1,2], Cynthia de Medeiros[1], Jovanka Skocic[1], Kiran Beera[1], Suzanne Laughlin[1,2], Donald J. Mabbott[1,2]; [1]Hospital for Sick Children, Toronto, Ontario, Canada, [2]University of Toronto, Toronto, Ontario, Canada, [3]McMaster University, Hamilton, Ontario, Canada, [4]McMaster Children's Hospital, Hamilton, Ontario, Canada

Children treated with cranial radiation for brain tumours exhibit continuous declines in information processing. Critically, reduced information processing speed (IPS) impairs cognition under greater task demands and relates to aberrant brain function. Exercise improves IPS and enhances neural activity. Here we aim to assess the efficacy of exercise training (ClinicalTrials.gov: NCT0194476) to improve IPS and underlying functional mechanisms during an increasingly demanding Go/No-Go visual-motor reaction time (RT) task using Magnetoencephalography (MEG) among this population. During MEG recording participants (n=20, 12.46 ± 3.03 years) pressed a button immediately after a green cross appeared (simple condition, SC) and additionally withheld response when a red cross appeared (increased demand condition, IDC) on a screen. Data with extraneous movement and electromagnetic artifacts was removed prior to analysis and subsequently filtered into 6 frequency bands. Changes in RT and neural activity after exercise were investigated. Linear mixed-effects regression was used to assess changes RT and local neural activity. Changes in functional connectivity were evaluated using partial least squares regression. After exercise, participants demonstrated stable visual-motor RT during the SC and IDC (p>0.05). During the SC, participants exhibited decreased high gamma (60-100Hz) power in the right cuneus after viewing the green cross (p=0.02-0.05) and increased connectivity between cerebellar and cortical sensorimotor sources during the button press (p<0.01). High gamma oscillations likely facilitate efficient information transfer. Thus, these preliminary results suggest exercise mitigates declines in IPS under increasing cognitive demands and improves functional mechanisms that support visual-motor IP under minimal demand in children treated for brain tumours.

Topic Area: PERCEPTION & ACTION: Motor control

Deficient posterior-to-frontal alpha-frequency connectivity and re-experiencing symptoms in combat-exposed veterans: a sensory model for PTSD

Poster B96, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Kevin Clancy[1], Alejandro Albizu[1], Mingzhou Ding[2], Wen Li[1]; [1]Florida State University, [2]University of Florida - Gainesville

Posttraumatic stress disorder (PTSD) is a neuropsychiatric disorder characterized by intrusive thoughts or flashbacks of one's traumatic experience, often triggered by an external stimulus that could culminate in a re-experiencing of the trauma. Accompanied by symptoms of hypervigilance and the excessive scanning of ones' environment for danger, such symptomatology implicates an aberration in memory activation due to exaggerated and distorted sensory processing. Alpha oscillations (8-12 Hz) are known to play an integral, inhibitory role in regulating sensory processing and the relay of sensory information across distal cortical regions. Using eyes-open resting-state electroencephalogram (EEG) in 37 combat-exposed veterans, we found deficits in alpha-frequency occipitoparietal-to-frontal Granger connectivity were related to greater intrusive re-experiencing symptoms, over and beyond general anxious and negative moods (β = -.30, t = -2.57, p = .015). Additionally, these deficits were related to higher ratings of combat-relatedness for presented combat-related odors (r = -.37, p = .03). Given the inhibitory nature of alpha oscillations, these associations suggest that compromised inhibition of sensory-driven, bottom-up projections could underpin intrusive thoughts and biased threat appraisal in PTSD. Furthermore, given that oscillations orchestrate large-scale resting state networks responsible for sensory-driven arousal (via the Salience Network) and auto-biographical memory (via the Default Mode Network), these data suggest that deficient posterior-to-frontal alpha-frequency connectivity could constitute a sensory mechanism of intrusive traumatic thoughts and memories in PTSD.

Topic Area: PERCEPTION & ACTION: Multisensory

Combining kinesthetic illusion and action observation to evoke cortical plasticity in the primary motor cortex

Poster B97, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Ambra Bisio[1], Monica Biggio[1], Piero Ruggeri[1], Laura Avanzino[1], Marco Bove[1]; [1]University of Genoa, Italy

In the present study action observation (AO) was combined the proprioceptive afferences, which were generated by means of a mechanical vibration able to evoke a kinesthetic illusion (KI) of movement. A proprioceptive stimulator was positioned over the extensor pollicis brevis muscle in order to evoke an illusory sensation of thumb abduction. The experiment was composed of two conditions where AO and KI could be either congruent or incongruent. In the congruent condition (AO-KI CONGR) participants observed a 10-sec video showing the thumb abduction of the right hand (generated by the activation of the abductor pollicis brevis muscle - APB), whilst in the incongruent condition (AO-KI INCONGR) they observed a thumb adduction. The activity of the primary motors cortex (M1) in correspondence to the APB muscle area was evaluated by means of recruitment curves before, immediately

after, and 30 and 60 minutes after the end of the stimulation. The results showed a significant increase of the M1 excitability that lasted until 60 minutes after AO-KI CONGR. No differences were observed before and after the administration of AO-KI INCONGR. Furthermore, in a control experiment the specificity for the kind of sensory input was tested, and a tactile vibration was delivered during the observation of thumb abduction. No changes to M1 excitability were observed. Therefore, AO when combined to KI evoked by a proprioceptive stimulation, was able to evoke plastic changes in M1 activity. These findings suggest that AO and KI likely act on the same neural circuitry inducing long-term plasticity effects.

Topic Area: PERCEPTION & ACTION: Multisensory

Exploring Categorical and Functional Boundaries of Tactile Perception Using Somatosensory Mismatch Responses

Poster B98, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Guannan Shen[1], Peter J. Marshall[1]; [1]Department of Psychology, Temple University

The current study examines categorical and functional boundaries in somatosensory perception, and explores two potential influences on tactile spatial discrimination: discrete body part representations and motor experiences. The mismatch negativity (MMN), an index of early automatic sensory discrimination, has been shown to be sensitive to categorical boundaries and language experience in the auditory modality. Here, we recorded somatosensory MMN (sMMN) using a tactile oddball paradigm, and compared sMMN elicited by within- and across-boundary oddball pairs. We first leveraged a categorical segmentation of tactile space at the wrist, and presented two pairs of tactile oddball stimuli with equal spatial distances, either across the wrist or within the forearm. Results showed that sMMN amplitude elicited by stimuli across the body part boundary was significantly greater than for sites within the forearm, suggesting a categorical effect on tactile perception at the early pre-attentive stage of somatosensory processing. We then examined sMMN elicited by an oddball contrast of the 3rd finger / thumb, which was significantly larger than for the 3rd / 5th fingers. We suggest this indicates a functional boundary effect on tactile perception of finger stimulation as a result of motor experiences (e.g., grasping, picking up objects). These findings demonstrate that the sMMN is a useful neurophysiological index of pre-attentive processing of somatosensory spatial discrimination, sensitive to both categorical and motor-related functional boundary effects. This paradigm can be potentially used in studying the development of somatosensory representations and body maps in early infancy.

Topic Area: PERCEPTION & ACTION: Other

Degree of responsibility influences outcome evaluation in joint action

Poster B99, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Janeen Loehr[1], Sarah Ardell[1], Dimitrios Kourtis[2]; [1]University of Saskatchewan, Canada, [2]University of Stirling, United Kingdom

People must often monitor joint action outcomes to evaluate whether their shared goals have been achieved. Recent research has shown that neural activity related to evaluating negative action outcomes is reduced when responsibility for an outcome is shared equally between two partners compared to when responsibility is held by one person alone. The current study examined whether neural activity related to negative outcome evaluation scales with the degree of responsibility people have over an outcome. Participants produced tones in alternation with a partner to produce 6-tone sequences that matched a metronome pace. Responsibility was manipulated by having participants produce 100%, 67%, 50%, or 33% of the tones for a given sequence (i.e., 6, 4, 3, or 2 of the 6 tones). Event-related potentials were measured in response to feedback indicating whether or not the sequence correctly matched the metronome pace. Both the feedback-related negativity and the P3a were reduced for low-responsibility conditions (50% and 33%) compared to high-responsibility conditions (100% and 67%). These results indicate that greater responsibility over a joint task is associated with more negative evaluation of unfavourable joint outcomes.

Topic Area: PERCEPTION & ACTION: Other

Retinotopically asymmetric effects of attentional load on early visual processing

Poster B100, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Karsten Rauss[1], Laura Herde[1], Mona Schönauer[1]; [1]University of Tuebingen, Germany

It remains disputed whether attention affects the earliest cortical stages of visual processing. In previous studies, we reported that attentional load at fixation modulates the initial component of the visual evoked potential (VEP), the retinotopic C1, but only for stimuli in the upper visual field. We proposed that known differences in spatial-frequency sensitivity between upper and lower visual field could explain such asymmetries. In the present study, we tested this proposal using high-density EEG. We first mapped VEPs in response to arrays of high-contrast line-elements with different spatial frequencies. The stimuli yielding maximum C1 responses in the upper and lower visual field in each subject were then used as peripheral distractors while subjects performed low- vs. high-load target detection on rapidly presented stimuli at fixation. As expected, we observed the previously elusive reduction of the C1 under high load in the lower visual field. However, we could not replicate our earlier finding of such a modulation in the upper visual field using individually optimized stimuli. We conclude that attentional load can affect early visual processing across the whole visual field; but that the stimulus features based on which such early filtering occurs may differ between upper and lower visual field.

Topic Area: PERCEPTION & ACTION: Vision

Impaired inter-hemispheric connectivity is a predictor of the failure to retrieve meaning from shape in visual agnosia

Poster B101, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Radek Ptak[1,2], François Lazeyras[3]; [1]Division of Neurorehabilitation, Department of Clinical Neurosciences, Geneva University Hospitals, Geneva, Switzerland, [2]Faculty of Psychology and Educational Sciences, University of Geneva, Geneva, Switzerland, [3]Department of Radiology and Medical Informatics, University of Geneva, Geneva, Switzerland

The neural mechanisms underlying the access to object knowledge from a 2D- or 3D-representation of shape are uncertain. On the one hand functional imaging studies support the view that representations of visual properties are distributed across occipito-temporal cortex of both cerebral hemispheres. Brain lesion studies on the other hand show that focal damage to the left or right lateral occipital cortex may lead to visual agnosia - a generalized impairment of object recognition. Using functional MRI we studied functional connectivity (FC) in AL, a patient with visual agnosia following left lateral occipital damage. Despite intact global and local processing of 2D and 3D object structure, the patient made consistent object identification errors. Six different experiments testing naming, visual matching or object priming showed that his errors mainly reflected the global visual similarity between objects. We compared AL's functional connectivity while watching similar or dissimilar and scrambled objects with age-matched healthy controls. Compared to controls AL exhibited strongly reduced FC between the damaged left and the intact right medial/lateral occipital cortex. In addition, controls showed stronger connectivity between the intact right occipital cortex and the left and right occipito-temporal and prefrontal cortices when participants viewed visually dissimilar as compared to similar objects. These findings support the view that bilaterally distributed coding is necessary for the retrieval of assocative knowledge from shape, and that focal damage to the lateral occipital cortex may have global effects on representations of objects in bilateral occipito-temporal cortex.

Topic Area: PERCEPTION & ACTION: Vision

The effects of tDCS on orientation discrimination task performance

Poster B102, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Abdullah Bin Dawood[1], Abigail Dickinson[2], Ali Aytemur[1], Clare Howarth[1], Elizabeth Milne[1], Myles Jones[1]; [1]The University of Sheffield, Sheffield, UK, [2]University of California, Los Angeles, CA, USA

Cortical excitation-inhibition (E-I) balance plays a critical role in cognition and behaviour and has been hypothesized to underlie neurodevelopmental disorders such as epilepsy and autism. In the case of Autistic Spectrum Conditions (ASC) differences in E-I balance ratio have been inferred from performance of psychophysical tasks such as the visual Orientation Discrimination Task (ODT). A superior performance of ODT in ASC is thought to be due to increased levels of inhibition in the occipital cortex but studies linking ODT to E-I balance are equivocal. Thus, the current study investigates the putative association between ODT performance and occipital E-I balance by manipulating E-I balance using transcranial Direct Current Stimulation (tDCS). tDCS is a non-invasive brain-stimulation technique that modulates neural excitability: Anodal-tDCS increases excitability, while Cathodal-tDCS increases neural inhibition. 19 neurotypical human participants completed two tDCS-ODT sessions. In each session, participants received 10-minutes 'off-line' occipital tDCS (1st session: Sham, 2nd session: Anode or Cathode, 2mA) followed by the ODT. Orientation discrimination thresholds were measured using a two alternative forced choice adaptive staircase procedure. On each trial a reference grating and a target grating were presented sequentially. Participants were asked to judge whether the target grating has been rotated clockwise or anti-clockwise compared to the reference grating using keyboard keys. For oblique ODT performance there was a significant increase in performance following Cathodal tDCS and but no difference following anodal TDCs. As such, this data provides some further evidence that higher neural inhibition may be related to superior performance of the ODT.

Topic Area: PERCEPTION & ACTION: Vision

Local field potential recordings reveal enhanced feedback in the primate visual system for familiar compared to novel objects

Poster B103, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Ryan E.B. Mruczek[1], Amalia K. Davis[1], David L. Sheinberg[2]; [1]Worcester State University, [2]Brown University

Repeated exposure to the same objects alters the selectivity of neurons in the inferior temporal cortex (IT) for those objects. Specifically, IT neurons respond to a smaller number of familiar objects (i.e., higher selectivity) and to a broader number of novel objects (i.e., lower selectivity). Previously, we reported differences in the shape of the local field potential (LFP) in anterior IT evoked by familiar and novel objects, starting approximately at 160-180 ms after stimulus onset (Anderson et al., 2008, Cerebral Cortex, 18:2540). Consistent with the selectivity changes noted above, classification of object identity based on the shape of the LFP was better for familiar objects. However, it is unclear how these experience-dependent changes alter intercortical communication within the visual system. Recent evidence has demonstrated that feedforward and feedback signals in primate visual cortex utilize different frequency channels: gamma-band oscillations mediate feedforward processing, whereas alpha-/beta-band oscillations mediate feedback processing (Bastos et al., 2015, Neuron, 85:390; van Kerkoerle et al., 2014, PNAS, 111:14332). Considering these advances, we reanalyzed our previous dataset (Anderson et al., 2008) to determine whether differences in LFPs evoked by familiar and novel stimuli reflect changes in feedforward or feedback processing. We most consistently observed increased power in the ~5-17 Hz alpha/beta range for familiar objects. We also observed, less consistently, decreased power in the ~65-100 Hz gamma range for familiar objects. These results support the hypothesis that long-term familiarity leads to stronger feedback connections within the visual system.

Topic Area: PERCEPTION & ACTION: Vision

Mechanisms for sampling distinct memory stores during decision-making

Poster B104, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Avinash Vaidya[1], David Badre[1]; [1]Brown University, Department of Cognitive, Linguistic and Psychological Sciences

In everyday tasks, value assessment frequently depends on judging the relevance of an option based on a schematic understanding of current goals. For example, the value of a hammer may be much higher when trying to build a table than when constructing a model ship. However, in other cases, option values may be learned from direct experience and cached in episodic memory. Despite the ecological relevance of these distinct memory systems in decision-making, relatively little is known about how these different information sources are sampled and assessed. Using a novel experimental paradigm, we tested the neural

and computational mechanisms underlying these processes. Subjects completed a task where they took the role of a restaurant chef and were asked to judge whether to feed food ingredients to customers. These ingredients could be assessed based on information about each customer's preferred recipes, or from directly learned cached values. Using functional MRI, we compared BOLD responses to retrieval from schematic and episodic memory during decision-making, and in updating memory stores based on feedback. We also applied a computational model to describe task behavior and test subjects' latent representations of ingredients in recipe space. Our experiment provides new mechanistic insights into the role of memory systems in informing this process.

Topic Area: THINKING: Decision making

The Neural Underpinnings of Projection Bias

Poster B105, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Roni Setton[1], Geoffrey Fisher[2], R. Nathan Spreng[1]; [1]McGill University, [2]Cornell University

In the last decade, the ability to imagine the future, or prospection, has been extensively investigated. However, individuals are rather poor at making accurate predictions. One explanation for this is provided by the behavioral economics literature as "projection bias," the tendency to inaccurately predict the value of goods to be acquired in the future. In the present study, we examined how value changes from imagining a future event to the realization of that event, in both brain and behavior. Twenty-five adults placed bids on a variety of snack foods while undergoing fMRI scanning across two sessions: once while hungry and once while satiated three days later. While hungry, participants placed bids according to how much they would pay for snack items in an imagined future hungry state or in an imagined future satiated state. In the second session while satiated, participants placed bids according to how much they would pay for the items immediately after the experiment. We hypothesized that participants would bid higher for foods when they were hungry compared to when they were sated, and critically, that bids made while imagining a sated state would exceed those made while actually sated. This projection bias was associated with activity in the ventral striatum, suggesting that greater engagement of ventral striatum, related to reward processing, influences prospection about the value of future events. The present study demonstrates how rewards may interact with a motivational state, such as hunger, and influence prospection as a source of bias.

Topic Area: THINKING: Decision making

Teens care more about their friends: An ERP study of social reward learning in adolescents and adults

Poster B106, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Xingjie Chen[1], Youngbin Kwak[1]; [1]University of Massachusetts Amherst

Adolescents spend a significant amount of time with their friends and peer relationships are particularly valued during adolescence. We investigated how adolescents and adults made decisions during the social gambling task (SGT) in which they earned money for themselves and their best friend. EEG was continuously recorded. Outside the task, participants were also asked how much they would share with the friend if they were given $50 (intended share). Behavioral results suggested that adolescents (N=34, 10-17 yrs), compared to adults (N=30, 21-32 yrs), earned relatively more money for their friend than themselves during SGT. They also showed greater intended share with friend compared to adults. ERP analyses were focused on the fronto-central feedback-related negativity (FRN) and the attention-related P2 and P3, time-locked to choice outcomes. A three-way ANOVA with age groups (adolescents vs. adults), outcome valence (gain vs. loss) and recipient (self vs. friend) was used to compare the ERP magnitudes. For FRN, adolescents showed greater difference in gain vs. loss for friend than self, while the adults showed no difference across recipients. For early attention-related P2, adolescents showed greater P2 for friend than self during losses, while adults showed no difference across recipients. For late attention-related P3b, adults showed greater P3b for self than friend during gains, while adolescents showed a similar P3b for self and friend. Moreover, within adolescents, greater loss – gain FRN was associated with greater intended share with friend. Collectively these results highlight how peer relationships shape adolescent's brain and influence their decisions involving friends.

Topic Area: THINKING: Decision making

The Unfolding Action Model of initiation times, movement times, and movement paths

Poster B107, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Cristian Buc Calderon[1], Wim Gevers[2], Tom Verguts[1]; [1]Ghent University, Department of Experimental Psychology, [2]Université Libre de Bruxelles, Center for Cognition and Neurosciences

Converging evidence has gradually led to a consensus in favor of computational models of behavior implementing continuous information flow and parallel processing between cognitive processing stages. Yet, such models still typically implement a discrete step between the last cognitive processing stage and motor implementation. This discrete step is implemented as a fixed decision bound that activation in the last cognitive stage needs to cross before action can be initiated. Such an implementation is questionable as it cannot account for two important features of behavior. First, it does not allow to select an action while withholding it until the moment is appropriate for executing it. Second, it cannot account for recent evidence that cognition is not confined prior to movement initiation, but consistently leaks into movement. To address these two features, we propose a novel neurocomputational model of cognition-action interactions, namely the unfolding action model (UAM). Crucially, the model implements adaptive information flow between the last cognitive processing stage and motor implementation. We show that such a model addresses the two aforementioned features. Empirically, the UAM accounts for traditional response time data, including positively skewed initiation time distribution, functionally fixed decision bounds and speed-accuracy tradeoffs in button-press experimental designs. Moreover, it accounts for movement times, movement paths, and how they are influenced by cognitive-experimental manipulations. This move should close the current gap between abstract decision making models and behavior observed in natural habitats.

Topic Area: THINKING: Decision making

Family History of Substance Abuse Affects Adolescents' Choices

Poster B108, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Yael M. Cycowicz[1,2], Diana Rodriguez Moreno[1], Lawrence V. Amsel[1,2], Chase A. Hill[1], Zhishun Wang[1,2], Xiaofu He[1,2], Christina Hoven[1,2]; [1]New York State Psyciatric Institute, [2]Columbia University

Adolescents vary in their ability to delay gratification, and this may distinguish adolescents who go on to abuse substances. We investigated the influence of family history of substance use (FH+) on adolescents' ability to delay gratification using the Intertemporal Choice Task (ICT), a delay discounting task. In this task, subjects choose between sooner-smaller (SS) or larger-later (LL) monetary reward. We assessed the effect of immediately available rewards by including two SS conditions: immediate (SS-today) and not immediate (SS-2-weeks). Adolescents (12-16 years old) from the FH+ group (N=25) and FH- group (N=26) performed the task in a 3T scanner to investigate the contribution of frontal and subcortical regions in the monetary decision process. The percentage of overall SS choices (SS/(SS+LL)) did not differ across groups (FH+: 68%; FH-: 69%), nor were there differences in brain activity. However, the percentage of SS-today choices was significantly different from SS-2-weeks choices (71% vs 63%), but only in the FH+ group, with no difference in the FH- group (69% vs 70%). Importantly, this difference was associated with increased activation of regions involved in delay discounting for immediate trials compared to not immediate trials, including Medial Orbitofrontal Gyrus, inferior Ventral Striatum, Posterior Cingulate Cortex, and Precuneus. These finding suggest that the immediate reward condition unmasks a deficit in delay gratification in the FH+ adolescents and may be an early behavioral indicator and neuro-marker of future appetitive impulsivity around immediate rewards such as substances. Subsequent scans (36 months) will reveal how this potentially relates to substance initiation.

Topic Area: THINKING: Decision making

Reliability of the Correlative Triad among Aging, Dopamine, and Cognition

Poster B109, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Eric J. Juarez[1], Jaime J. Castrellon[1], Mikella A. Green[1], Galen A. McAllister[1], Kendra L. Seaman[1], Christopher T. Smith[2], Linh C. Dang[2], David H. Zald[2], Gregory R. Samanez-Larkin[1]; [1]Duke University, [2]Vanderbilt University

The evidence that dopamine receptor availability mediates the association between aging and cognition is one of the most widely cited findings in the cognitive neuroscience of aging. However, relatively few studies have directly examined these associations. Most of these studies have very small sample sizes and results have been inconsistent. Here we examined correlations among adult age, dopamine receptor availability, and cognition in a sample of eighty-three healthy adults (ages 22–83, M=50, SD=18). Subjects completed a short neuropsychological test battery (delayed recall from verbal paired associates, digit span, letter-number sequencing, trail-making test) and, on a separate day, a PET scan with the high-affinity D2-like receptor tracer [18F]fallypride. Digit span was the only variable for which the measure of dopamine receptor availability mediated the age effect on cognitive performance. Age was negatively correlated with digit span (r=–.27). Striatal receptor availability was positively correlated with digit span controlling for age (r=.29). The age effect on digit span was reduced (r=–.27 to r =–.13) when controlling for striatal receptor availability. Although the other cognitive measures used here have been individually associated with both age and dopaminergic variables in prior studies, we found no evidence for significant associations between D2 receptors and cognitive performance on these measures using either ROI-based or whole-brain analyses. Overall, the results partially support the correlative triad of age, D2 receptors, and cognition, with evidence that some previously reported D2-cognition associations may not be as reliable.

Topic Area: THINKING: Development & aging

Insight is facilitated by high definition tDCS to the right temporal lobe

Poster B110, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Carola Salvi[1,2], Ryan Conrardy[2], Richard McKinley[3], Mark Beeman[1], Jordan Grafman[2,4,5]; [1]Department of Psychology, Northwestern University, Chicago, Illinois, USA, [2]Shirley Ryan Ability Lab, Chicago, Illinois, USA, [3]Air Force Research Laboratory, Wright-Patterson AFB, Ohio, USA, [4]Department of Neurology, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA, [5]Department of Physical Medicine and Rehabilitation, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

In the last two decades, neuroscientific research has identified a distinctive brain network for insight problem solving. Several studies, employing various research techniques, converge in showing the activation of the right Superior Temporal Gyrus (rSTG) when participants experience a so called Aha! Moment. While this brain area has been demonstrated to be crucial for the creation of distant semantic relations, fMRI and EEG data involving the rSTG in insight problem solving has so far remained only correlational. Here we attempt a causal approach by applying High Definition Transcranial Direct Current Stimulation (tDCS) to the rSTG of participants, while solving Compound Remote Associates problems. A comparative analysis between and within subjects showed a higher percent of problems solved via insight during and after stimulation, compared to pre-stimulation (on the same participant) and compared to the sham control group. This result represents an important step forward in both understanding the involvement of the rSTG in insight problem solving and a causal approach for its enhancement.

Topic Area: THINKING: Problem solving

Investigating verbal creative problem solving - the role of search as a function of task difficulty

Poster B111, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Maxi Becker[1], Simone Kühn[1]; [1]University Medical Center Hamburg-Eppendorf

Solving ill-defined problems like the compound remote associates (CRA) can be regarded as a dynamic search process through a problem space. The solution path is unknown and the solution relies on finding remote semantic associations. While this task

has been used to study insight, little research has been done on the dynamics of the search process itself: How does search change as a function of restructuring the problem space and which brain areas modulate this process? To investigate these questions, we developed a modified CRA paradigm using semantic priming to induce restructuring: In contrast to the semantic close prime condition, participants need to reinterpret the first target word in the distant prime condition to derive a solution. We measured BOLD activity of 30 participants performing the modified CRA task instructing them to indicate every potential solution they think of. While accuracy decreased, response time and the amount of potential solutions increased for the distant prime compared to the close prime condition. The univariate whole brain analysis revealed a stronger activation for the ACC and bilateral Anterior Insula network for the same contrast at the moment of correct problem solution. Furthermore, this network was positively correlated with the semantic distance between prime and solution. These results suggest that inducing task difficulty through restructuring leads to higher demands in cognitive control modulated through the ACC and Anterior Insula most likely leading search to more distant semantic associations which results in a change from an automatic to a more conscious search for solutions.

Topic Area: THINKING: Problem solving

On the Influence of Regulated Emotions on Pain Processing

Poster B112, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Philipp Reicherts[1], Christiane Hoessle[1], Matthias J. Wieser[2], Paul Pauli[1]; [1]University of Wuerzburg, [2]Erasmus University Rotterdam

It is a well-established finding that emotions alter the processing of pain, such that positive emotions reduce pain and negative emotions increase pain. However, it is unclear whether the active down-regulation of emotions results in a corresponding change of the pain modulating effect. To answer this question, we presented participants pleasant and unpleasant pictures, which they should either only watch or down-regulate during reappraisal trials. Six seconds after picture-onset, we administered painful electrical stimuli to the participant's lower leg. In control trials, participants watched neutral pictures and received the same pain stimuli. In addition to emotion (valence and arousal) and pain ratings (intensity and unpleasantness), we recorded EEG data and evaluated emotion sensitive visually (Late Positive Potential, LPP) and somatosensory (SEP) evoked potentials. The results demonstrate successful emotion regulation especially for unpleasant pictures on the subjective and the neurophysiological level. This was also true for the pain ratings, which were significantly lower during down regulation of unpleasant pictures compared to the watch trials. Analysis of the SEP instead revealed an effect of down-regulation only for pleasant pictures. Taken together, these results show that down regulation of negative emotions also leads to a reduced potentiation of pain. These findings, once again, demonstrate the strong interaction of pain and emotions processing. Future studies should explore the potential of a more elaborate training regarding the use of reappraisal strategies and compare up- vs. down- regulation of emotions.

Topic Area: EMOTION & SOCIAL: Emotional responding

The relationship between moral reasoning and theory of mind effective connectivity

Poster B113, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Araya Lacy[1], Timothy K. Gray[1], Robert S. Ross[1,2]; [1]University of New Hampshire Neuroscience and Behavior Program, [2]University of New Hampshire Psychology Department

Studies show that people with Autism Spectrum Disorder (ASD) have difficulty with moral reasoning and theory of mind (ToM) tasks. This study is intended to reveal differences in effective connectivity during ToM based on moral reasoning ability in neurotypical adults to better understand what might happen neurologically in ASD. Participants performed a moral reasoning task and were sorted into those that make moral decisions based on intention vs outcome. Participants then performed a ToM task in which they indicated whether the character in a story would have positive or negative feelings. We hypothesized that alpha oscillations in the parietal cortex would precede, and subsequently cause, prefrontal cortical alpha oscillations more strongly during the ToM task for participants who focused on intention, compared to those who focused on the outcome of the moral situation. We used the groupSIFT plugin for EEGLAB to determine effective connectivity during theory of mind. Results showed increased connectivity in beta frequency (14-30 Hz) from left anterior cingulate to left insula 800 ms after being shown the ToM question and

increased connectivity in theta (4-8 Hz) from right upper basal ganglia to left anterior cingulate 400 ms post-question in the intention compared to outcome group. Connectivity in beta from left middle cingulate cortex to left precuneus at 600 ms and left middle cingulate cortex to left insula at 2200 ms was increased in the outcome compared to intention group. These results indicate that interoception during ToM may be an important component of moral decision-making.

Topic Area: EMOTION & SOCIAL: Other

White Matter and Social Cognition

Poster B114, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Athanasia Metoki[1], Yin Wang[1], Kyie H. Alm[1], Ingrid R. Olson[1]; [1]Temple University, Department of Psychology

There is a growing consensus that social cognition and behavior emerge from interactions across distributed regions of the "social brain." Researchers have traditionally focused their attention on functional response properties of these gray matter networks and neglected the vital role of white-matter connections in establishing such networks and their functions. In this study we conducted a comprehensive review of prior research on structural connectivity in social neuroscience to clarify structural connectivity underlying social cognition. We paid particular attention to three key social processes: face processing, embodied cognition, and theory of mind, and their respective underlying neural networks. Next, we implemented probabilistic tractography on a large sample of diffusion-weighted imaging data to define the particular tracts involved in each social process, as well as to examine overlap. Together, these findings provide us with an unprecedented, well-defined landscape of large white matter pathways underlying major social brain networks.

Topic Area: EMOTION & SOCIAL: Person perception

The Perception and Cognition of Racialized Voices

Poster B115, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Tedra James[1], Maxime Bouvagnet[1], Psyche Loui[1]; [1]Wesleyan University

The human voice contains abundant information about its owner. Human listeners are able to determine racial and/or ethnic background from the voice based on acoustic and linguistic cues (Perrachione et al, 2010), but little is known about the neural mechanisms that underlie this determination. Here we report a combined behavioral and EEG study to investigate the perception and cognition of race identification from the human voice. We generated a database of short (<1s) audio samples of speech utterances by black and white speakers from natural speech downloaded from TED.com. A norming study was conducted online in which subjects (n = 100) listened to each sample and completed two-alternative forced choice (2AFC) tests to identify the race of the speaker. Samples that were racially identifiable above chance level were then used in a behavioral and EEG study. 64-channel EEG was recorded while participants listened to each sample and, in randomized trials in a 2AFC task, identified either the speaker's race or the word spoken. ERPs showed a large early left anterior negativity around 100 ms, followed by another later negativity in left prefrontal sites at 600 ms, in response to black voices compared to white voices. Compared to word-identification trials, race-identification trials show an early frontocentral positivity (200 ms) followed by a late left-lateralized negativity (900 ms). Taken together, we observe early perceptual as well as late cognitive mechanisms of race identification from the human voice. This neural time-course of race identification has implications for understanding and reducing racial prejudice.

Topic Area: EMOTION & SOCIAL: Person perception

Sex Differences in Brain Network Connectivity Subserving Theory of Mind in Individuals with Alcohol Use Disorder

Poster B116, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Sergey V. Chernyak[1], Marisa M. Silveri[1,2], Amy Janes[1], Jennifer T. Sneider[1], Shelly Greenfield[1], Lisa Nickerson[1]; [1]McLean Hospital, Harvard Medical School, Belmont, MA, [2]Boston University School of Medicine, Boston, MA

Alcohol use disorder (AUD) is associated with impairments in Theory of Mind (ToM), which is the ability to infer actions and emotions of self and others. Converging evidence that ToM may be more impaired in males (M) versus females (F) with AUD has been reported, yet sex differences in the neural correlates of ToM are understudied in those with AUD. To address this issue, we analyzed resting state functional connectivity (RS-FC) data from 104 participants (52 F) with AUD (matched for tobacco/marijuana use) and 104 healthy controls (HC) matched for sex, age, menstrual cycle factors, and family history of drug/alcohol disorders. RS-FC was analyzed using group independent component analysis (GICA) with dual regression ($p<0.05$, corrected). Interactions between sex and AUD were evaluated using two-way ANOVAs in ToM-related brain networks. Importantly, a sex-by-AUD interaction (F>M for AUD, F<M for HC) was found for RS-FC of the dorsal attention network (dAN) with the bilateral temporo-parietal junction (TPJ), a key region in the default-mode network (DMN) implicated in ToM. Increased RS-FC in AUD relative to HC was found within the DMN itself (in dorsomedial prefrontal cortex, left superior temporal gyrus and TPJ). Alterations in the RS-FC within the DMN in individuals with AUD and a sex-by-AUD interaction in the connectivity of the TPJ, a key node of the DMN, with the dAN, suggest that processing involved in orienting to social stimuli via dAN in the context of mentalizing, and ToM via DMN/TPJ, may be differentially affected by sex and AUD.

Topic Area: EMOTION & SOCIAL: Self perception

Efficacy of EEG Neurofeedback in Individuals with Traumatic Brain Injury: Does Age Matter?

Poster B117, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Marielle L. Darwin[1], Savannah Regensburger[1]; [1]Colorado State University

Traumatic brain injury (TBI) often results in neurological deficits that impair cognitive-behavioral and social functioning. EEG neurofeedback (NFB) training utilizes real-time neurophysiological activity to improve regulation of EEG oscillations. High frequency of the alpha rhythm (8-12 hertz) relates to efficient cognitive performance; however, frequency decreases with age. The current study aimed to determine the efficacy of NFB training of the alpha rhythm in individuals with TBI. It was expected that alpha rhythm would improve over the course of treatment. Exploratory analyses determined if age influenced the efficacy of alpha rhythm training. Archival patient records (N=29) collected from a TBI unit of an inpatient rehabilitation center were analyzed. Inclusion criteria include history of moderate-severe TBI and 20 bi-weekly sessions of NFB. The NFB sessions were conducted using BioGraph Infiniti v6.0 software (Thought Technology, Ltd.). A QEEG analysis was conducted prior to individual treatment to identify alpha rhythm frequencies that were +/- two standard deviations from the normative database. A paired t-test revealed that average alpha frequency was significantly higher for the last five NFB sessions compared to the first five sessions, indicating a positive effect of treatment ($t(21)=2.245$, $p=.036$). A linear mixed effect model with age as a categorical variable (individuals below and above the age of 50, respectively; range=21-80 years old) indicated that age did not have a significant effect on the efficacy of NFB to improve the alpha rhythm. Overall, these results indicate that the success of alpha rhythm training in individuals with TBI is not limited by age.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Susceptibility to boredom predicted by cortical grey matter volume in adolescents with familial risk for alcoholism

Poster B118, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Arkadiy L. Maksimovskiy[1,4], Anna Seraikas[1], Emily Oot[1,5], Maya Rieselbach[1], Carolyn Caine[1], Julia Cohen-Gilbert[1,4], Jennifer T. Sneider[1,4], Sion K. Harris[3], Lisa Nickerson[2,4], Marisa M. Silveri[1,4,5]; [1]Neurodevelopmental Laboratory on Addictions and Mental Health, McLean Imaging Center, McLean Hospital, Belmont, MA, [2]Applied Neuroimaging Statistics

Lab, McLean Imaging Center, McLean Hospital, Belmont, MA, [3]Boston Children's Hospital, Harvard Medical School, Boston, MA, [4]Harvard Medical School, Boston, MA, [5]Boston University School of Medicine, Boston, MA

Developmental reductions in grey matter volume (GMV) coincident with adolescence have been associated with age-related maturation of behavioral and cognitive control. Adolescents with a family history of alcoholism (FH+) exhibit alterations in grey matter structure that may confer neurobiological vulnerability for future hazardous drinking. To date, only focal regions have been examined in FH studies of brain structure. Thus, this study examined the influence of FH status on whole-brain morphology, and associations with sensation seeking and impulsiveness, two traits known to predict hazardous drinking. Thirty-three adolescents, ages 13-14 years old, were stratified into FH+ (n=17) and FH- (n=15) groups. Participants underwent magnetic resonance imaging (MRI) at 3T and completed the Brief Sensation Seeking Scale (BSSS) and the Barratt Impulsiveness Scale (BIS). Volumetric brain data were extracted using the Freesurfer pipeline and all FH comparisons were analyzed using regression models that included age and sex as covariates, which accounted for head size. FH+ status was associated with larger total GMV ($p<0.03$), relative to the FH- group, which appeared to be driven by larger cortical ($p<0.001$) rather than subcortical GMV. Although behavioral measures did not differ significantly between groups, the boredom susceptibility component of sensation-seeking was negatively correlated with larger cortical GMV ($p<0.01$), only in the FH+ group. The relationship between higher GMV and susceptibility for boredom in the FH+ group suggests that FH status may moderate the trajectory of grey matter sculpting that is developmentally adaptive, which may provide one possible pathway to a predisposition for risk-taking behavior.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Effects of Multicomponent Training of Cognitive Control (MTCC) on Cognitive and Brain Structural Changes in Adolescents

Poster B119, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Dasom Lee[1], Seyul Kwak[1], Jeanyung Chey[1]; [1]Seoul National University

Cognitive control refers to the ability to adjust a series of thoughts and behaviors in correspondence to an internal goal. Adolescence is a unique period in which cognitive control ability develops to adult-level and neural and behavioral plasticities are high. However, there are limited numbers of cognitive training for adolescents and specific underlying mechanism of brain structure has not been established yet. This study was conducted to investigate the effects of Multicomponent Training of Cognitive Control (MTCC), whether the training enhanced adolescents' cognitive control ability and the effects were generalized to other cognitive domains. Participants were middle school students (aged 11-14) and they performed 30 minutes of MTCC per day for 6 weeks. For analysis, we examined the relationship between the changes in cognitive performance and regional gray matter volume using Voxel-based morphometry (VBM). We conducted small-volume correction (SVC) method to narrow the region of interest into the right inferior frontal cortex (rIFC) because rIFC is the critical area associated with inhibition. After the training, there were significant improvements in the block design test. Furthermore, VBM analysis showed that the volume of rIFC increased in the training group compared to the control group. Moreover, the increased volume of rIFC was correlated with better performances in the Stroop color-word reading, Stroop interference index, and delayed recall of verbal paired associates task. These results imply that MTCC has improved cognitive control ability in adolescents, especially the inhibition sub-component.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Age-Related Declines in Cerebellar-Basal Ganglia Functional Circuits: Implications for Motor Function in Older Adulthood

Poster B120, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Hanna K. Hausman[1], T. Bryan Jackson[1], Jessica A. Bernard[1]; [1]Texas A&M University

With a growing elderly population, it is important to understand brain interactions that may affect behavioral performance declines with age. Resting state functional magnetic resonance imaging (rs-fMRI) has been increasingly used to investigate connections

between different brain regions. Imaging studies have indicated disruptions in functional connectivity of various networks in older adults (OA) relative to younger adults (YA). While the default mode network has been well studied in OA, the literature investigating other networks, particularly subcortical networks, is relatively lacking. Both the cerebellum and the basal ganglia are important areas of investigation in OA due to their role in cognitive and motor functions, as well as their involvement in the pathophysiology of neurological disorders. Here, we performed a targeted rs-fMRI analysis of the cerebellar and the basal ganglia seeds in healthy YA and OA individuals. Structural and rs-fMRI images were obtained from 30 YA and 20 OA. After preprocessing, rs-fMRI connectivity patterns of the cerebellum and basal ganglia were quantified using the CONN toolbox. We computed an ROI-ROI analysis of lobular cerebellar seeds and basal ganglia subregions as defined by DiMartino. We found significantly stronger connectivity between regions of the putamen and the anterior lobules of the cerebellum in YA as compared to OA. Notably, these regions are associated with motor networks and function. These functional changes may contribute to age-related performance declines, and are particularly interesting in the context of Parkinson's disease where the interactions between the cerebellum and basal ganglia are of increasing interest.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Investigating individual differences in context dependent rule learning performance

Poster B121, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Allen Chang[1], Yiren Ren[1], Andrew Whiteman[1,2], Chantal Stern[1]; [1]Boston University, [2]University of Michigan-Ann Arbor

The goal of this study was to investigate individual differences in behavioral and fMRI activity during the learning of context dependent rules. In the experiment, naive participants (n = 31) were scanned using fMRI while being asked to learn two types of rules concurrently over the course of an experimental session. There were 8 complex rules in which the correct response to pairs of stimuli was context dependent, and one 1 simple rule in which the correct response a pair of stimuli was context independent. Our analyses examined the relationship between individual behavioral performance and activity in the prefrontal cortex, medial temporal lobe, and basal ganglia. We observed a wide range of performance (range 42.9%-96% correct; median, 75.0%) across our subjects. Next, we examined how activity differed between correct and incorrect trial outcomes for context dependent rules using behavioral performance as a covariate. We found an interaction between behavioral performance and trial outcome in ventrolateral prefrontal cortex (VLPFC) and dorsolateral prefrontal cortex (DLPFC), with activity in these regions lower for incorrect trials. A second analysis examined how activity for context dependent rules varied across time based on performance. We split the time course of the task into thirds and tested the interaction between time and overall performance. Activity in DLPFC and VLPFC for strong learners increased across time, while activity for poor learners decreased across time. These results suggest activity in the prefrontal cortex plays an important role in successful context dependent rule learning performance.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Reduced Feedback-Based Performance Monitoring at the FRN level When Goal Impact is Transiently Increased

Poster B122, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Mario Carlo Severo[1], Wioleta Walentowska[2,1], Agnes Moors[3,1], Gilles Pourtois[1]; [1]Ghent University, [2]Jagiellonian University in Krakow, [3]KU Leuven

Successful execution of goal-directed actions entails continuous monitoring of ongoing actions and evaluation of their outcomes and contexts. The evaluative component of performance monitoring (PM) has been extensively documented in the electrophysiological domain through two event-related potential (ERP) markers: the Feedback-Related Negativity (FRN) and P3 components. Our recent work revealed that motivational demands can influence and shape the course of PM at the level of these ERP components. More specifically, we demonstrated that the feedback's relevance or importance to one's goal (referred to as goal impact) modulated the FRN (& P3) component in a general way. In that, regardless of its valence, the feedback of higher goal impact showed an overall less negative FRN than that of lower goal impact, suggesting a general decrease in monitoring for the former relative to the latter. As a follow up, we ran a between-subjects design experiment in which 40 participants completed a speeded Go/No Go Task while 64-channel electroencephalography was recorded concurrently. Critically, participants were randomly assigned to two goal impact conditions (high vs. low), manipulated through instructions on the supposed diagnosticity of the task, while maintaining the reward probabilities constant (i.e., deviant positive vs. frequent negative feedback). The current ERP results replicated our initial findings. Furthermore, we noted significant differences in the internal monitoring (at the response-locked level) between the two experimental groups, akin to the pattern at the feedback-locked level. This replication of previous findings stamps the idea that PM brain processes are context dependent and influenced by motivational effects.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Dissociating Components of Multitasking Using HD-tDCS

Poster B123, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Francesca Raileanu[1], Thomas McWilliams[1], Geoffrey Genova[1], Scott Mongold[1], Morgan Taylor[1], Jasper Park[1], Anisha Jain[1], Isabella Montoya[1], Joseph Pajka[1], Erika Hussey[1,2], Nathan Ward[1]; [1]Tufts University, [2]Natick Soldier Research, Development, and Engineering Center

Multitasking is a common cognitive activity that often leads to performance declines, presenting a need to understand how to offset errors. We investigated the efficacy of transcranial direct current stimulation (tDCS) to selectively influence sub-processes of multitasking, including dividing attention between tasks, or dual-tasking (DT), and switching between tasks, or task-switching (TS). Participants (N=24) received tDCS as they completed a novel task that parametrically manipulated TS and DT demands. Using neuronavigation models, we developed high-definition (HD-)tDCS montages that delivered electric current to mutually exclusive neural regions that support TS and DT demands (based on functional neuroimaging results from another study using the same task). All participants completed four tDCS sessions: anodal over TS areas, anodal over DT areas, anodal over TS+DT areas, and sham tDCS over TS+DT areas. Additionally, we tested montages that either maximized focality for each condition while allowing stimulus intensity to vary, or equalized stimulus intensity across conditions while varying focality. A mixed ANOVA of Montage Type (2) x Stimulation Type (4) x TS Demand (2) x DT Demand (2) revealed a three-way interaction between Stimulation Type, TS Demand, and DT Demand, suggesting that HD-tDCS models targeting neural resources reputed to support TS and DT demands lead to changes in TS and DT abilities. Furthermore, we found no interactive effects of Montage Type, indicating little relative benefit to selecting montages that prioritize focality versus intensity. Together, these results offer initial evidence that neuronavigation-informed tDCS montages hold promise for mitigating performance declines associated with sub-processes of multitasking.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Motor conflict and error saliency: The ERN predicts post-error reductions in P1 at short response-stimulus intervals

Poster B124, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Paul Beatty[1], George Buzzell[1,2], Daniel Roberts[1], Craig McDonald[1]; [1]George Mason University, [2]University of Maryland

Empirical research demonstrates that when the time following error commission is constrained, subsequent sensory processing can be impaired (Buzzell et al., 2017). This reduction in sensory processing is presumably due to a bottleneck for cognitive resources produced by an overlap between error processing and subsequent stimulus processing. This finding suggests that, at least within the context of a difficult visual discrimination task, the system dedicated to improving task performance, can actually be the source of performance failures. However, it remains unclear whether this phenomenon is generalizable to other contexts such as those in which motor conflict is the primary source of performance failures. In the present study, event-related potentials and behavioral measures were recorded while participants performed a modified version of a Simon task in which the duration of the response-stimulus interval (RSI) was varied. We found that the depth of error processing was associated with reduced sensory processing at short (200-533 ms), but not long (866-1200 ms) RSIs, providing confirmatory evidence of a bottleneck for cognitive resources when error activity and subsequent stimulus processing overlap. Contrary to previous findings however, the error-related negativity, as opposed to the error positivity, modulated sensory processing on the subsequent trial, possibly because error

salience is greater in a task that produces motor conflict as opposed to stimulus uncertainty. This suggests that although error processing in tasks eliciting motor conflict and stimulus ambiguity might utilize different neural processes to elicit cognitive control, the impact on subsequent sensory processing remains the same.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Separating Inhibitory and Attentional Neural Signals in the Stop-Signal Paradigm

Poster B125, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Darcy Waller[1], Jan Wessel[1]; [1]University of Iowa

Introduction: A common paradigm in the field of cognitive science, the stop-signal task (SST) elicits prepotent motor inhibition in the laboratory setting. While most research that utilizes this task stresses inhibitory processes, other factors may contribute to task performance and successful motor inhibition. Here, we disentangle these neural processes using independent component analysis (ICA) of EEG data collected during the SST and a novel non-inhibition task. Methods: Eighteen participants participated in data collection. EEG recording was conducted while participants completed a novel visual task and SST. The new task is similar to the SST in the first visual stimuli presented (a fixation cross followed by a black arrow on all trials), but displays a second, red arrow during every trial and has participants respond with a button press when the red arrow appears so that no inhibition is initiated. Results: Two independent processes were elicited time-locked to the stop signal. The stopping P3 component (an index of inhibition) was significantly active during the SST but not the novel task. Another independent component occurred ~300ms following the stop signal that was not related to inhibition. Onset of both components correlated significantly with stop-signal reaction time. Conclusions: We found that both inhibitory and non-inhibitory neural signals active during the SST contribute significantly to task performance. Though the SST is an excellent paradigm for studying motor inhibition, it is necessary to consider effects of non-inhibition processes, especially when using the SST to study populations in which deficits are not constrained to motor inhibition.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Individual differences in executive control as a function of combination of trait mindfulness, trait anxiety and associated neural correlates

Poster B126, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Satish Jaiswal[1], Shao-Yang Tsai[1], Neil G. Muggleton[1,2,3], Chi-Hung Juan[1], Wei-Kuang Liang[1]; [1]National Central University, [2]University College London, [3]Goldsmiths, University of London

There are several ways in which cognitive and neurophysiological parameters have been consistently used to explain the variability in cognitive ability between people. However, little has been done to explore how the sources of variability in cognition are influenced by individual differences in personality traits. Dispositional mindfulness and anxiety are two reciprocally linked traits that have been independently attributed to a range of cognitive functions. The current study investigated the relationship between these two traits and measures of the attentional network, cognitive inhibition, and visual working memory capacity. 392 prospective participants were screened to create two experimental groups each of 30 healthy young adults, divided into high mindfulness-low anxiety (HMLA) and low mindfulness-high anxiety (LMHA). They performed an attentional network test, a color Stroop task, and a change detection test of visual working memory capacity, in addition to recording of resting EEG. Results showed that HMLA individuals were more accurate than the LMHA individuals on Stroop and change detection tasks. Additionally, the former group was better in detecting change and had a higher working memory capacity than the latter group. Although there were no group differences for the resting state eyes closed condition, for the eyes open condition, the LMHA group showed higher activation of beta frequencies in frontal and central areas and higher activation of gamma frequencies in central areas of the left hemisphere. This activation of higher frequencies may indicate that LMHA individuals may show greater emotional and physiological arousal than HMLA people (Oathes et al., 2008).

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Differential activation of rostral prefrontal cortex (BA 10) in autism spectrum disorder: An fNIRS study of time-based, prosocial prospective memory

Poster B127, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

James Crum[1]; [1]University College London

Cognitive neuroscientific studies on autism spectrum disorders (ASD) have recently demonstrated atypical activation in brain regions implicated in retrieving future intentions (prospective memory) and simulating the mental states of others and the self, namely rostral prefrontal cortex (Brodmann area 10). The present study used functional near-infrared spectroscopy and behavioral methods to investigate the performance of a group of 27 high-functioning participants with ASD and an age- and IQ-matched control group of 29 participants—representing typical neurodevelopment—on a time-based prospective memory task. Results showed general as well as hemispheric activation differences in rostral prefrontal cortex. Unlike the control group, the majority of rostral prefrontal cortex subregions did not achieve activation significance in the ASD group, and this group did not recruit the right hemisphere of the rostrolateral prefrontal cortex to support time-based prospective memory. At the behavioral level, results showed that performance of the control group on the time-based prospective memory task improved when the retrieval context was prosocial; whereas performance of the ASD group indicated no significant change. These findings support previous research suggesting differential activation of rostral prefrontal cortex and functional underactivation in ASD, and extend findings on the neural basis of time-based prospective memory in typical neurodevelopment.

Topic Area: EXECUTIVE PROCESSES: Other

Dopaminergic modulation of rostral-caudal fronto-striatal loops

Poster B128, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

David Amadeus Vogelsang[1,2], Daniella J. Furman[1,2], Mark D'Esposito[1,2]; [1]1. Helen Wills Neuroscience Institute, University of California, Berkeley, California, 94720, United States, [2]2. Department of Psychology, University of California, Berkeley, California, 94720, United States

Research has shown that the lateral prefrontal cortex (LPFC) may be hierarchically organized along a rostral-caudal functional gradient such that control processing becomes progressively more abstract from caudal to rostral frontal regions. A similar rostral-caudal gradient may also exist in the striatum. The neuromodulator dopamine plays an important role in fronto-striatal interactions and in cognitive control, however it remains unknown whether dopamine influences fronto-striatal connections in a way that accords with the known hierarchical processing gradient. Using a double-blind within-subject design, we analysed resting state fMRI data of healthy young subjects who were scanned twice at rest, once after administration of the dopamine D2 receptor agonist bromocriptine, and once after administration of a placebo. We determined whether dopamine stimulation modulated functional connectivity between frontal regions, that have previously been identified along the rostral-caudal gradient, and rostral and caudal striatal regions. We found that bromocriptine modulated LPFC-striatal connectivity between the inferior frontal sulcus and the mid and caudal part of the caudate. This finding is consistent with previous research demonstrating that the mid lateral frontal regions in humans have higher dopamine receptor density compared to more rostral and caudal frontal regions, suggesting that subregions within LPFC may be differentially modulated by brainstem dopaminergic projections. These results may provide new insights into the role dopamine may play in the hierarchy of cognitive control.

Topic Area: EXECUTIVE PROCESSES: Other

EEG correlates of working memory for action

Poster B129, Sunday, March 25, 8:00-10:00 am, Exhibit Hall C

Edmund Wascher[1], Bianca Zickerig[1], Stephan Getzmann[1], Stefan Arnau[1], Sven Thönes[1], Daniel Schneider[1]; [1]Leibniz Research Centre for Working Environments and Human Factors

Working memory (WM) reflects an interface between perception, long-term memory and action. Either stimulus information or an anticipated response can be stored. Supramodal mechanisms of WM are performed by a wide-spread cortical network including the dorsolateral prefrontal cortex. Additionally, modality specific processing can be assumed, processed not in early sensory but in higher level regions that reflect specific representations of the information that has to be stored. While there is substantial literature regarding the comparison of different sensory modalities, WM for action is hardly ever directly compared to semantic and sensory WM. We evaluated a new approach to WM-functions allowing to differentiate between remembering a stimulus and remembering a response, based on the same stimulus material. A sequence of digits (1-6) was presented continuously. Participants had to make an odd-even decision on either the actual digit (Task: N0), the preceding digit (N-1) or the sum of the actual and the preceding digit (S-1). In S-1, the current digit had to be remembered because no response could be assigned to a single element. Sustained frontal negativity indicated that the digit was maintained in a verbal loop. In N-1, the participants could evaluate the stimulus in advance and store the response until the next stimulus. A modulation of mu- and beta oscillatory activity in the ERSPs was observed that indicated continuing response storage. Moreover, mu- and beta activity varied with the efficiency of response preparation. We thus argue that modulations in mu- and beta- activity provide cortical correlates for WM for action.

Topic Area: EXECUTIVE PROCESSES: Working memory

Comparisons of Mismatch Negativity in Clinical High Risk and Schizophrenia Populations

Poster C1, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Ian T. Kim[1], Migyung Lee[1,2], Pejman Sehatpour[1,2], Cheryl M. Corcoran[1], Daniel C. Javitt[1,2]; [1]Columbia University Medical Center, [2]Nathan Kline Institute

Auditory mismatch negativity (MMN) is a well-characterized biomarker for schizophrenia. However, there have not been many studies investigating whether auditory MMN deficits exist in the clinical high risk (CHR; or prodromal) population. In this investigation, we tested multiple types of deviation from a standard tone, including the well-studied duration deviant and the frequency-modulated (FM) tone. The detection of the later type of mismatch is hypothesized to be related to emotion recognition, used here to investigate if prodromal MMN response is different compared to patients with schizophrenia (SCZ) and healthy controls (HC). Preliminary analysis of time-domain event-related potential (ERP) show that although the MMN waveform in CHR do not differ significantly from SCZ or HC in both duration and FM mismatch conditions, there is a modulatory effect that segregates the three groups. Furthermore, the wider standard error of the means in the duration compared to the FM condition indicate that the FM deviant produces a relatively more consistent difference. This project builds on the previous studies of MMN in SCZ and expands its applicability in CHR.

Topic Area: EMOTION & SOCIAL: Other

Improving auditory spatial attention by non-invasive brain stimulation and training

Poster C2, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Stephan Getzmann[1], Christina Hanenberg[1,2], Joerg Lewald[1,2]; [1]Leibniz Research Centre for Working Environment and Human Factors (IfADo), Germany, [2]Ruhr University Bochum, Germany

Speech perception in complex acoustic environments usually declines with increasing age. This decline is based – at least in part – on difficulties in detecting and localizing a relevant target speaker among concurrent sound, indicating deficits in selective auditory spatial attention. Our project aims at improving localization of speakers of interest under simulated “cocktail-party” conditions in younger and older human subjects using non-invasive brain stimulation (transcranial direct current stimulation, tDCS) and short-term training. Based on previous findings of beneficial effects of tDCS on behavioral performance (Lewald, 2016, Neuropsychologia

84: 282-293), in Exp. 1 we investigated cortical correlates of improved sound localization using electrophysiological methods. We found that effects on attentional processing occurred after anodal, but not cathodal, tDCS and for targets presented on the side contralateral, but not ipsilateral, to the hemisphere stimulated by tDCS. Electrical imaging indicated specific modulation of activity in a focal region around ipsilateral intraparietal sulcus at the time of the N2 ERP component, reflecting modulation of attentional control. In Exp. 2, two types of short-term training were applied using either synchronized auditory targets and visual stimuli presented at the same location or auditory spatial feedback about the correct location of the target. Here, short-term effects on the behavioral level were found for lower performing participants, as well as related modulations of ERP components by training. Taken together, the present results demonstrate for the first time brain correlates of tDCS- and training-induced plasticity of processes involved in selective auditory spatial attention.

Topic Area: ATTENTION: Auditory

Implicit temporal orienting of attention is preserved in healthy aging

Poster C3, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Hunter Johndro[1], Monica Lyons[1], Aniruddh D. Patel[1], Elizabeth Race[1]; [1]Tufts University

Temporal predictions can increase attention to particular points in time and optimize behavioral performance. Temporal orienting has been proposed to occur in two distinct manners (Coull & Nobre, 2008). Explicit (endogenous) orienting occurs in a top-down, voluntary manner when symbolic cues explicitly direct attention in time. Implicit (exogenous) orienting occurs in an automatic, bottom-up manner when rhythmic or temporally-structured stimuli implicitly direct attention in time. In young adults, both explicit (Rohenkohl et al., 2011, 2012) and implicit (Escoffier et al., 2010; Kunert & Johngman, 2017; Large & Jones, 1999) temporal orienting have been shown to entrain neural oscillations and enhance perception. However, the extent to which temporal orienting is preserved in older adults is a matter of debate. Evidence from explicit orienting tasks has been mixed (Chauvin et al., 2016; Zanto & Gazzaley, 2014), and little is known about the status of implicit temporal orienting. The current study tested whether implicit temporal orienting is preserved with age by having younger and older adults perform a visual discrimination task in the context of background, rhythmic music or in silence. In both groups, discrimination was faster for stimuli appearing at predicted (on-beat) compared to unpredicted (off-beat) moments in time. This effect was greatest in individuals with better capacities to discriminate musical beats. These results indicate that implicit temporal orienting of attention can be preserved in aging. Future work can investigate whether these individual differences in implicit temporal orienting reflect age-related variability in neural entrainment to rhythm (Henry et al., 2016).

Topic Area: ATTENTION: Development & aging

Working memory recruitment and network membership of visual, auditory and tactile sensory-biased regions in lateral frontal cortex

Poster C4, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Sean M. Tobyne[1], Abigail L. Noyce[1], James A. Brissenden[1], Stephanie R. Jones[2], Manuel Gomez-Ramirez[2], Christopher I. Moore[2], David C. Somers[1]; [1]Boston University, [2]Brown University

Our laboratory and others have recently reported that preferences for sensory modality characterize distinct subregions of lateral frontal cortex (LFC). We previously used an auditory/visual sustained attention fMRI task to identify four bilateral interleaved regions in LFC with a bias for attention to visual or auditory stimuli (Michalka et al., Neuron, 2015); and have since replicated this finding with an auditory/visual working memory paradigm (Noyce et al., JNeurosci, 2017). These regions form intrinsic networks with posterior sensory-biased regions; a finding we replicated using data from the Human Connectome Project (Tobyne et al., Neuroimage, 2017). Here, we extend our auditory/visual fMRI paradigms to include tactile stimulation. While prior unimodal tactile studies have reported LFC recruitment, visual-, auditory- and tactile-biased cognitive regions within individual subjects remains to be investigated in concert. We observe two unique tactile-biased regions of LFC that abut previously identified auditory- and visual-biased regions. The whole-brain intrinsic connectivity profiles of these six bilateral LFC regions reveal that LFC ROIs possess unique fingerprints of network membership both across and within a modality. Our results elucidate the complex topography of

LFC and highlight the specific profiles of connectivity and task recruitment between and across modality-biased LFC ROIs. In ongoing studies, we are analyzing whether these same representations can be isolated with MEG. Together, these results shed light on the complexity of LFC modality-biased network nodes supporting higher-order cognition.

Topic Area: ATTENTION: Multisensory

Convergent functional network connectivity changes in stimulus-driven attention and awareness

Poster C5, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Hana Eaton[1], Hongyang Sun[1], Jocelyn Sy[1], Doug Godwin[1], Padma Raghavan[1], Rene Marois[1]; [1]Vanderbilt University

Salient, unexpected events are known to powerfully capture attention and disrupt goal-oriented behavior. However, little is known about how attention capture alters connectivity across the brain's functional networks. Recent work showed that perceptual awareness of a task-relevant target is associated with an increase in functional connectivity across diverse neuronal networks of the cerebral cortex (Godwin et al., PNAS, 2014). Given the intricate relationship between awareness and stimulus-driven attention, we hypothesized that the exogenous capture of attention by unexpected 'oddball' stimuli may require large-scale changes in functional connectivity that are similar to the changes seen with perceptual awareness. FMRI data was collected as 30 participants monitored a rapid serial visual presentation of letters for a target. The presentation of task-irrelevant oddballs (faces) in a small proportion of trials (6 out of 40) captured attention and disrupted target detection, especially with the first two oddball presentations. Using graph-theoretic analysis, we found that, like with awareness, the brain's connectivity across functional networks increased – as measured by the modularity and participation coefficient metrics – with the presentation of the first two oddballs relative to subsequent oddball presentations or during target search alone. These results suggest that the capture of attention by an unexpected event is associated with an increase in functional integration of the brain's networks. Moreover, together with the findings in Godwin et al (2014), these results suggest that awareness and stimulus-driven attention are associated with similar integrative, global changes in the brain's functional connectivity.

Topic Area: ATTENTION: Nonspatial

Neural mechanisms of reflexive social attention: a combined eye-tracking and fMRI study

Poster C6, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Lara Rösler[1], Matthias Gamer[1]; [1]Julius Maximilians University of Würzburg, Würzburg, Germany

When being presented with pictures of naturalistic scenes, humans rapidly allocate attention to social features (i.e. human heads or bodies) within these scenes. Various eye-tracking studies have confirmed that this social attention takes place reflexively and independently from the physical saliency of competing image areas. What remains unknown, however, is which neural mechanisms facilitate this rapid allocation of social attention. A viable candidate region is the amygdala which might modulate local activity in early visual cortex and thereby facilitate saccade preparation or execution towards social features. In the current study, we presented naturalistic scenes with social features in one quadrant of the visual field for 200 ms to 37 participants while simultaneously recording eye movements and brain activity using functional magnetic resonance imaging. On the behavioral level, participants made significantly more saccades towards social cues than a distribution of saccades at chance level would imply. Activity changes in early visual cortex reflected the localization of social features in the visual field and were modulated by the occurrence of saccades. However, on the level of univariate analyses, amygdala activity did not differ between trials with saccades towards social features as compared to trials in which saccades were executed towards non-social image regions. It seems possible that localization of social features in the visual field or the elicitation of saccades are rather represented in multivariate patterns of amygdala activity. Collectively, our findings support the notion of a reflexive component of social attention that is reflected in early visual cortex activity.

Topic Area: ATTENTION: Other

Caffeine boosts preparatory attention for reward-related information

Poster C7, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Marlon de Jong[1], Berry van den Berg[1,2], Marty G. Woldorff[2], Monicque M. Lorist[1]; [1]University of Groningen, Groningen, Netherlands, [2]Duke University, Durham, NC 27708, United States

Both the intake of caffeine-containing substances and the prospect of rewards have been associated with improved behavioral performance. These improvements might be related to an effect on attentional preparatory mechanisms, potentially through the influence of both caffeine and the prospect of rewards on the dopaminergic system. To examine the common influence of caffeine and reward on preparatory attention, we tested twenty-four participants during a two-session experiment in which they performed a cued-reward Stroop task. At the start of each trial, participants were presented with a cue to inform them whether they had to prepare for presentation of a Stroop stimulus and if they would receive a reward based on their performance. During each session, participants received either coffee with caffeine (3 mg/kg) or with lactose (placebo). In addition to behavioral measures, electroencephalography (EEG) was recorded. Results showed that both the intake of caffeine, as well as the prospect of reward improved speed and accuracy. However, the effects of caffeine and reward-prospect did not interact on the performance level. Furthermore, the prospect of rewards resulted in enlarged contingent negative variation (CNV), which has been shown to be related to enhanced preparatory attention. Interestingly, the reward-related CNV enhancement was more pronounced in the caffeine condition as compared with the placebo condition. These results revealed that caffeine intake boosts preparatory attention for task-relevant information that can lead to reward.

Topic Area: ATTENTION: Other

Same underlying neural mechanisms for spatial neglect and anosognosia for functional disability

Poster C8, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Stephanie A. Waldman[1], Peii Chen[2], Meghan D. Caulfield[1,2]; [1]Lafayette College, Easton PA, [2]Kessler Foundation, West Orange, NJ

Commonly occurring after unilateral brain injury such as stroke, spatial neglect is characterized by a failure or slowness to respond, orient, or initiate action towards the side of space contralateral to the brain lesion. Spatial neglect often co-occurs with awareness deficits, demonstrated as under-reporting one's own cognitive or motor impairment. Awareness deficits in conjunction with spatial neglect can have profound consequences for rehabilitation progress in regaining functional independence. We examined this hypothesis in 58 individuals with left-sided neglect after right brain stroke, using a secondary data analysis method. In this cohort (46.5% female; mean age=67.3 years, SD=13.3), severity of spatial neglect was determined with the Behavioral Inattention Test. Awareness of deficits was operationally defined as the over-estimation of one's own abilities in daily activities self-rated on the Barthel Index (BI), in comparison to caregiver rated BI. Using discrepancies between the two ratings (i.e., unawareness index), two groups were created for comparative analysis: no/mild unawareness and moderate/severe unawareness. Between-group comparisons revealed significant differences in spatial neglect severity, $t(56) = 2.19$, $p = .033$, and for functional independence at rehabilitation discharge, $t(52) = 3.06$, $p = .003$, suggesting poor self-awareness is associated with both spatial neglect and disability. Lesion analysis revealed that lesion size is not responsible for observed between-group differences, $p > .05$. However, between-groups lesion subtractions indicate similar underlying neural mechanisms are responsible for both spatial neglect and awareness deficits (i.e. right superior temporal gyrus and right superior longitudinal fasciculus) and may play a key role in regaining functional improvement after stroke.

Topic Area: ATTENTION: Spatial

Dynamics of parietal lobe activity predict variability in sustained attention

Poster C9, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

AJ Simon[1], Richard Campusano[1], Josh Volponi[1], Sasha Skinner[1], Joaquin Anguera[1], Adam Gazzaley[1], David A. Ziegler[1]; [1]UCSF, [2]UCSF, [3]UCSF, [4]UCSF, [5]UCSF, [6]UCSF, [7]UCSF

Response time variability (RTV) during cognitive tasks is an indicator of sustained attention abilities in healthy adults. While brain networks that are related to sustained attention abilities have been identified, the relationship between variance in activity in these networks and RTV has seldom been explored. In the present study, we investigated the relationship between variance in activity in key attentional areas and RTV. Forty-four healthy young adults performed a visual sustained attention task while undergoing electroencephalography. We found that variability in the spectral power of parietal beta oscillations, bilaterally, was positively correlated with RTV, while beta power in right parietal electrodes was negatively correlated with RTV. Moreover, beta power was uncorrelated with beta variability, but multiple regression showed that the two interacted to predict RTV, such that high beta power and low variability were better indicators of low RTV than either measure alone. Given the tight link between visual attention and posterior cortical activity, we also investigated the relationship between RTV, activity in parietal regions, and visual cortical responses. We found a negative correlation between P1 amplitude in lateral occipital electrodes, and a positive correlation between P1 amplitude and right parietal beta power, suggesting that parietal beta power is related to enhanced visual processing and behavioral measures of sustained attention. These results suggest that both the strength and consistency of attention-related oscillatory activity uniquely contribute to sustained attention abilities. Taken together, these results improve our understanding of how trial-by-trial fluctuations in parietal lobe activity impact sustained attention.

Topic Area: ATTENTION: Spatial

Differential neural activity for self-referentially processed objects in older and younger adults

Poster C10, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Ryan T. Daley[1], Holly J. Bowen[1], Katelyn R. Parisi[1,2], Elizabeth A. Kensinger[1], Angela H. Gutchess[2]; [1]Boston College, [2]Brandeis University

The self-referencing effect (SRE), or relating information to the self at the time of encoding, is known to be a helpful strategy for memory retrieval in older and younger adults (Gutchess, Kensinger, Yoon, & Schacter, 2007). Literature surrounding the SRE primarily examines memory for personality traits, asking participants explicitly to encode stimuli in relation to themselves or to others. Because adjectives may be implicitly valenced and evaluative, here we instead asked participants to imagine explicitly emotional and neutral objects in their house or yard or in a stranger's house or yard. We sought to determine whether we could replicate the SRE for younger and older adults using this design and to examine the neural activity corresponding with the SRE. Participants performed the encoding task while undergoing a functional magnetic resonance imaging scan and completed an unexpected recognition test outside the scanner. Results suggest overall age-consistency in the regions active during the SRE. Although older adults recruited more regions to process self-related objects compared to young adults, these regions did not appear to be associated with successful encoding of self-related objects. It is possible that age differences during self-referential processing may reflect stronger self-schemas in older adults compared to younger adults.

Topic Area: EMOTION & SOCIAL: Development & aging

Neural Correlates of Loneliness in Adolescence

Poster C11, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Janelle Beadle[1], Mallory Feenstra[1], Abi M. Heller[1], Vince D. Calhoun[2,5], Julia Stephen[2,5], Yu-Ping Wang[3], David E. Warren[4], Tony W. Wilson[4]; [1]University of Nebraska at Omaha, [2]University of New Mexico, [3]Tulane University, [4]University of Nebraska Medical Center, [5]The Mind Research Network

Loneliness is a significant concern in adolescence because it is a risk factor for depression and suicide. However, the brain networks associated with loneliness in adolescence are not yet known. In this study, we investigated the brain networks associated with loneliness in 85 healthy youths and adolescents aged 9-14 years old. We hypothesized that a key region of the default network, the posterior cingulate, would show increased connectivity to regions associated with the experience of loneliness. All 85 participants underwent resting-state fMRI, high-resolution T1-weighted structural MRI, and completed the NIH Toolbox, including measures of loneliness, rejection, and friendship. Using resting-state functional connectivity analyses (rs-FC), we examined whole brain connectivity to the posterior cingulate seed as a function of loneliness. Correlations between regional brain volumes and social measures were also examined. Our results indicated that greater loneliness was associated with lower rs-FC between the posterior cingulate seed, and the bilateral superior parietal cortex. Furthermore, there was reduced rs-FC between the posterior cingulate and the middle temporal gyrus as a function of age and loneliness. Previous research has implicated the superior parietal cortex and middle temporal cortex as playing a role in mentalizing. Our findings are consistent with an account that lonely adolescents' may be less focused on others' intentions, but additional work will be necessary to validate this interpretation.

Topic Area: EMOTION & SOCIAL: Development & aging

For the Win! The Role of Emotion Regulation in Competitive Gaming Performance

Poster C13, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Kyle Nolla[1], Mark Beeman[1]; [1]Northwestern University

The emerging field of competitive gaming offers unique and exciting opportunities for studying expert cognition. Gamers combine complex cognition with trained sensorimotor skill under high-pressure circumstances to best opponents. Past research shows that anxiety from performance pressure harms sensorimotor skill execution (Pijpers et al, 2005) as well as cognition that places high demand on working memory (Beilock & Carr, 2005), two domains critical to competitive gaming. Thus, competitive gaming offers a uniquely suitable context in which to study anxiety's effects on expert performance and how regulation of emotions such as anxiety affect performance. This study examines the role of emotion regulation (ER) in performance in national-level tournaments for Super Smash Bros Melee. Measures were developed to quantify skill in the game, while placing in tournament was used as the performance measure. Between individuals, expertise predicted tournament placing beyond ER (expertise: $\beta= 0.058$, SE=0.02, t=-7.27, p<.0001; ER: $\beta=-0.122$, SE=0.02, t=1.53, p=0.13). However, within individuals, mood valence ($R^2=0.02$, $F(1,339)=6.22$, $p=0.013$) as well as arousal ($R^2=0.03$, $F(1,339)=12.0$, $p=0.0006$) before a match predicted self-rated play quality in that match, demonstrating the importance of ER on the individual level. To better understand this finding, factors predicting mood within individuals were examined, including game outcome, time in the tournament, and self-rated play quality. The cognitive costs of ER in relation to performance are considered. Although more research is needed to determine the best ways to regulate emotion in competitive contexts, this study provides a baseline understanding of the role of ER in real-world, high-demand, skilled competition.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Emotion processing in Moebius Syndrome

Poster C14, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Shruti Japee[1], Jessica Jordan[1], Savannah Lokey[1], Chris Baker[1], Leslie Ungerleider[1]; [1]Lab of Brain and Cognition, NIMH/NIH

Many researchers believe that humans learn to recognize facial expressions by mimicking the expressions of others, thereby experiencing the emotion themselves. But what happens when one cannot generate or mimic facial expressions due to congenital facial palsy, such as that seen in Moebius Syndrome (MoS)? MoS, a rare congenital neurological disorder, is characterized by paralysis of the face and diminished skeletal muscle feedback. Thus, it is possible that individuals with MoS have trouble identifying or processing emotion. To investigate this question, we used a set of computer-based behavioral tasks to characterize the ability of MoS patients to detect and label emotional facial expressions. Individuals with MoS and a group of healthy controls were shown morphs of neutral to fearful and neutral to happy faces, and were instructed to distinguish between fearful and neutral, and happy and neutral faces, with a button press. A one-up, three-down staircase procedure was used to determine each participant's threshold for 79% accuracy. The same morph stimuli and staircase procedure were used in a feature-detection control task, where participants were instructed to indicate with a button press whether the face depicted an open or closed mouth. Analysis of threshold levels for the emotion-detection task revealed that individuals with MoS, compared to controls, showed a deficit in detecting fearful faces, but not happy faces. MoS individuals also performed similar to controls on the feature-detection control task. These results suggest that an emotion-detection deficit may be present in MoS, but further testing with additional patients is needed.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

The Impact of Anxious Arousal on the Discrimination Between Threat and Safety Cues

Poster C15, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Nadia Haddara[1,2], L. Jack Rhodes[1], Thomas Nguyen[1], Kendra Deschamps[1], Stephanie Ijomah[1], Erica Miller[1], Vladimir Miskovic[1,2]; [1]SUNY Binghamton, [2]Center for Affective Science, SUNY Binghamton

The ability to discriminate between sources of threat and safety is critical for adaptive behavior. Falsely attributing threat to perceptually similar, yet benign, environmental cues is known as overgeneralization. While overgeneralization has been demonstrated in individuals with clinical anxiety, we know little about how experimentally induced anxious arousal interacts with conditioned fear learning to influence generalization processes in a healthy population. We used high-density EEG to examine the consequences of an anxious arousal induction on the cortical processing of morphed generalization stimuli that were systematically varied in resemblance to a conditioned threat cue. Following conditioning, participants passively viewed CS+, CS- and five morphed generalization stimuli while EEG was recorded. Specifically, we were interested in the simultaneous capture of steady-state visual evoked potentials (ssVEPs) and late positive potentials (LPPs) in threat-of-electric-shock compared to safe conditions. ssVEPs originate from dipolar sources in early visual cortex and served as an index of the sensory generalization gradient. LPPs represent conglomerate brain response that indexes motivational engagement of subcortical circuitry, allowing us to construct a generalization gradient of motivational significance. We hypothesized that threat-of-shock would promote overgeneralization, showing greater phase synchrony and magnitude of ssVEPs and LPPs, respectively. Results showed a similar magnitude of ssVEPs in both conditions. However, there was a clear difference in motivational value between CS+ and generalization stimuli, as indexed by LPPs, which was enhanced in the threat-of-shock condition. These findings suggest that motivational generalization gradients are more sensitive to the effects of anxious arousal than are gradients in perceptual processing.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Prosodic influence in face emotion perception: evidence from electroencephalography

Poster C16, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Katherine M Becker[1], Donald C Rojas[1]; [1]Colorado State University

Emotion perception occurs via the simultaneous integration of affective vocal and facial information. However, it's unclear how these modalities interact and influence perception when they're integrated. Humans possess a special network of neural structures dedicated to the recognition of facial expressions, which is distinct from brain regions devoted to face detection and prosody recognition. This study examined the neural correlates of these responses by measuring changes in brain activity (n=26) using electroencephalography (39 electrodes). Prosodic stimuli consisted of emotional vocalizations of the vowel /a/ produced in neutral, angry, and happy tones. Face stimuli were made by morphing images of an actor portraying a happy and angry face to create a continuum of faces that varied from 100% happy to 100% angry. These stimuli were used to create seven conditions, three bimodal (face and voice), three voice only (one for each prosody) and one face only condition. Both the bimodal happy (310-355ms) and angry (345-365ms) conditions exhibited a greater positivity than the neutral condition in right motor areas. The happy condition exhibited a greater negativity in frontal (480-680ms) and central parietal areas (500-680ms) than the neutral condition. Bimodal angry stimuli showed a larger negativity bilaterally in occipital areas (100-440ms) compared to happy stimuli. Face only stimuli exhibited a greater negativity in right motor and parietal areas (760-820ms) than the happy condition. Conversely, angry stimuli

showed a greater positivity in left parietal (180-220ms) and bilateral occipito-parietal areas (220-290ms). These findings indicate that occipito-parietal, frontal, and motor areas are involved in emotion perception.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Low-frequency connectivity with memory regions during stress and alcohol cue exposure distinguishes alcoholics from social drinkers

Poster C17, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Elizabeth V. Goldfarb[1], Dongju Seo[1], R. Todd Constable[1], Rajita Sinha[1]; [1]Yale University School of Medicine

Alcohol use disorder (AUD) is a chronic and debilitating illness. Previous work has demonstrated that AUD patients have atypical biological responses to stress as well as alcohol-related cues. As these situations both contribute to alcohol craving and relapse, perhaps through activating memories of prior experiences of alcohol use, it is critical to understand differences in neural network responses to cue exposure among regions related to memory retrieval. Here we used a region of interest (ROI)-based approach in an ongoing study to investigate background connectivity with the hippocampus and putamen (anatomically defined) during prolonged exposure to alcohol, stress, and neutral cues. In a block design, treatment-seeking AUD patients (N = 26) and demographically-matched light drinkers (N = 26) were exposed to neutral/relaxing, stress (negative, high-arousal images from the International Affective Picture System), and alcohol images for six minutes each. As previous work has shown that low-frequency correlations in BOLD signal track affective neural states, we bandpass-filtered the timeseries (0.01 – 0.1 Hz), then averaged the filtered timeseries across voxels within each ROI. Compared to light drinkers, AUD patients had lower hippocampal-medial prefrontal cortex (mPFC) connectivity during stress relative to neutral image exposure (Group x Cue: $p = .017$). In contrast, they showed higher right putamen-mPFC connectivity during alcohol relative to neutral cues (Group x Cue: $p = .019$). These results demonstrate that atypical cue responses in AUD patients include cue-specific disruption of memory-related networks. Further analyses will examine whether these connectivity findings relate to individual differences in real-world drinking behavior.

Topic Area: EMOTION & SOCIAL: Emotional responding

Patient-clinician concordance in social mirroring circuitry supports non-verbal communication and placebo analgesia in the context of pain treatment – a fMRI hyperscanning study

Poster C18, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Dan-Mikael Ellingsen[1,2], Changjin Jung[1,2,3], Jeungchan Lee[1,2], Kylie Isenburg[1,2], Jessica Gerber[1,2], Ishtiaq Mawla[1,2], Roberta Sclocco[1,2], Robert R Edwards[4], John Kelley[5], Irving Kirsch[2], Ted J Kaptchuk[2], Vitaly Napadow[1,2]; [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Korea Institute of Oriental Medicine, Daejeon, Korea (the Republic of), [4]Brigham and Women's Hospital, Boston, MA, [5]Endicott College, Beverly, MA

The patient-clinician relationship can shape patients' clinical outcome, but the brain basis for this is unknown, and psychosocial aspects of pain treatment have typically been studied in patients in isolation. We hypothesized that patient-clinician concordance in social mirroring circuitry, such as ventrolateral prefrontal cortex (vlPFC) and temporoparietal junction (TPJ), during pain treatment, supports non-verbal communication and placebo analgesia. We simultaneously recorded functional Magnetic Resonance Imaging (fMRI hyperscanning) in 21 patient-clinician dyads (fibromyalgia patients and acupuncturists), who interacted via video transfer, during clinician-initiated treatment (real/sham electro-acupuncture) of patients' evoked pain. Using MRI-compatible cameras, participants were enabled to communicate non-verbally throughout the scan. Patients' pain, as well as clinicians' vicarious pain, was decreased during both real and sham treatment compared to overt no-treatment (pain+treatment, relative to no-treatment). Furthermore, patients' placebo analgesia (no-treatment–sham) correlated with clinicians' perceived efficacy (no-treatment–sham). A conjunction analysis of brain responses of patients (receiving pain+treatment) and clinicians (providing treatment) demonstrated activation of vlPFC, aINS, and TPJ for both patients and clinicians. Using ROI extraction from the group vlPFC conjunction cluster, we found that the number of co-activated voxels (treatment–no-treatment) between patients

and clinicians correlated with patients' placebo analgesia, within dyads. Furthermore, patient-clinician concordance in right TPJ correlated with self-reported emotional expressiveness, frequency of eye-contact, and patients' placebo analgesia. In sum, increased patient-clinician concordance in vlPFC and right TPJ during pain treatment may support patient-clinician communication and ultimately placebo analgesia.

Topic Area: EMOTION & SOCIAL: Emotional responding

Personality Measures and Reward-Related Neural Activations among Individuals with Different Substance Using Patterns

Poster C19, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Tien Tong[1], Jatin Vaidya[1], John Kramer[1], Samuel Kuperman[1], Doug Langbehn[1], Daniel O'Leary[1]; [1]University of Iowa Carver College of Medicine

Use of substances is associated with enhancement of positive affect (PA) and reduction of negative affect (NA). Individual differences in PA and NA are in turn associated with differential brain responses to reward and loss, respectively. The purpose of this study was to examine the associations between substance use and positive motivational (PA; reward activations), negative motivational (NA; loss activations), and control (impulsivity) processes. Toward this goal, we recruited 221 emerging adults (112 males, Mean Age=18.69) with varying levels of substance use (controls, monosubstance use: alcohol, and polysubstance use - PSU: alcohol and marijuana), as well as varying levels of alcohol use (Bingers – have 4-6 (females) or 5-8 (males) drinks in 2 hours, and Extreme Bingers – have 8+ (females) or 10+ (males) drinks in 2 hours). Heightened impulsivity was associated with cumulative use of both alcohol and marijuana (p's<.05). PA and NA, however, were correlated with marijuana use (p's<.01) but not with alcohol use. When participants were categorized into groups (Controls, Bingers, Extreme Bingers, PSU Bingers, and PSU Extreme Bingers), there was no significant group effect for PA and NA. Neural activation of monetary gain revealed similar results. Activation in the mesial prefrontal cortex during gain outcome was marginally correlated with alcohol use (p=.05) but not marijuana use, and groups with different substance use patterns didn't show a difference in reward activation. In summary, choices of different substances as measured by cumulative use were related to PA, NA, and reward-related neural activation.

Topic Area: EMOTION & SOCIAL: Other

Effect of social context on stimuli processing: comparing the ERPs of individuals tested alone, with a friend or with a stranger

Poster C20, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Ashley Chau-Morris[1], Maud Haffar[1,3], Sheila Bouten[1], Tarlan Daryoush[1], Natalie Frye[1], Ursula Hess[4], Hugo Pantecouteau[1,5], J. Bruno Debruille[1,2,3]; [1]Research Center of the Douglas Institute, Montréal, Canada., [2]Department of Psychiatry, McGill University, Montréal, Canada., [3]Department of Neurosciences, McGill University, Montréal, Canada., [4]Department of Psychology, Humboldt University, Berlin, Germany., [5]École Normale Supérieure, Lyon, France

When we are with a close other, we know what reactions to expect from them. On the contrary, when we are with an unknown person we cannot anticipate his/her behavior. These two situations could correspond to different modes of processing. For instance, with the unknown person we have to be prepared for any reaction. We sought to determine whether these modes of processing actually exist and whether they impact the processing of stimuli that are neither related or relevant to the other person. To achieve that goal, we recorded the event-related brain potentials (ERPs) elicited by pictures in 34 participants who were tested next to a stranger and in 32 participants who were tested next to a friend. The former had ERPs that were much less negative than the latter in the time windows of the N300s, N400s, and late posterior positivities. In a second experiment, we tested 32 matched participants who went through the same experiment alone. Although their ERPs were closer to those who were tested with a friend, some specific differences exist that were not accounted for by anxiety. Thus, stimulus processing largely and automatically depends on whom we are with.

Topic Area: EMOTION & SOCIAL: Other

Exposure to different bodies modulates eye movements to high- and low-calorie foods

Poster C21, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Fatemeh Fereidooni[1], Natalie A. Ceballos[1], Reiko Graham[1]; [1]Texas State University

Studies indicate that exposure to images of bodies influences eating behaviors and cognitions. For example, exposure to thin models is associated with increased chocolate avoidance and guilt, whereas exposure to overweight models is related to decreased chocolate approach and guilt (Durkin et al., 2012). The current study sought to determine if exposure to bodies influences gaze behavior to different foods. Participants (46 undergraduates, 6 males, mean age = 22.3, mean BMI = 24.8) were assigned to one of two body viewing conditions (thin or heavy bodies). First, each participant viewed pairs of savory or sweet food images that varied in their calorie content (high vs. low). After viewing same sex bodies that were either heavy or thin, participants viewed another set of food images. Eye movements were monitored throughout. Analysis of duration to first fixation (attentional orienting) revealed several interactions, including a body viewing condition by time interaction, such that participants took longer to gaze at all foods after viewing heavier bodies. Participants also took longer to fixate on high calorie sweet foods at Time 2, regardless of body viewing condition. With respect to total fixation duration (attentional maintenance), several interactions were noted, including a time x calorie x taste interaction. Specifically, participants looked longer at low calorie (vs. high calorie) savory and sweet foods at Time 1, a difference that disappeared for savory foods after viewing bodies. Overall, results suggest that the effects of body exposure are manifested primarily during attentional orienting, suggestive of food avoidance.

Topic Area: EMOTION & SOCIAL: Person perception

Probing the Time-course of Face Representations with Time-resolved Multivariate Pattern Analyses of EEG Signals

Poster C22, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Laurie Bayet[1], Rachel Wu[2], Benjamin Balas[3], Richard N. Aslin[4]; [1]Boston Children's Hospital, Harvard Medical School, [2]University of California, Riverside, [3]North Dakota State University, [4]Haskins Laboratories

Time-resolved MVPA (decoding) of MEG data has successfully uncovered the time-course and temporal dynamics of neural representations in adults. EEG, a low-cost alternative to MEG, is generally better suited for developmental research. Thus, a question is whether decoding from EEG signals would similarly uncover the timing of representations in adult and developmental populations. This talk presents two uses of EEG decoding to uncover the time-course of neural representations associated with face perception in adults and children. In a first study, adults completed a visual search task for non-human animal (N = 20) or human (N=21) faces. Target location (i.e., right or left) could be decoded from EEG signals from approximately 200ms onwards, with similar accuracy for both human and animal faces. Neural patterns associated with individual versus categorical searches were more robustly differentiated for human than animal faces from 176-204ms. These findings suggest that perceptual narrowing affects task-dependent neural representations during visual search, but surprisingly preserves the attentional selection of targets. In a second study, 5-7 year-olds (N=18) and 8-10 year-olds (N=18) passively watched pictures of real or doll faces presented in an upright or inverted orientation. Information about face orientation (inverted vs. upright), but not face animacy (real vs. doll), could be decoded from the EEG signal in 5-7 year-olds from 248-316ms. The same time-course was evident in 8-10 year-olds, although decoding accuracy for face orientation only marginally reached statistical significance (272-316ms). Taken together, these findings demonstrate the potential of time-resolved EEG decoding for developmental and cognitive neuroscience research.

Topic Area: EMOTION & SOCIAL: Person perception

Alterations in neural circuits supporting executive functions in children with reading difficulties

Poster C23, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Tzipi Horowitz-Kraus[1,2], Rola Farah[1]; [1]Educational Neuroimaging Center, Faculty of Education in Science and Technology, Technion, Haifa, Israel, [2]Reading and Literacy Discovery Center, General Pediatrics, Cincinnati Children's Hospital Medical Center, Ohio, USA

Reading difficulties have been linked to challenges in engaging executive functions (EF) while reading, such as working memory, attention, and speed of processing. Our study was designed to directly define the differences in neural processing during the Stroop task, which is a classical EF task, in children with reading difficulties compared with typical readers. Reading and EF abilities were assessed in 8-12 year-old children with reading difficulties and typical readers. Functional connectivity and global efficiency of several cognitive-control networks during a functional MRI Stroop task were defined in both groups. Children with reading difficulties showed lower reading and EF abilities and demonstrated greater functional connectivity between the EF network and visual, language, and cognitive-control regions during the Stroop task compared to typical readers. Our results suggest that children with reading difficulties utilize neural circuits supporting EF more so than do typical readers in order to perform an EF task. The connection between reading and EF suggests that insufficient triggering of EF in childhood will harm reading acquisition later in life. It also suggests that an EF-based training in childhood has the potential to improve future reading abilities in children.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Socioeconomic Disadvantage, Prefrontal Cortical Structure, and Executive Function in School-Aged Children

Poster C24, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Pooja M. Desai[1], Emily C. Merz[2], Elaine Maskus[2], Xiaofu He[3], Kimberly G. Noble[2]; [1]Barnard College, Columbia University, [2]Teachers College, Columbia University, [3]Columbia University Medical Center

Currently, in the United States, it is estimated that more than 1 in 5 children live below the poverty line. Socioeconomic disparities in children's development of executive function (EF) have been well established. In addition, socioeconomic disadvantage has been associated with decreased surface area (SA) in regions of the prefrontal cortex (PFC) that are closely involved in EF skills. However, little work has examined which specific PFC regions mediate socioeconomic differences in children's EF. In this study, we investigated whether structural differences in PFC regions mediated associations between socioeconomic status (SES) and EF in 5- to 9-year-old children (N = 31). Children from socioeconomically diverse families completed a high-resolution T1-weighted MRI scan. FreeSurfer was used for quality control, preprocessing, and extraction of SA in PFC regions-of-interest. Children also completed inhibitory control, working memory, and cognitive flexibility tasks from the NIH Toolbox Cognition Battery. Lower family income-to-needs ratio (ITN) was significantly associated with decreased working memory and cognitive flexibility, and lower parental education was significantly associated with decreased working memory. Further, lower family ITN was associated with decreased SA in the medial orbitofrontal cortex (OFC), which in turn was linked with decreased cognitive flexibility, although this did not reach conventional levels of significance via bias-corrected bootstrapping. Lower parental education was found to have a marginally significant indirect effect on reduced inhibitory control through decreased lateral OFC SA. Together, these findings suggest that OFC regions are potentially implicated in the pathway from socioeconomic disadvantage to childhood EF difficulties.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Local functional connectivity development in early childhood: Associations with socioeconomic status

Poster C25, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Ursula A Tooley[1], Allyson P Mackey[1]; [1]University of Pennsylvania

Mounting evidence suggests that low socioeconomic status (SES) is associated with accelerated structural brain development. However, this presents a paradox, as lower SES is not typically associated with accelerated cognitive development. Further, it is unclear how and when SES disparities emerge over the course of development. We examined the development of resting-state functional connectivity in early childhood (ages 3-10, n = 64, Pediatric Imaging Neurocognition & Genetics dataset), and tested whether SES was associated with alterations in developmental trajectories. We focused on regional homogeneity (ReHo), a whole-brain approach that compares each voxel's blood oxygen time course to its neighboring voxels, yielding an estimate of local functional connectivity. In adults, ReHo is highest in sensorimotor regions and in the default mode network (DMN), perhaps reflecting domain-specific local processing in the former and a modular, tightly coupled network in the latter. We found that, in young children, ReHo is also high in sensorimotor regions. We found that ReHo decreased with age in sensorimotor regions, and increased in the DMN (corrected at $p < .05$ with FSL's randomise). Children from higher SES backgrounds showed faster developmental changes in these regions than children from lower SES backgrounds. Additionally, there was a positive correlation between socioeconomic status (SES) and ReHo in an area of right anterior inferior frontal gyrus at the intersection of three networks: default mode, frontoparietal, and ventral attention (Yeo et al., 2011). Our findings suggest that SES may have an impact on the development of local connectivity across multiple cortical networks.

Topic Area: EXECUTIVE PROCESSES: Development & aging

The relative neuropsychological effects of physical, cognitive, and interactive exercise (iPACES™) for mild cognitive impairment (MCI): Pilot data comparing two-week windows of each as in-home interventions

Poster C26, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Kathryn M Wall[1], Jessica Stark[1], Alexa Schillaci[1], Carolyn Doty[1], Hannah Christian[1], Anvit Karla-Lall[1], Molly Maloney[1], Cay Anderson-Hanley[1]; [1]Union College, NY

Dementia cases are on the rise among our aging global population, and thus there is increasing urgency to identify efficacious interventions for preserving or ameliorating cognitive decline. Physical exercise has been found to slow the decline of cognitive abilities in those with mild cognitive impairment (MCI). Cognitive training has sometimes been reported to have a positive effect, but many critiques cast doubt on its ability to be widely endorsed as an effective treatment. Some research has found that interventions which combine both physical and cognitive exercise may yield greater benefits. This quasi-experimental within-subjects design compared each of these three components to assess impact on neuropsychological function. Participants were evaluated over eight weeks at two week intervals. Executive function was assessed at each evaluation through the use of tablet-based neuropsychological tests (i.e., Stroop, Trails and Flanker). The Montreal Cognitive Assessment (MoCA) was also used to assess overall cognitive function. This pilot study enrolled 14 older adults, 13 of which met criteria for MCI (MoCA< 26), with ten study completers. Paired t-tests were used to compare change from baseline to after each condition. Relative comparisons were also made between conditions. Results suggest that cognitive exercise (game-only) and interactive physical and cognitive exercise (iPACES™) yielded significant gains in executive function from baseline (moderate effect sizes), with the iPACES™ improving significantly more than exercise alone ($p = .04$). Further research is needed to replicate and extend this pilot research; in particular, it would be useful to compare such interventions in a randomized controlled trial.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Differential associations between large-scale networks during externally and internally directed attention

Poster C27, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Julia W. Y. Kam[1], Sandon Griffin[1], Jack J. Lin[2], Anne-Kristin Solbakk[3], Tor Endestad[3], Pal G. Larsson[4], Robert T. Knight[1]; [1]University of California, Berkeley, [2]University of California, Irvine, [3]University of Oslo, [4]Oslo University Hospital

Our capacity to flexibly shift between internally and externally directed processes is crucial for successful performance in our daily life. While recent neuroimaging evidence has implicated the fronto-parietal control network in both internally directed processes, including autobiographical memory retrieval and future planning, and externally directed processes, including cognitive control and selective attention, the underlying neural mechanism is still largely unknown. To address this issue, we recorded intracranial EEG activity in patients undergoing presurgical monitoring for intractable epilepsy who were implanted with subdural and/or depth electrodes. Patients performed an attention task wherein half the time, they had to detect target tones (i.e. external condition); the other half of the time, they were instructed to think about whatever comes to mind and ignore all the tones (i.e. internal condition). We correlated low frequency activity (theta: 4-8Hz, alpha: 8-14Hz, beta: 14-30Hz) between electrode pairs across networks (i.e. target detection network, default mode network, and fronto-parietal control network), which were then examined as a function of condition across patients. We found increased correlation between the default mode network and fronto-parietal control network during the internal relative to external conditions, and increased correlation between the task detection network and frontoparietal control network during the external relative to internal conditions. These results indicate that the enhanced spatiotemporal integration of information between the relevant network and the fronto-parietal control network is one potential mechanism in facilitating both externally and internally directed attention.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Learning Cognitive Flexibility: Neural Mechanisms of Adaptive Switch Readiness

Poster C28, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Anthony W. Sali[1], Christina Bejjani[1], Tobias Egner[1]; [1]Duke University

Individuals adapt their readiness to switch task sets ("cognitive flexibility") according to environmental demands, such that the cost associated with switching tasks is reduced when a switch is likely (e.g. Dreisbach & Haider, 2006). However, the neural mechanisms underlying this form of cognitive control learning remain unknown. To this end, we used functional magnetic resonance imaging (fMRI) and a task-switching paradigm in which the frequency of switches varied over time, ranging from 25% to 50% to 75% switch-likelihood, to probe the neural mechanisms involved in learning to match switch-readiness to changing contexts. Behaviorally, participants demonstrated smaller task-switch costs in blocks when switching was highly likely relative to blocks when switches were rare, and a temporal difference reinforcement learning model successfully accounted for both within-subject and between-subject variability in performance. A subsequent model-based fMRI analysis revealed that activity within left inferior parietal and frontal cortex increased with the magnitude of trial-by-trial unsigned switch prediction error, thus serving as a potential neural substrate of learning. Furthermore, activity within bilateral dorsal parietal cortex was associated with signed switch prediction errors such that activity was highest when switching was the most surprising. Together, our results suggest that components of the frontoparietal control network code for moment-by-moment deviations from task-switch predictions and provide a potential substrate of learned adjustments in switch-readiness.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Effective connectivity via brain oscillations during cognitive control post-concussion

Poster C29, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Natasha Fansiwala[1], Stephanie E. Barlow[1], Paolo Medrano[1], Robert S. Ross[1]; [1]University of New Hampshire

Concussions may impact the brain through network activity alterations. Brain oscillations underlie how brain regions communicate with each other. Rule-switching requires engagement of cognitive control mechanisms, which are related to alpha (8-12 Hz) and beta (13-30 Hz) frequency bands. Therefore, concussions may impact rule-switching behavior through changes in effectivity connectivity in alpha and beta bands. The current study examined changes in effective connectivity in alpha and beta during a rule-switching task in participants that had suffered two or more concussions. Thirty-six participants, matched for age and gender, underwent EEG recording during a rule-switching task (n = 17 controls, n = 19 with concussion). Unique visual stimuli containing red or green, and circle or square dimensions were presented on every trial. A cue was given prior to each stimulus presentation informing participants which rule to use on the current trial. The rule changed after 3-5 trials which were named switch trials. The data was analyzed using MATLAB with the EEGLAB plugin groupSIFT. These preliminary results show that accuracy during switch trials is less for those with concussions compared to controls. Additionally, results suggest there may be an effective connectivity difference from left frontal superior cortex to right insula at 750 ms post-cue in the beta band in people with multiple concussions. There may also be effective connectivity differences between left insula to right postcentral cortex 650-900 ms post-cue in the alpha and beta band. These results may suggest that concussions change network activity in oscillatory bands associated with control.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Conflict-related ERPs in the Temporal Flanker Task: N2 under conditions of perceptual mismatch and response conflict

Poster C30, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Kerstin Jost[1], Mike Wendt[2], Aquiles Luna-Rodriguez[3], Andreas Löw[3], Thomas Jacobsen[3]; [1]Brandenburg Medical School, [2]Medical School Hamburg, [3]Helmut-Schmidt-University/ University of the Federal Armed Forces Hamburg

Processing of conflicting distractor-target conjunctions is frequently associated with a pronounced N2 component of the event-related potential, assumed to reflect control processes like conflict/error detection or response inhibition. We here investigated processing of distractor-target conflict in a Temporal Flanker Task in which a target stimulus is preceded by a congruent or an incongruent distractor presented in the same location. As indicated by behavioral congruency effects and the distractor-related lateralized readiness potential, incongruent distractors yield response conflict, particularly when the proportion of incongruent trials is low. The analysis of target-locked brain waves revealed a broadly distributed negative component around 270 ms in incongruent trials. When the proportion of incongruent trials was low, this negativity was much larger than typical N2 effects in conflict or oddball tasks, suggesting that it was driven by both cognitive conflict and unexpected perceptual mismatch. Distractor-target mismatch also elicited an earlier component at posterior electrodes, resembling the P150 observed in letter priming studies. This component was, however, unaffected by the congruent/incongruent ratio. Together, the results suggest a series of processes, involving stimulus-related mismatch detection and context-dependent conflict evaluation or regulation.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Dopaminergic polymorphisms C957T and ANKK1 contribute to distinct aspects of delay discounting

Poster C31, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Amy T Nusbaum[1], John M Hinson[1], Paul Whitney[1]; [1]Washington State University

Impulsivity is characterized in part by the tendency to make decisions that lead to immediate reward without consideration of potential future consequences. Excessive impulsivity has been conceptualized as an imbalance between top-down processes, driven by the prefrontal cortex, and bottom-up processes, driven by regions including the striatum. Thus, neurochemical modulation of impulsivity may rely on those two regions. Further, impulsivity as measured by delay discounting tasks can be altered using constraints such as working memory loads, but the biological factors that confer resiliency or vulnerability to such constraints have not been identified. We examined the role of dopamine-related genetic polymorphisms in impulsivity under baseline conditions and while engaged in a working memory task. Participants (n=121) were genotyped for COMT (rs4680), a polymorphism that affects dopamine in the prefrontal cortex, C957T (rs6277), and ANKK1 (rs1800497), polymorphisms that affect dopamine in the striatum. Participants two conditions of a delay discounting task involving choices of hypothetical amounts of money while maintaining either a relatively small or relatively large working memory load of randomly selected digits. Using a repeated measures ANOVA, we found that the C957T C allele increased discounting of delayed amounts of money, consistent with more impulsive decision making, while the ANKK1 A1 allele increased discounting rates only when individuals were undergoing a working memory load. These results provide further support for the role of genetics in impulsivity, while also suggesting a potential biomarker that may confer vulnerability to factors that alter impulsivity, such as working memory loads and stress.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

The Feedback-Related Negativity, but not Frontal Midline Theta, Reflects Prediction Errors During Both Positive and Negative Reinforcement

Poster C32, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Eric Rawls[1], Yoojin Lee[2], Elizabeth Shirtcliff[2], Connie Lamm[1]; [1]University of Arkansas, [2]Iowa State University

Dopamine signals convey neural representations of past rewarding and aversive experiences by encoding prediction errors that drive reinforcement learning. The feedback-related negativity (FRN) is a component of the event-related potential that is sensitive to valenced feedback; Holroyd & Coles (2002) theorize that the reinforcing properties of the FRN derive from dopaminergic prediction error signals. Reinforcement processing has also been studied using frontal midline theta (4-7 Hz) activity, which peaks around the same time as the FRN and increases in response to unexpected events compared to expected events. We recorded EEG while subjects completed a Monetary Incentive Delay task that included positive reinforcement and negative reinforcement conditions with multiple levels of reward and punishment, as well as control conditions that had no reinforcement value. We show that despite temporal overlap of FRN and frontal midline theta, these measures index dissociable neuro-cognitive mechanisms. Results suggest that the FRN, but not frontal midline theta, is specifically sensitive to reinforcing outcomes. The FRN represented prediction errors in both positive and negative reinforcement, while frontal theta instead represented unexpected outcomes regardless of reinforcement value. Furthermore, the FRN was sensitive to the point value of feedback in both positive and negative reinforcement, while theta activity was not influenced by feedback point value. These results are consistent with the theory that the FRN is influenced by dopaminergic signaling, and suggest that frontal theta instead represents local processing of unexpected events regardless of whether they are reinforcing or not.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Altered Functional Networks Underlying Post-Error Adaptation in Women with Drug Use Disorder and Comorbid Post-Traumatic Stress Disorder

Poster C33, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Bradford S. Martins[1], Clinton D. Kilts[1], G. Andrew James[1]; [1]University of Arkansas for Medical Sciences

Individuals with either Drug Use Disorder (DUD) or Post-Traumatic Stress Disorder (PTSD) have well-established deficits in error processing, yet no research has studied the neural correlates of these processes in comorbidity. We conducted a retrospective analysis of women with DUD, DUD+PTSD, and healthy comparison subjects to model altered interactions among neural regions underlying error-adaptation with comorbidity. We hypothesized that altered connectivity in the salience and reward networks would most significantly contribute to post-error adaptation, and that differences in these two networks would be seen across disorder groups. 44 females (healthy controls=23, cocaine use disorder=11, comorbid=11) underwent fMRI neuroimaging while performing a Stop Signal task. Dynamic causal modeling using Bayesian statistics characterized network connectivity differences between 32 regions in 5 networks across the 3 subgroups. Pearson's correlation coefficient was used to relate altered connections to post-error adaptation (measured by post-error slowing on subsequent Go trials). One connection in the comorbid group and one connection in the DUD group were significantly modulated by post-error adaptation. Group differences in the neural correlates underlying post-error adaptation showed that while both groups share altered network connectivity involved in error recognition and error adaptation, error adaptation in comorbid females is more closely associated with altered connectivity involving regions that confer cognitive-flexibility and learning, while error adaptation in DUD females is more closely related to altered connectivity involved in attention and self-control. By highlighting the unique neural differences underlying similar behaviors across disorder groups, we can develop better treatment strategies for individuals with comorbid diagnoses.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Dysexecutive impairment in first-episode of Schizophrenia

Poster C34, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Gricel Orellana[1], Andrea Slachevsky[1]; [1]Facultad de Medicina, Universidad de Chile

Background: Deficit in executive functions may be central to schizophrenia and it is present in adolescents at risk of developing the disease [ultra-high risk], in patients with a first outbreak of schizophrenia, and apparently in their first-degree relatives. Mild to moderate impairments on executive functions tests have particularly been described in patients with a first-episode of schizophrenia. In aged schizophrenic patients, a more severe cognitive impairment has been described that mainly involves executive functions. Executive dysfunction has been significantly associated with psychosocial impairment in this disease. Despite its importance, there are still few studies that analyze the disexecutive behaviors' in FES. We compared executive functions and disexecutive behaviors' of a group of first-episode schizophrenia [FES] patients and a group of healthy participants using the Modified Six Elements Test [MSET], the Modified Wisconsin Card Sorting Test [MWCST], the Frontal Assessment Battery [FAB], the Questionnaire which probes symptoms of Dysexecutive syndrome [DEX] and the Behavioral Dysexecutive Syndrome Inventory [BDSI]. Methods: Twenty-two FES participants took part in this study. The 22 FES patients met the clinical and DSM-IV-TR criteria for schizophrenia in the Structured Clinical Interview for DSM-IV Axis I Disorders [SCID-I]. Nineteen FES patients were paranoid, two disorganized, and one catatonic. During the evaluations of our study, FES patients were clinically stable, receiving a single atypical antipsychotic medication. Results: We found that the control group demonstrated significantly greater Executive functions efficiency than FES patients in the tests. Patient group demonstrated significantly greater disexecutive behaviours than FES patients in the questionnaires.

Topic Area: EXECUTIVE PROCESSES: Other

Different procrastination measures correlate with different neural activities

Poster C35, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Zhoumao Duo[1,2], Sunao Iwaki[1,2]; [1]National Institute of Advanced Industrial Science and Technology, [2]University of Tsukuba

Irrational Procrastination Scale (IPS) represents a widely recognized conceptualization, in which procrastination is defined as "the irrational delay". However, the General Procrastination Scale (GPS), which describes procrastination as "postponing have-to-do things" is frequently used to measure the individual procrastination tendency. The primary objective of this study is to confirm whether the "procrastination" of two scales have a common neurological basis from the perspective of executive functions (EFs). During the block design fMRI experiments, participants performed N-back, Simon, and task-switching tasks to measure brain activities underlying three basic components of EFs, namely, working memory, inhibition control and, cognitive flexibility. IPS and GPS were used to characterize the individual procrastination tendency. The performance of n-back ($n=21$) and simon ($n=26$) did not show any significant correlation with IPS/GPS score. In task-switching ($n=21$), mixing cost of reaction time positively correlated with IPS scores ($r=.53$, $p<.05$). Main results of fMRI showed IPS scores negatively correlated ($p<.05$) with middle frontal gyrus (MFG) in all tasks (n-back: (left) $r=-.50$; simon: (left) $r=-.42$; task-switching: (right) $r=-.47$). GPS showed negative correlation ($p<.05$) with most regions' activities in task-switching, but no significant correlation in simon. The results indicate that more efficient functional circuit of cognitive flexibility is associated with higher GPS's tendency. In short, the IPS/GPS scores differently correlated with performance and brain activities relating to EFs suggested the different neural basis of IPS and GPS. This finding emphasized the importance of conceptional unification to study neural correlates of procrastination.

Topic Area: EXECUTIVE PROCESSES: Other

Electrophysiological markers of stress on working memory networks in adolescents

Poster C36, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Alana Campbell[1,2], Jessica Graham[1], Margaret Nicopolis[1,2], Louis Murphy[1], Hannah Waltz[1], Ashley Williams[1], Candace Killian-Farrell[1,2], Aysenil Belger[1,2]; [1]University of North Carolina at Chapel Hill, [2]Carolina Institute for Developmental Disabilities

Risk for many psychological diseases have an onset in late adolescence and may be initiated or exacerbated by stress. This window of adolescence is marked by cortical growth and neural network development. Stress mediates plasticity of this development, modulates working memory, and plays a role in the etiology of psychological diseases, including psychosis. In this study, we tested the differential impact that stress may have on working memory in adolescents with (high, n = 33) or without (low, n = 35) familial risk for psychiatric disease. We recorded their brainwaves during an n-back task (with n = 0,1,2) before and after the Trier Social Stress Test (TSST). The TSST reliably elicits a stress response, measured via hear-rate variability and cortisol. We predicted that adolescents at greater risk would exhibit reduced P3 amplitude and reduced theta (4-8Hz) power with increased load and post stress. We observed that the high risk group has an overall reduced P3 amplitude ($p < .001$), accompanied by greater, and more diffuse, theta activity with increased load. These results suggest that adolescents with familial risk for psychiatric illness show evidence of altered neural processing even in the absence of symptoms. Additionally, stress may further disrupt working memory in this group by diminishing synchronous firing in neuronal assemblies and by reducing the strength of the signal.

Topic Area: EXECUTIVE PROCESSES: Working memory

Frontoparietal EEG phase coupling reflects the maintenance and successful memory encoding of constructed objects in visual working memory

Poster C37, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Patrick H. Khader[1,2], Satu Palva[3], Frank Rösler[4], Julia A. Ewerdwalbesloh[2]; [1]Brandenburg Medical School, Neuruppin, Germany, [2]Ludwig-Maximilians-Universität Munich, Germany, [3]University of Helsinki, Finland, [4]University of Hamburg, Germany

How are mental images that have been constructed from their constituting elements maintained as a coherent representation in visual working memory (vWM)? Participants maintained visual objects that they either had to construct from single features or that were presented to them as complete objects. Increased fronto-parietal-occipital EEG phase coupling was found during the maintenance of constructed objects in the theta, alpha, and gamma frequency bands. A similar pattern was found for an increase in vWM load (2 vs. 4 features) for non-constructed objects. Under increased construction load (2 vs. 4 features for constructed objects), the pattern was restricted to fronto-parietal couplings, suggesting that the fronto-parietal attention network is coping with the higher attentional demands involved in maintaining constructed images, but without increasing the communication with the occipital visual buffer in which the visual representations are assumed to be stored. In a subsequent study, we investigated whether fronto-parietal phase coupling during maintenance promotes encoding into more permanent memory traces. Overall, the maintenance of later remembered in comparison to non-remembered objects was associated with increased fronto-parietal coupling across frequency bands. Importantly, for alpha and beta, this effect dissociated topographically for constructed vs. non-constructed objects, suggesting specific contributions to encoding depending on the kind of elaborative processing in vWM. We conclude from these findings that fronto-parietal phase coupling could be a neural implementation of an attentional control process the serves to keep object elements together as a coherent vWM representation, and, in so doing, promotes memory encoding of these representations.

Topic Area: EXECUTIVE PROCESSES: Working memory

The influence of storage capacity versus control in visual working memory capacity limitations

Poster C38, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Ying Cai[1,2], Andrew D Sheldon[3], Bradley R Postle[2,4]; [1]National Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, [2]Department of Psychiatry, University of Wisconsin–Madison, [3]Medical Scientist Training Program and Neuroscience Training Program, University of Wisconsin–Madison, [4]Department of Psychology, University of Wisconsin–Madison

Many studies of visual working memory (VWM) capacity confound the constructs of "storage capacity," "context binding," and "inter-item interference." During fMRI of a delayed-estimation task (n=16), we dissociated the experimental factor of load -- one bar that could vary in orientation ("1O") vs. three differently oriented bars ("3O") – from that of category homogeneity -- 3O vs. one bar, one patch that could vary in chrominance, and one concentric-circle stimulus that could vary in luminance contrast ("1O1C1L"). Fitting behavioral data to a 3-factor mixture model revealed no difference in memory precision between 1O and 1O1C1L conditions, but significantly worse precision for 3O. Subjects with higher VWM capacity, estimated offline with color change-detection, had a smaller decline in precision of 3O relative to 1O1C1L. Probability of target responses was highest for 1O, followed by 1O1C1L, followed by 3O. Delay-period BOLD signal in parietal and frontal areas was comparable in 1O and 1O1C1L conditions, and higher for 3O. Orientation reconstruction with multivariate inverted encoding modeling (IEM) of this delay-period signal was only successful for 1O trials, a pattern most consistent with a context binding function. IEM of encoding-related signal in occipital cortex, in contrast, produced successful orientation reconstruction for 1O and 1O1C1L, but not for 3O. Furthermore, dividing subjects into homogeneity-sensitive versus homogeneity-insensitive groups (based on the behavioral measures) indicated that the 1O1C1L-3O reconstruction difference was most pronounced in the homogeneity-sensitive group, a pattern most consistent with an inter-item interference. Fronto-parietal VWM activity reflects control, an important determinant of VWM capacity.

Topic Area: EXECUTIVE PROCESSES: Working memory

The circuit analyses of Anesthesia-resistant memory in Drosophila.

Poster C39, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Emmanuel Antwi-Adjei[1], Diana Hilpert[2], Martin Schwärzel[1]; [1]Free University Berlin

The memory consolidation theory classifies memory in accordance to whether it resists an amnestic treatment, or not. The Drosophila aversive odour-learning is a Pavlovian training where flies are trained to avoid an olfactory cue- the conditioned Stimulus- after it has been presented in combination with an electric shock. However, the Drosophila aversive learning are composed of two different types of consolidated memories, i.e., Long-term memory and anesthesia-resistant memory. Also, in contrast to LTM, anesthesia-resistant memory is induced by single cycle and it forms an integral part of mid-term memory . Furthermore, presynaptic proteins have been shown to be pivotal for distinct memory phases. Bruchpilot, a presynaptic protein was revealed to be essential for olfactory memory, and specifically affected Anesthesia-resistant memory at the level of mushroom body (Knapek et al., 2011). In addition to this, Bruchpilot is homologous to the mammalian ELKS/CAST family of active zone proteins, which is specifically localized to the presynaptic dense bodies (Wagh et al., 2006). Henceforth, the focus of this research project was to investigate the role of Bruchpilot on the olfactory pathways in the Drosophila. This was done by performing a transgenic knockdown of this presynaptic protein at the level of olfactory receptor neurons , antennal lobe, mushroom body, dopaminergic neurons and extrinsic neurons. The outcome of this research project revealed that the antennal lobe local interneurons 2 was the main target for the encoding of the anesthesia resistant memory and was phase locked with the mushroom body neurons and extrinsic neurons.

Topic Area: EXECUTIVE PROCESSES: Working memory

Metabolic Syndrome and its Association with Self-Reported Sleep Quality and Cognitive Function

Poster C40, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Tori Ferland[1,2], Saba Chowdhry[3], William Milberg[1,2], Regina McGlinchey[1,2], Elizabeth Leritz[1,2]; [1]Harvard Medical School, [2]VA Boston Healthcare System, [3]Boston University School of Medicine

Inadequate sleep quality and duration have been associated with the development of cerebrovascular risk factors such as obesity, diabetes, hypertension and hyperlipidemia. Chronic sleep deprivation has also been associated with poor cognitive performance in many populations. Metabolic Syndrome (MetS) is characterized by three or more co-occurring risk factors for cerebrovascular disease and has been linked to poor sleep quality. However, less is known about the effect of sleep quality on cognitive function in this particular MetS sample. The purpose of this study was to examine how sleep quality in MetS impacts neuropsychological function. 117 adults (mean age 61.44) completed the PSQI, a well-validated, self-report questionnaire that assesses the quality and patterns of sleep over a 1-month time interval. A comprehensive battery of neuropsychological tests and measurements of blood pressure, cholesterol, weight, and fasting glucose were also obtained. Fifty-four participants were diagnosed with MetS according to NCEP-III guidelines. The two groups differed on the PSQI global sleep quality score, with the MetS group reporting significantly worse sleep quality than the control group. Within the MetS sample, poor sleep quality was significantly associated with worse performance on tests of working memory and executive function. Our results are consistent with prior literature, demonstrating that self-reported poor sleep quality is significantly related to MetS and its individual risk factors. However, to the best of our knowledge, this is the first study to demonstrate that inadequate sleep quality and duration may have a specific impact on executive function and working memory in MetS.

Topic Area: EXECUTIVE PROCESSES: Working memory

ANXIETY MODULATES AUTONOMIC REGULATION AND NEURAL ACTIVATION DURING HIGH-LOAD WORKING MEMORY FOLLOWING ACUTE STRESS IN ADOLESCENCE

Poster C41, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Jessica Graham[1,2], Ashley Williams[1,2], Candace Killian-Farrell[1], Hannah Waltz[1], Joshua Bizzell[1], Erin King[1], Alana Campbell[1], Aysenil Belger[1,2]; [1]University of North Carolina at Chapel Hill, Department of Psychiatry, [2]Duke-UNC Brain Imaging Analysis Center

Dysregulated stress response may impact important cognitive neural circuits and contribute to the onset and severity of neuropsychiatric illness in adolescents. This study uses fMRI (N=54) and respiratory sinus arrhythmia (RSA; N=23) to explore the relationship between stress response, functional brain activity, and anxiety in adolescents. Participants completed an imaging protocol with an acute psychosocial stress task and a series of n-back (n=0,1,2) tasks, during which RSA was collected as a non-invasive measure of autonomic nervous system (ANS) activity. We predicted that adolescents with higher trait anxiety (STAI) would exhibit reduced RSA withdrawal in response to stress, suggesting inadequate ANS adaptation. RSA at baseline correlated with STAI ($p<.05$), supporting this prediction. Statistically significant correlations between change in RSA from baseline and STAI during pre- and post-stress n-back tasks were found ($p<.05$). We also predicted that adolescents who exhibit reduced RSA withdrawal or high trait anxiety would show greater fMRI activation in limbic regions. Posterior cingulate cortex (PCC) activation correlated with STAI at the post-stress 2-back ($p<.05$). These results suggest that aberrant RSA reactivity may be closely linked to trait anxiety and influenced by cognitive stressors such as increased working memory load. In turn, trait anxiety is related to activation in a brain region involved in the default mode and cognitive control networks. Improved understanding of the role of stress regulation in cognitive network modulation may inform neurodevelopmental models of adolescent cognitive dysregulation and risk for neuropsychiatric disorders.

Topic Area: EXECUTIVE PROCESSES: Working memory

The impact of literacy on microstructural properties of white matter

Poster C42, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Falk Huettig[1], Vidur Mahajan[2], Madhuri Barnwal[2], Nishant Lohagun[3], Ouroz Khan[3], Anuradha Singh[3], Deepshikha Misra [3], Vaishna Narang[3], Ramesh Mishra[4], Alexis Hervais-Adelman[1]; [1]Max Planck Institute for Psycholinguistics Nijmegen, [2]Mahajan Imaging Delhi, [3]Jawaharlal Nehru University New Delhi, [4]University of Hyderabad

Learning to read is a profound cultural experience, requiring systematic instruction, and intensive practice. Previous research suggests that literacy acquisition results in substantial structural reorganization of the brain even in adults, but conclusions drawn from these studies are limited because of important methodological constraints and/or the small number of illiterate participants involved. In a large-scale study we recruited 48 completely illiterate and 13 literate individuals from informal settlements in New Delhi (India). Both groups were matched for their socioeconomic background. Participants underwent diffusion-weighted imaging

which is more sensitive than other morphological analyses such as VBM. Four DTI sequences (2mm isotropic voxels, b=1000s/mm2, 64 directions, two sequences with AP phase-encoding, two with PA phase-encoding) were acquired. Raw diffusion images were processed using top up in FSL to correct for susceptibility artefacts and eddy to correct for eddy current-induced distortions and participant movements. FSL's dtifit was used to estimate diffusion properties. Fractional anisotropy and mean diffusivity images were then 'skeletonised' using the procedure implemented for Tract-Based Spatial Statistics, to enable voxel-wise analyses. Group-wise differences were tested using Randomise to implement a non-parametric unpaired t-test. Resulting statistical images were corrected for multiple comparisons using threshold-free cluster enhancement. Significant differences in mean diffusivity were found in a large number of white matter tracts bilaterally, including the inferior fronto-occipital fasciculus, the inferior and superior longitudinal fasciculi the anterior thalamic radiations and the forceps major. This pattern suggests that literacy has a broad impact on the white matter underlying and connecting sensory and language-related brain regions.

Topic Area: LANGUAGE: Development & aging

Meaning above (and inside) the head: Electrophysiology to combinatorial visual morphology

Poster C43, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Neil Cohn[1], Tom Foulsham[2]; [1]Tilburg University, [2]University of Essex

As in linguistic morphology, visual communication uses complex combinatorial relationships. In comics and emoji, elements frequently appear with faces to convey a combined meaning, such as gears floating above a character's head to imply thinking. These "upfixes" are visual "affixes" located "up" from the root they connect with (i.e., a face). Upfixes have been argued to be a productive class whereby new forms (ex. fish above the head) use constraints specified by an abstract schema (1). These constraints include a restriction that faces must match the emotion of their associated upfix (ex. storm clouds accompany a sad face, not a happy face). We measured event-related potentials to upfixes that that were conventional or unconventional and either matched or mismatched the face's expression. A greater frontal positivity to unconventional than conventional upfixes interacted with a greater positivity to mismatching than matching upfixes, consistent with findings that frontal positivities are evoked by lower probability stimuli (2). Also, a late posterior positivity was evoked only by face-upfix mismatches. Given the interpretation that posterior positivities index mental model updating (2), the insensitivity of this effect to conventionality suggests that constraints on matching persist even for unfamiliar face-upfix relations. This thereby supports upfixes as a productive class of visual morphology where novel forms draw on the constraints of an abstract schema. 1. Cohn, Murthy, & Foulsham. 2016. Journal of Cognitive Psychology. 28(5):559-574 2. Donchin & Coles. 1988. BBS. 11(3):357-374

Topic Area: LANGUAGE: Lexicon

Testing native language neural commitment at the brainstem level: A cross-linguistic investigation of the association between frequency-following response and speech perception

Poster C44, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Luodi Yu[1], Yang Zhang[1]; [1]Department of Speech-Language-Hearing Sciences, University of Minnesota, Minneapolis, MN, 55455, USA

A topic of current interest in auditory neurophysiology is how brainstem sensory coding contributes to higher-level perceptual, linguistic and cognitive skills. The present cross-language study was designed to compare tonal (Chinese) (N = 17) and non-tonal (English) (N = 19) language users and examine the correlation between FFR and behavior as a function of language experience. Frequency following responses (FFRs) were measured to examine experience-dependent tuning effect in relation to behavioral perceptual tasks which assessed how lexical tones may interfere with vowel category and duration judgement. The FFR results replicated previous findings about cross-language differences, showing enhanced pitch tracking strength and accuracy at the brainstem level in the Chinese group in comparison with the English group. The behavioral data showed that lexical tone variation

in the vowel stimuli significantly interfered with vowel identification in both subject groups with a greater effect in the Chinese group. Moreover, neural phase-locking measured by the FFR pitch tracking strength for the lexical tone stimuli was significantly correlated with the behavioral interference effect only in the Chinese group. This pattern of language-specific link between brainstem encoding of fundamental frequency and speech perception provides supporting evidence for a possible native language neural commitment (NLNC) at the subcortical level, highlighting the role of experience-dependent brainstem tuning in influencing subsequent linguistic processing in the adult brain.

Topic Area: LANGUAGE: Other

Cortical Hemodynamics and Neural Network Connectivity During Stuttered and Fluent Speech

Poster C45, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Allison S. Hancock[1], Nick Wan[1,2], Sushma Alphonsa[1], Sandra L. Gillam[1], Ronald B. Gillam[1]; [1]Utah State University, [2]Cincinnati Reds

Functional near infrared spectroscopy (fNIRS) was used to assess cortical hemodynamics and neural connectivity in adults who do and do not stutter during fluent and disfluent speech. fNIRS data was acquired using a Hitachi ETG-4000 two-probe system as seven adults who stutter and seven adults who do not stutter made phone calls. We asked, does the fNIRS signal during stuttered and fluent speech differ significantly in cortical regions that are known to be activated during speaking? Also, are there differences in hemodynamic response functions between adults who stutter (AWS) and adults who do not stutter (AWNS)? Finally, we asked whether there were group differences in the functional connectivity of the hemodynamic response function among five regions of interest (ROI): inferior frontal cortex, superior temporal cortex, inferior parietal lobule, primary motor cortex, and supplementary motor cortex). Area under the curve (AUC) analyses of the oxygenated and deoxygenated hemodynamic response function concentration values were compared for fluent and stuttered speech in each group across five ROIs. There were significant ROI main effects for both oxy and deoxy AUC analyses, and significant region x task and task x group interactions. Granger Causality analyses revealed stronger networks between supplementary motor cortex and primary motor cortex for adults who did not stutter as compared to adults who stutter. Taken together, these results suggest that multiple aspects of cortical hemodynamics and neural connectivity differ between individuals who do and do not stutter, whether they are speaking fluently or stuttering.

Topic Area: LANGUAGE: Other

Knowledge Structure and Expository Texts Comprehension: A Neurocognitive Study

Poster C46, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Chun-Ting Hsu[1], Roy Clariana[1], Ping Li[1]; [1]Pennsylvania State University

Knowledge Structure (KS) refers to the textual organization of the conceptual topology, and could be quantified by graph centrality (GC), a graph-theoretic metric (ranging from 0 to 1). Lower GC indicates linear or hierarchical organization, while higher GC represents network or star-like organization. We hypothesize that expository texts with higher GC require the reader to recruit more integrative cognitive resources to integrate different pieces of information with one or several key concepts while building the KS. In this study, 50 adults read five 300-word expository texts while their eye-movements and BOLD signals were collected. For each text, beta images of content-word-fixations (representing word processing efforts) and word position parametric predictor (representing sentence comprehension processes) were regressed with the textual GC values within subject. Group-wise, GC showed positive effect on word processing in associative/integrative regions including Angular gyrus and dorsolateral prefrontal cortex (dlPFC). Positive effects on sentence comprehension were found in associative/integrative regions including bilateral dlPFC, anterior and posterior cingulate cortex. By contrast, negative correlation between sentence comprehension and GC values showed in canonical language/semantic processing regions, e.g., left anterior to posterior temporal cortex, right anterior temporal lobe, left inferior frontal gyrus, and left dorsomedial PFC. Group level regression with behavioral measures showed that when reading texts with higher GC, readers' electronic device time per day (e.g., smartphone, internet gaming) is negatively correlated with BOLD

level in the right dlPFC and right cerebellum, suggesting reading habits in this digital era might negatively impact reader's KS integration for expository texts comprehension.

Topic Area: LANGUAGE: Other

Common recruitment of neural resources for phonological working memory regardless of behavioral demands.

Poster C47, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Terri L. Scott[1], Sara C. Dougherty[1], Ja Young Choi[2], Tyler K. Perrachione[1]; [1]Boston University, [2]Harvard University

Phonological working memory is the process by which we maintain representations of sounds important for speech and language in short-term memory. This ability is believed to be critical for language and reading acquisition and is often assessed clinically using nonword repetition tasks. Inconsistencies exist in the neuroimaging literature as to whether phonological working memory is supported by fronto-parietal brain regions classically associated with short-term memory storage or perisylvian brain structures canonically implicated in speech perception and production. In this study, we used fMRI to assess neurophysiological responses while individuals performed two tasks—nonword repetition and nonword discrimination—at two levels of working memory load. These tasks closely reflect the clinical operationalization of phonological working memory, though the behavioral demands of nonword discrimination more closely parallel classic working memory tasks. Using group-constrained subject-specific functional analysis, a method specifically employed to address individual subject variability, we found significant neural responses to the critical contrast of high vs. low phonological working memory load in both tasks were supported by a similar set of regions closely resembling those involved in speech (i.e., superior temporal gyrus, planum temporale, motor cortex, and cerebellum). Moreover, within those regions, the voxel-wise patterns of load-related activation were highly correlated between the two tasks. These results suggest that processing increased phonological load involves recruitment of a consistent set of neural regions known to be integrally involved in speech, regardless of the specific behavioral demands of the working memory task.

Topic Area: LANGUAGE: Other

Implicit Learning of Adjacent and Non-Adjacent Dependencies: Relationships with Measures of Language, Attention, and Working Memory

Poster C48, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Joanne A. Deocampo[1], Tricia Z. King[1], Christopher M. Conway[1]; [1]Georgia State University

Learning non-adjacent sequential dependencies only occurs under favorable circumstances (e.g., Lany & Gomez, 2008). However, both adjacent and non-adjacent dependencies (AD and NAD) are learned in natural language. Vuong et al. (2016) recently showed that adults learn visuo-verbal AD and NAD with training over multiple sessions. We tested whether adults could learn AD and NAD together with spatial and verbal stimuli during a single session and whether a second session would increase performance. We also examined the relationship between this learning and language, attention, and working memory. Participants reproduced two types of "grammatical" sequences: visuo-spatial with sequential stimuli in four locations, and visuo-verbal with sequential syllables. Each contained AD and NAD. Participants were tested for incidental learning on reproduction of novel sequences, half grammatical and half ungrammatical, containing either violations of AD or NAD. The procedure was repeated on a second day. Results revealed that grammatical sequences were learned better than ungrammatical for both AD and NAD in both visuo-spatial and visuo-verbal sequences within a single session. AD learning was better than NAD. Furthermore, learning of NAD decreased over time, possibly due to increased exposure to ungrammatical sequences suggesting NAD learning is more easily disrupted than AD. Finally, NAD learning was positively correlated with language measures for both spatial and verbal tasks whereas AD performance on both visuo-spatial and visuo-verbal tasks was negatively associated with working memory and attention span in the opposite domain. These findings highlight the nuanced relationship between AD and NAD learning and specific cognitive processes.

Topic Area: LANGUAGE: Other

Psychoeducational outcomes in children following left or right hemispherectomy

Poster C49, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Kelly Halverson[1], Olivia Meegoda[2], Heather Beckius[2], Andrea Imhof[2], Stella deBode[3], Tami Katzir[4], Joanna A. Christodoulou[2]; [1]University of Houston, [2]MGH Institute of Health Professions, [3]CTC Widney, Los Angeles, CA, [4]University of Haifa

We examined psychoeducational skills in children who had undergone either a left or a right hemispherectomy. The goal of this study was to investigate cognitive, language, and literacy skills in children obligatorily relying on a left versus a right hemisphere to inform our understanding of compensatory role of either hemisphere. Participants who had undergone left hemispherectomy (LH; n = 10) or right hemispherectomy (RH; n = 14) completed standardized assessments of nonverbal cognition, language, and reading in 1:1 sessions. Groups were balanced for gender and age. While both LH and RH groups demonstrated largely below age-normed performance across standardized measures, relative areas of strength (within 1.5 SD of the standardized population mean) were shown for rapid automatized naming skills across groups and in the RH group only for phonological awareness, sentence memory, timed and untimed real and pseudoword reading, vocabulary, and reading fluency. This trend favoring the RH group versus the LH group for these language-based measures was statistically significant for untimed real word and pseudoword reading. Investigations of psychoeducational skills in children following hemispherectomy surgery can offer important insights into compensatory potential for left and right hemispheres.

Topic Area: LANGUAGE: Other

Catching a Snitch vs. catching a Bludger: Variability in world knowledge influences real-time access to word meaning

Poster C50, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Melissa Troyer[1], Marta Kutas[1]; [1]University of California, San Diego

Not only the contents but the structure of semantic memory influence the retrieval of word meaning during sentence comprehension. For example, properties of words that are inappropriate continuations of a sentence, but are related to the sentence and/or appropriate continuation, seem to be pre-activated during sentence comprehension (e.g., Federmeier & Kutas, 1999; Laszlo & Federmeier, 2009; Metusalem et al., 2012; Amsel et al., 2015). From one individual to the next, the contents and presumably functional organization of semantic memory vary according to their respective knowledge; yet little work has systematically tested the assumption that individual-level knowledge is directly responsible for effects of semantic memory on sentence comprehension. Here, we asked individuals more or less knowledgeable about the narrative world of Harry Potter (HP) to read sentences about HP that ended in one of the following: the best completion; an inconsistent word related to the sentence context and/or best completion; or an inconsistent, unrelated word. For example: 'In Quidditch, games are usually won in one way. This is when the seeker catches the SNITCH (best completion) / BLUDGER (related-inconsistent) / DRAGON (unrelated-inconsistent).' At the critical word, both the consistency effect (unrelated-inconsistent minus best completion) and the related anomaly effect (unrelated-inconsistent minus related-inconsistent) were correlated with individual knowledge, with greater effects for more knowledgeable individuals. These findings illustrate the immediate influence that (in this case fictional) world knowledge, gleaned from experience, exerts on the use and organization of information during real-time sentence processing.

Topic Area: LANGUAGE: Semantic

Predicting Conceptual Change during Naturalistic Reading with fMRI

Poster C51, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Benjamin Schloss[1], Ping Li[1]; [1]The Pennsylvania State University

We report a model that can predict online changes in neural representation of science concepts resulting from reading expository texts about those concepts. We modeled the expected change using Google's Word2Vec model, an error driven model of conceptual learning, and the Bound Encoding of the Aggregate Language Environment model (BEAGLE; Jones & Mewhort, 2007), a Hebbian model of conceptual learning. Then, we regressed the difference in the BOLD responses between the first and last time a participant looks at the same target word onto the corresponding changes in the computational models' representational units before and after reading the text. BOLD responses were estimated using simultaneously acquired eye-tracking and multiband fMRI data. This paradigm allowed self-paced reading, while maintaining a high degree of precision in aligning the onset of an initial fixation, an index of the onset of word processing, to the BOLD response of a target word. Multiband fMRI was used to increase the temporal resolution of our data from the standard 2 seconds per volume to 400 ms per volume. Our best models achieve significant accuracy in approximately 75% of the 50 participants. Among participants whose data could be successfully predicted, average accuracy for pairwise left out words discrimination is 64%, but ranging up to 78% for some individuals. The results suggest that a modest amount of the online change in neural representations during reading can be accounted for by functions of distributional co-occurrence statistics.

Topic Area: LANGUAGE: Semantic

Alpha- and theta-band time-frequency representations in free reading of stories using EEG and EM coregistration

Poster C52, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Max Cantor[1], John Trueswell[2], Albert Kim[1]; [1]University of Colorado Boulder, [2]University of Pennsylvania

We used coregistration of eye movements (EM) and electroencephalography (EEG) to investigate the neurocognitive mechanisms of naturalistic story reading. We examined how semantic fit between a word and its context influenced neural oscillatory activity during, and immediately prior to, fixation on the word. Contextual fit for a word was quantified as the summed cosine distance between each word and the 10 closest content words in its left context, within a space that represented each word as a vector derived from co-occurrence statistics in a large corpus (using the Global Vectors for Word Representation, or GloVe system). For each content word fixated by readers, we created a time-frequency representation (TFR) of brain activity surrounding the first fixation on that word. We compared brain activity to words with low vs. high contextual fit. Contextual fit influenced word-related brain activity in three main ways. First, ~250 to 50 ms prior to fixation, alpha band activity (8-12Hz) was reduced for low- relative to high-fit contexts. We suggest that this reflects event-related desynchronization (ERD) due to greater anticipatory processing in low-fit contexts, which are higher in uncertainty and trigger attempts to predict the upcoming word. Second, in a period ~200-600ms after fixation onset, we observed increased alpha band activity for low-fit words. This may correspond to inhibitory activity related to the competitive dynamics of word recognition. Third, ~300-700ms post-fixation, theta band activity (~5-7 Hz) was greater for high than low fit words. This may reflect memory retrieval operations related to integrating a word with context.

Topic Area: LANGUAGE: Semantic

The neural substrates for predictive processes in sentence comprehension

Poster C53, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Chih-Ting Chang[1], Ping Li[2,3], Jie-Li Tsai[4], En-Ju Lin[5], Pei-Chun Chao[1], Chia-Ju Chou[1], Chia-Ying Lee[1,4,5,6]; [1]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan, [2]Department of Psychology, Pennsylvania State University, University Park, PA, USA, [3]Center for Brain, Behavior, and Cognition, Pennsylvania State University, University Park, PA, USA, [4]Department of Psychology, National Chengchi University, Taiwan, [5]Institute of Linguistics, Academia Sinica, Taipei, Taiwan, [6]Institute of Cognitive Neuroscience, National Central University, Taipei, Taiwan

This study aimed to investigate the neural substrates of the predictive processes in sentence comprehension. Twenty-eight university students (10 males, mean age 21.94 years; range 19-26) served as participants in an fMRI study. Participants read a set of leading sentences for comprehension and had to predict the upcoming target word that should complete the sentence best within 4 seconds (2 TRs). The leading sentences provide either high (HP) or low predicative (LP) contextual information. A target

word, which was rated as the best completion of the leading sentence in a separate norming study, would appear, and participants were required to decide whether the presented word was the same as participants' prediction. The fMRI data revealed that, LP sentences led to greater activations in left inferior frontal gyrus (IFG), middle temporal gyrus (MTG), angular gyrus, and posterior cingulate indicating that the LP sentences posted greater cognitive demand on the reader. By contrast, HP sentences led to greater activations in left inferior temporal gyrus (ITG), bilateral temporo-occipital visual cortex that is implicated in orthographic processing, and in insula and IPL that are related for rule extraction and computation. The findings suggested that readers were able to take advantage of richer contextual information to predict the upcoming word. Furthermore, at the word level, LP target words, as compared with the HP words, showed greater activations in bilateral IFG, left STG, MTG, angular gyrus, supramarginal gyrus and SPL. Together, these data revealed the neural substrates of predictive processes in sentence comprehension.

Topic Area: LANGUAGE: Semantic

The Effects of Age and Familial Sinistrality on Late Positive Components

Poster C54, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Michelle Leckey[1], Kara D. Federmeier[1]; [1]University of Illinois at Urbana-Champaign

The P600 – a late, positive ERP component – has been linked to syntactic processing, as P600 effects have been seen in response to syntactic violations as well as during complex sentence processing. A P600 response has also been seen to violations of thematic constraint, when the more semantically related N400 component may have been expected. Given a number of similarities between the P600 and the more general P3b component, some have proposed that the P600 is a P3b, with differences in latency and amplitude reflecting the complexity of linguistic structure. Previous work has found that the P600, like the P3b, is response aligned, and is modulated by saliency, task relevance and subjective probability, all of which are known to modulate the P3b. Despite these similarities, no one has yet made direct comparisons between them when they are elicited within the same person using component-typical tasks. In the current study 48 young adults with differing familial sinistrality profiles and 24 older adults, were given three tasks, each of which is known to elicit one of the components of interest. These included a visual oddball (P3b), as well as morphosyntactic and thematic role violations (syntactic/semantic P600). Each of the tasks elicited the desired components, and analyses suggest similarities between the syntactic P600 and the P3b, providing further evidence that these components may be related. However there are differences between these components and the semantic P600, suggesting that the semantic and syntactic P600 may be reflecting different types of processing.

Topic Area: LANGUAGE: Syntax

Dissociating the Effect of Dependency from Embedding in Syntactic Hierarchy

Poster C55, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Kyung-Hwan Cheon[1], Hee-Dong Yoon[1], Hyeon-Ae Jeon[1,2]; [1]Department of Brain and Cognitive Sciences, Daegu Gyeongbuk Institute of Science and Technology (DGIST), Daegu, Korea, [2]Partner Group of the Max Planck Institute for Human Cognitive and Brain Sciences at the Department of Brain and Cognitive Sciences, DGIST, Daegu, Korea

We investigated cognitive subcomponents supporting syntactic hierarchy by dissociating dependency from embedding using a left-branching language. We hypothesized that dependency would impose an additional processing demand on the modificand, whereas embedding would increase overall processing demand due to additional working memory caused by holding a main clause subject. In a non-cumulative self-paced reading experiment, participants read Korean sentences and answered comprehension questions. By exploiting the free word order nature of Korean, we controlled not only the length of sentences but also the type and number of constituents. Accordingly, every sentence had 2 clauses and each clause was composed of a subject, an object, and a verb. Using a factorial design (dependency × embedding), we manipulated embedding either by linearly conjoining two clauses (S1-O1-V1-S2-O2-V2) or embedding a subordinate clause within a main clause (S1-[S2-O2-V2]-O1-V1). To manipulate dependency, different types of suffix (conjunctive or adjective) were adhered to the verb of the subordinate clause. A main effect was found in both dependency and embedding. Dependency increased reaction time (RT) of the modificand and the remaining clause, whereas embedding slightly increased RT of the subordinate clause only when there was no dependency. With

our precisely controlled design, we suggest that dependency recruits most of the cognitive resources in processing syntactic hierarchy.

Topic Area: LANGUAGE: Syntax

Age differences in memory retrieval: The role of regulatory downregulation of medial temporal lobe activity by the prefrontal cortex

Poster C56, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Jaclyn Ford[1], Elizabeth Kensinger[1]; [1]Boston College

We have recently argued (e.g., Ford & Kensinger, 2017) that age differences in memory retrieval are partially due to an affective process by which older adults (OAs) recruit dorsomedial prefrontal (dmPFC) regions to decrease richness of negative memories via downregulation of the hippocampus (HC). The current analysis examined this claim by testing two predictions. First, if dmPFC serves to downregulate hippocampus, then OAs should show a dip in HC activity during negative event retrieval following recruitment of the dmPFC. Second, based on evidence that regulatory processes require cognitive control (e.g., Mather & Knight, 2005), this dmPFC-HC pattern should be strongest in OAs with greater cognitive control. In a memory task, participants (ages 18-85) encoded images paired with verbal titles. During an fMRI scan, they were presented with titles and asked whether each had been seen with an image during encoding. Participants provided vividness ratings following retrieval of each image. Consistent with our hypotheses, OAs initially recruited hippocampal regions equally for positive and negative events, but exhibited a significant decrease in activation for negative events following dmPFC recruitment. This pattern was related to connectivity estimates between these two regions. DmPFC-HC connectivity in OAs was also related to scores on a test of cognitive control, mental arithmetic. OAs with better scores had more negative dmPFC-HC connectivity estimates, suggesting that this connectivity reflects a controlled process. These findings are consistent with studies suggesting that OAs will reallocate cognitive control resources to regulate emotions during cognitive tasks if they are able to do so.

Topic Area: LONG-TERM MEMORY: Development & aging

Investigating neural effects of memory training to reduce false memories in older adults

Poster C57, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Indira Turney[1], Jonathan G. Hakun[1], Brenda A. Kirchhoff[2], Nancy A. Dennis[1]; [1]Pennsylvania State University, [2]Saint Louis University

The growing population of older adults emphasizes the need to develop interventions that prevent or delay some of the negative cognitive changes that accompany aging. In particular, as memory impairment is the foremost cognitive deficit affecting older adults, it is vital that such interventions include improving memory functioning. With regard to memory, it has been shown that age-related memory impairment arises equally from age-related increases in forgetting and increases in false memories (FMs). The current study will address the problem of FMs in aging by training older adults to use details of past events during memory retrieval in order to distinguish targets from related lures. Specifically, we will examine the cognitive and neural basis of a retrieval-based monitoring strategy in reducing FMs. Behaviorally, repeated measures analysis show training-related decreases in rates of FMs and increases in true memories and correct rejections. Neurally, results show increased neural activity in regions supporting retrieval of item-specific encoded details (e.g., medial temporal lobe; early visual cortex) and decreased activity in regions supporting gist processing (e.g., lateral temporal cortices). Additionally, we observed more efficient functioning in prefrontal cortex (PFC) regions associated with retrieval monitoring (e.g., superior medial PFC; dorsolateral PFC) following training. Training-related connectivity shifts between these regions will be discussed. Together, results provide a better understanding of the neural mechanisms underlying cognitive training, and suggest a method by which false memories could be reduced in older adults.

Topic Area: LONG-TERM MEMORY: Development & aging

Phenotypic expression of presenilin 1 p.Gly206Ala autosomal dominant Alzheimer's disease

Poster C58, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Evin Bender[1], Maya Lichtenstein[1]; [1]Geisinger Health System

This case presentation describes the phenotypic expression of a Presenilin-1 gene mutation resulting in a glycine-alanine substitution (p.Gly206Ala) for autosomal dominant Alzheimer's disease (AD), which has not previously been detailed in the literature. Our patient is a 56 year old woman with a family history of early onset dementia who presented with symptoms of behavioral changes including an initial 100 pound weight loss followed by hyperorality, disinhibition, apathy, disturbing visual hallucinations, restlessness and memory changes. Symptoms began two years prior and were initially attributed to depression. Methods for this case include review of history, neurological examination, imaging, CSF and genetic testing. Neurological examination was significant for redirectable lability, difficulty maintaining adequate attention, cognitive deficits across domains, and lack of parkinsonian features with otherwise normal examination. Brain MRI showed bilateral amygdala and hippocampal hyperintensities; repeat MRI 1 week later showed resolution. Autoimmune/paraneoplastic testing was negative; CSF was compatible with Alzheimer's disease. Genetic testing revealed a presenilin-1 gene mutation, which has been described in Caribbean Hispanic families. It has been suggested to present with psychiatric features, which have not previously been described in detail. In summation, this patient presented with early dramatic neuropsychiatric changes, followed by cognitive decline including attention, memory and disorientation, and MRI concerning for an autoimmune process. She was found to have a Presenilin-1 mutation (p.Gly206Ala) for autosomal dominant AD. The phenotype for this mutation has not previously been described in the literature. Clinicians should be aware of AD "masquerading" as psychiatric disease, frontotemporal dementia or an autoimmune process.

Topic Area: LONG-TERM MEMORY: Development & aging

Definition-based unitization improves associative memory of older adults: mechanism and training studies

Poster C59, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Juan Li[1], Baoxi Wang[1], Zhiwei Zheng[1]; [1]Institute of Psychology, Chinese Academy of Sciences, Beijing 100101, China

Unitization has been shown to enhance familiarity-based associative recognition in younger adults, but it is less clear whether it would reduce older adults' associative memory deficits given their preserved familiarity. In Experiment 1, event-related potential (ERPs) were recorded during retrieval phase of an associative memory task. The results showed that older adults' associative recognition performance under unitized encoding was related to the frontal old/new effect only, and significantly superior to that under un-unitized encoding which was reflected in the parietal old/new effect only, suggesting that during retrieval phase relatively preserved familiarity in older adults helped to enhance their associative memory performance.Experiment 2 further proved that unrelated word pair was integrated into a single-concept (item) representation during unitized encoding phase via a divided-attention paradigm. The results showed that only the divided attention with item processing (but not divided attention with relational processing) significantly reduced associative memory performance under unitized encoding. In experiment 3 we tested the hypothesis whether training via unitized encoding strategy would produce larger gains for older adults compared with traditional non-unitized strategy training. Older adults were randomly assigned to definition training, sentence training and control groups. The results showed the training effect was comparable between two training groups in general. But participants' verbal ability mediated their training gains from definition encoding. Specifically, older adults with higher verbal ability indeed gained more from definition than sentence training.

Topic Area: LONG-TERM MEMORY: Development & aging

THC disrupts the encoding of perceptual details while sparing item-context bindings.

Poster C60, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Manoj Doss[1], Jessica Weafer[1], David Gallo[1], Harriet de Wit[1]; [1]University of Chicago

Although it is known that the main psychoactive constituent of marijuana, Δ9-tetrahydrocannabinol (THC), impairs memory encoding, it is unclear which sub-processes are specifically affected. This is important, as marijuana is increasingly being prescribed for posttraumatic stress disorder (PTSD), which consists of existing memory impairments such as weak item-context bindings and decreased memory specificity. In a double-blind, placebo-controlled, within-subjects design, we tested the effects of 15 mg of THC on a task developed in our lab that produces a memory illusion via item-context bindings (Doss et al., in review). Healthy participants studied objects overlaid onto scenes while under the influence of THC or placebo. Forty-eight hours later, memory for the objects was tested by presenting participants with the exact same object pictures (targets), similar versions (similar lures), or completely new object exemplars. Context reinstatement was manipulated for targets and similar lures by presenting objects on their original scene or switching it to one of the other familiar scenes. We replicated our previous findings that context reinstatement increases false alarm rates for similar lures, representing a context-based memory illusion. Furthermore, THC reduced memory accuracy, but critically, THC did not interact with the context-based memory illusion, consistent with the idea that this illusion is driven by conceptual associations that are robust to drug effects. Therefore, in spite of decreasing perceptual specificity in memory, THC did not magnify the distorting effects of intact item-context bindings, suggesting that THC may not necessarily exasperate the overgeneralities in memory observed in disorders like PTSD.

Topic Area: LONG-TERM MEMORY: Episodic

Hippocampal damage impairs creativity in conceptual combination

Poster C61, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Heather D. Lucas[1], Mahima Goel[2], Kara D. Federmeier[2], Melissa C. Duff[3], Neal J. Cohen[2]; [1]Louisiana State University, [2]University of Illinois Urbana-Champaign, [3]Vanderbilt University

Much of human communication involves conceptual combination, or the integration of multiple concepts (e.g., “snow” and “man”) to form new, emergent concepts (“a snowman”). However, relatively little is known about the neural mechanisms that support conceptual combination, particularly as it applies to unfamiliar word pairs (e.g., “dress swan”), or when word pairs must be interpreted in novel or creative ways. The present study examined whether the hippocampus—a brain region traditionally associated with memory, but recently linked more broadly to creativity and cognitive flexibility—contributes to the ability to interpret novel compound phrases. We asked patients with hippocampal damage as well as healthy comparison participants to generate either a plausible or creative definition for a series of word pairs. Definitions were coded according to a set of common relational structures used in compound words, and creativity was assessed by comparing the salience of each chosen relation against normed data. For example, a high-salience/low-creativity definition of “snow cave” might use the “MADE OF” relation (a cave that is made of snow), whereas a lower-salience/higher-creativity definition might use the “FOR” relation (a cave intended for the storage of snow). Patients and comparisons used similarly-salient relations when asked to generate plausible definitions. When asked to generate creative definitions, however, comparisons’ definitions used relations that were significantly less salient than the patients’ definitions, indicating greater creativity. These results reinforce the notion that the hippocampus is involved in creative and flexible thinking, and provide specific support for the idea that hippocampal damage limits flexibility in conceptual combination.

Topic Area: LONG-TERM MEMORY: Episodic

Building and accessing a compressed internal timeline of the future

Poster C62, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Inder Singh[1,2], Marc Howard[2]; [1]Northeastern University, [2]Boston University

Prior neurophysiological and modeling work seems to suggest a symmetry between the mechanisms that allow us to access the past and the future. However, there is a derth of behavioral paradigms that directly compare the symmetry between the

mechanisms used to access the past and the future events. In this study we use temporal order judgment paradigms to test retrospective and prospective access under carefully controlled experimental conditions that ideally mirror the search through representations of the past and future. The Judgement of Recency (JOR) task measures order judgments for the past. Hacker (1980) found that the response time varies as a function of the distance to the more recent item and does not depend on the distance to the less recent item. This finding suggests a serial self-terminating search along a temporally ordered representation. Further, the response times vary as a sub-linear function of the lag to the target item. This suggests that the representations are compressed. We propose a novel Judgement of Imminence (JOI) task that closely parallels the design of the JOR task. We find that the response times in the JOI task reflect the search mechanics observed in the JOR task. This supports the hypothesis that ordered representations for the future are symmetrical to the ordered representations of the past and can be accessed using a serial search process. Further, the response times show evidence for sub-linearity thereby suggesting a compressed future timeline.

Topic Area: LONG-TERM MEMORY: Episodic

Neural representations of temporal statistics can predict subsequent reasoning

Poster C63, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Athula Pudhiyidath[1], Anna C. Schapiro[2], Alison R. Preston[1]; [1]The University of Texas at Austin, [2]Harvard Medical School

Life never stops moving forward, and yet we segment events into discrete moments in time, with a beginning and an end. Here, we test how event segmentation guides the formation of neural representations that code the temporal statistics of the environment, and how these temporal statistics promote reasoning about the relationships among memory elements. We used a temporal community structure paradigm developed by Schapiro et al. (2013) to generate an iterative sequence of novel, 3D objects that participants viewed while we measured their neural responses with fMRI. Unbeknownst to the participants, the sequence was structured so that a given object belonged to one of three highly structured temporal clusters. After exposure to the temporal community structure, participants completed a series of reasoning tasks outside of the scanner, including inductive generalization. We hypothesized that participants' knowledge of the temporal community structure would influence inductive reasoning. Behaviorally, participants were more likely to induce that members of the same temporal community shared non-temporal properties (e.g., preferred habitat) than members of different communities. Moreover, using representational similarity analysis, we found that that neural representations of temporal regularities in the hippocampus predicted subsequent reasoning behavior. Objects that were represented more similarly in hippocampus after exposure to the temporal communities were associated with higher levels of induction. Collectively, these findings add to a growing body of literature demonstrating spatial and temporal codes within the hippocampus influence decision-making beyond the domain of memory.

Topic Area: LONG-TERM MEMORY: Episodic

Episodic Memory Training Induces Functional Plasticity in PFC – Hippocampal Neural Circuitry

Poster C64, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Farah Naaz[1], Lindsay Knight[1], Teodora Stoica[1], Brendan Depue[1]; [1]University of Louisville

Training programs for cognition are becoming more ubiquitous in mainstream society. However, there are relatively few studies exploring whether specific task related training leads to functional plasticity in the brain. Furthermore, understanding which neural regions show changes across training highlights important areas underlying the putative neural networks under investigation. We explored this question using fMRI before and after episodic memory training. Eighteen undergraduate students were recruited in a 5-day training study. Participants were scanned on day 1 and day 5. The episodic memory task and training consisted of mnemonic practice of cue-target paired associates (scenes and objects) or a single scene presented in isolation. A cued recall task (approximately 30 minutes later) required participants to either recall the name of the object when presented with the scene, or indicate if the scene was presented alone. Behaviorally, a significant increase in recall accuracy on day 5 compared to day 1 was found (Day 1= 67%; Day 5=75%). Functional analyses revealed greater activation in left ventral lateral prefrontal cortex

(VLPFC), bilateral hippocampus (HC), bilateral inferior parietal sulcus (IPS), and ventral visual processing stream (VVPS) during the task (Paired > Single) on day 5 compared to day 1. Using accuracy as a regressor in functional analyses revealed positive relationships with the same regions mentioned above, but also included the dorsal attentional network. The results indicate that training leads to increased activation of the neural regions associated with encoding/retrieval, attention, and visual processing.

Topic Area: LONG-TERM MEMORY: Episodic

Memory for stereotype-consistent and stereotype-inconsistent information is supported by distinct brain regions

Poster C65, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Niv Reggev[1], Jason Mitchell[1]; [1]Harvard University

What governs the effects that stereotypes have on our memory? Several theories propose that stereotype-consistent characteristics are more easily associated with social group information stored in memory compared to stereotype-inconsistent traits and behaviors. Alternative theories posit that the unexpected nature of inconsistencies triggers more efficient association mechanisms. Here we report a first attempt to examine these theories using a neural perspective. Undergoing fMRI, participants (N=28) were presented with 204 statements describing various traits and behaviors which were either consistent, neutral or inconsistent with gender stereotypes. Each statement was followed by a male or a female face, and participants judged how likely the presented person was to be characterized by the displayed description. Once outside the scanner, participants completed a memory test for the associations between statements and faces. Results indicated that participants remembered stereotype-consistent information slightly better than stereotype-inconsistent information. Although some cortical regions supported successful memory performance for both consistent and inconsistent information, other regions were uniquely sensitive to memories of only one type of information. The fusiform gyrus, typically implicated in the processing of face information, predicted subsequent memory of stereotype-consistent information. Conversely, the anterior temporal lobe and the ventromedial prefrontal cortex, implicated in storing and integrating semantic and socially-relevant knowledge in long term memory, contributed uniquely to memory of inconsistent information. Together, these findings suggest that memory of stereotype consistency is supported by facilitated association of perceptual information, whereas stereotype inconsistencies rely on more elaborate activation of the underlying stereotypical concepts.

Topic Area: LONG-TERM MEMORY: Episodic

Biasing Memory Replay During Sleep: A Quantitative Synthesis of Targeted Memory Reactivation Effects

Poster C66, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Xiaoqing Hu[1], Larry Y. Cheng[2], Ken A. Paller[2]; [1]The University of Hong Kong, [2]Northwestern University

Many correlative findings suggest that memory reactivation during sleep contributes to memory stabilization. Compelling support for this idea has also been provided by studies using sensory input during sleep to directly manipulate neural processing (i.e., Targeted Memory Reactivation, TMR). Here we present a comprehensive meta-analysis of currently available TMR datasets (46 articles with 1,666 participants) to estimate overall effect size and identify possible boundary conditions with moderator analyses. Moderators included 1) stimulation state, sleep vs. wake; 2) stimulation sleep stage, N2 vs. N3 vs. N2/N3 vs. REM; 3) stimulation modality, auditory vs. olfactory vs. tactile; and 4) memory type, conditioning vs. declarative vs. skill memory. Our results revealed that overall, TMR is highly effective in modulating memory (Hedge's $g=0.328$, 95% Confidence Interval [0.206, 0.447], $Z=5.372$, $p<.001$). Moreover, this effect is specific to sleep as TMR did not produce a significant effect during wakefulness, although this conclusion is tempered by the fact that only a small number of types of wakefulness were studied. For other moderators, TMR during N3, but not N2 or REM, produced robust effect sizes. As for stimulation modality, both auditory and olfactory stimulation produced significant effects while the only study using tactile stimulation failed to influence skill memory. Lastly, while all types of learning examined were influenced by TMR, conditioning was associated with the largest effect size, followed by skill memory and

declarative memory. In sum, TMR during sleep, and particularly during slow-wave sleep, is effective for promoting memory reactivation and enhancing multiple types of memory.

Topic Area: LONG-TERM MEMORY: Episodic

Effect of Congruency Between Encoding and Retrieval on Associative Retrieval

Poster C67, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Courtney R. Gray[1], M. Andrew Rowley[2], Kayla McGraw[2], Alexandra P. Giglio[2], Joanna M. Salerno[2], Amy A. Overman[2], Nancy A. Dennis[1]; [1]The Pennsylvania State University, [2]Elon University

Healthy aging is associated with decline across a wide range of cognitive functions, most notably a deficit in associative memory. While this deficit is assume to be ubiquitous across different types of associations, recent evidence from our lab suggests that older adults may show less impairment for item-item compared to item-context associations. Additionally, our past research has shown that congruency between encoding and retrieval is also a critical factor in accounting for age differences in associative memory. In line with our past work, the current experiment compared memory for both item-item and item-context pairs using the same categories of objects across conditions. Importantly, manner of presentation during retrieval was manipulated so that pairs were presented in a manner that was either congruent or incongruent with their presentation during encoding. In line with recent neuroimaging evidence showing that different types of associations are processed by different MTL subregions, we found that congruent and incongruent associative retrieval are supported by differential recruitment across regions including the prefrontal cortex, MTL and visual cortex. As such, results suggest that the manner of presentation influences neural processes supporting associative memory. Results advance our understanding of the mechanisms supporting associative deficits in aging, as well as processes underlying different types of associative retrieval in young adults.

Topic Area: LONG-TERM MEMORY: Episodic

Comparing and contrasting the neural mechanisms of autobiographical memory and problem solving

Poster C68, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Sarah L. Peters[1], Carina L. Fan[1]; [1]McGill University

Emerging research has indicated that the neural processes that support autobiographical memory retrieval are also recruited during open-ended forms of goal-oriented behaviour, such as solving personal problems. The majority of this research has focused on how the hippocampus similarly supports retrieving detailed memory and solution representations (an elaboration form of retrieval). However, in the real world, memories and solutions are not always retrieved at this level of detail. In many cases, multiple related memories or relevant solutions must be brought to mind (a generation form of retrieval). Here, we investigated the similarities and differences in the neural overlap between autobiographical memory and problem solving as a function of these two retrieval forms. In a functional Magnetic Resonance Imaging (fMRI) study, young participants viewed memory and problem solving cues. To each cue, they generated multiple exemplars (generation) and then elaborated on one exemplar in detail (elaboration). Using multivariate analysis (Partial Least Squares), we found that neural activity dissociated between the generation and elaboration forms of retrieval across tasks, such that generation was commonly associated with anterior cortical activity and elaboration with posterior cortical activity. This dissociation was also evident within the hippocampus, which showed an anterior to posterior shift from generation to elaboration. Overall, these results indicate that common retrieval demands drive neural overlap between higher cognitive tasks like autobiographical memory and problem solving.

Topic Area: LONG-TERM MEMORY: Episodic

Hippocampal theta-gamma coupling predicts associative memory performance as measured by chronic ambulatory electrocorticography

Poster C69, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Anita Shankar[1], Simon Henin[1], Daniel Friedman[1], Patricia Dugan[1], Lucia Melloni[1,2], Werner Doyle[1], Lila Davachi[3], Anli Liu[1]; [1]New York University School of Medicine, [2]Max Planck Institute for Brain Research, [3]Columbia University

Previously, increased hippocampal gamma power and theta-gamma coupling have predicted successful encoding of single items and word pairs, termed the subsequent memory effect. To investigate the mechanisms supportive of cross-modal learning, we examined physiological changes in the hippocampus in one epilepsy patient with chronic ambulatory electrocorticography (Responsive NeuroStimulator, Neuropace) and two patients undergoing invasive EEG for surgical evaluation as they participated in a novel associative memory task. During the task, face-profession pairs were presented simultaneously for an encoding period of five seconds, followed by a cued recall session in which patients were shown the face and asked to freely recall the paired profession. In our RNS patient, we observed a significant increase in gamma band (70-90 Hz) power during encoding in the 1500 – 2500 ms interval after stimulus presentation for subsequently recalled versus forgotten pairs. Furthermore, we observed a significant increase in theta-gamma phase amplitude coupling during successful encoding. We found similar increases in two surgical epilepsy patients predictive of successful encoding. We conclude that increased hippocampal theta-gamma coupling and an increase in gamma activity can predict successful encoding of cross-modal associations. Furthermore, that our patient with the RNS device demonstrated similar changes in hippocampal physiology compared to our surgical epilepsy patients suggests that chronic ambulatory electocorticography may serve as a useful platform for cognitive experiments, allowing for sensitive measurements of hippocampal physiology under controlled experimental conditions.

Topic Area: LONG-TERM MEMORY: Episodic

Cortical oscillations underlying strict and lax decision criteria in recognition memory

Poster C70, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Charlie Nettles[1], Evan Layher[2], Justin Kantner[1], Michael B. Miller[2]; [1]California State University, Northridge, [2]University of California, Santa Barbara

Most theories of recognition memory assume that people reach recognition decisions by establishing a criterion reflecting the amount of memory evidence necessary to judge a test probe as previously studied (“old”). The decision criterion can be manipulated, such that individuals are induced to respond “old” only when probes are associated with a large amount of memory evidence (a “strict” or conservative criterion) or on the basis of relatively little memory evidence (a “lax” or liberal criterion). Research with patient populations and neuroimaging work are consistent with the idea that maintaining a strict decision criterion is more demanding of frontal cortical regions than maintaining a lax criterion. We hypothesize that when an individual is compelled to adopt a strict recognition criterion, s/he must engage cognitive control processes that suppress prepotent “old” judgments and support cautious responding. If so, strict and lax decision states should be associated with differing patterns of cortical oscillations. We collected EEG recordings while manipulating participants’ decision states via a “security patrol” recognition paradigm in which old-new discrimination was minimal and shifts between lax and strict criteria were necessary to avoid critical misses (letting dangerous people go free) or false alarms (harming innocent people), respectively. Theta power following hits (versus correct rejections) was higher during strict than lax test blocks at frontal channels, while the results for alpha power were mixed. We also observed differences in baseline activity on strict versus lax test blocks, potentially reflecting the global maintenance of these two decision states.

Topic Area: LONG-TERM MEMORY: Episodic

Theta oscillations increase at critical junctures of overlapping mazes

Poster C71, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Justine Cohen[1], Chantal E. Stern[1]; [1]Boston University

Neuroimaging studies have shown increased activation in medial temporal and prefrontal brain regions while participants traverse critical points in overlapping mazes compared to non-overlapping mazes. In both humans and animals, theta rhythm has been theorized to play a role in spatial coding. Theta rhythm oscillations have been shown to increase in the prefrontal cortex in response to cognitively demanding tasks and are coherent with hippocampal oscillations. Based on an earlier fMRI design, we designed a task in which participants learned twelve mazes, three pairs that began and ended in distinct locations but converged in the middle to share a hallway (overlapping condition) and six distinct mazes (nonoverlapping condition). Each hallway within the mazes was lined with unique objects. One day after learning, participants returned for testing while undergoing EEG recording. Results showed that in the initial hallway, where participants were cued to which maze they were in, theta activity increased during the overlapping condition compared to the nonoverlapping condition. In addition, at the critical choice point – the end of the shared hallway in the overlapping condition - there was an increase in theta rhythm in overlapping compared to nonoverlapping mazes. Increases in theta activity coincided with time points where functional imaging using a similar task showed increased activation in hippocampus and prefrontal cortex. These results suggest that oscillatory dynamics in the hippocampus and prefrontal cortex are integral to disambiguation between mazes with overlapping routes.

Topic Area: LONG-TERM MEMORY: Episodic

Retrieval-induced forgetting and second language acquisition: Preliminary insights from a Welsh language word-learning study

Poster C72, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Lyam Bailey[1], Aaron J. Newman[1]; [1]Dalhousie University

The current investigation explored the role of retrieval-induced forgetting (RIF), a process whereby retrieval of information from memory perturbs access to related material, in second language (L2) vocabulary acquisition. Prior research on bilingual subjects has indicated that retrieving words in one language may cause difficulties remembering equivalent words in another language (Levy et al. 2007, Psychological Science, 18[1]). The potential involvement of RIF in early L2 acquisition remains to be investigated. Here, subjects learned novel Welsh words by means of picture-noun association training. In an adaptation of the traditional retrieval-practice RIF paradigm, half of the learned items were retrieved in participants' first language (L1), prior to a final test of knowledge for all of the learned Welsh words. In two separate experiments, we used our adapted paradigm to investigate participants' reaction times to all of the previously learned Welsh words at test, and later, their ability to recall these words in a written test. Our results show that participants exhibited significantly longer reaction times to learned words retrieved in L1 (compared to those that were not retrieved in L1), suggesting some degree of forgetting induced by L1 retrieval. These data provide the first tentative evidence that RIF may impact newly formed memory representations, and more generally act as a barrier to early L2 acquisition.

Topic Area: LONG-TERM MEMORY: Other

A direct pathway to anterior IPS for graspable objects: fMRI evidence from a patient with a lesion to the geniculostriate pathway

Poster C73, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Quanjing Chen[1], Colleen Schneider[1,2], Emily Prentiss[1], Zoe Williams[3], Bogachan Sahin[4], Bradford Z. Mahon[1,4,5,6]; [1]Department of Brain and Cognitive Sciences, University of Rochester, [2]Medical Scientist Training Program, University of Rochester School of Medicine and Dentistry, [3]Department of Ophthalmology, University of Rochester School of Medicine and Dentistry, [4]Department of Neurology, University of Rochester School of Medicine and Dentistry, [5]Department of Neurosurgery, University of Rochester School of Medicine and Dentistry, [6]Center for Visual Science, University of Rochester

Prior research demonstrates a primarily left-lateralized frontoparietal network is automatically engaged when participants view images of manipulable objects. However, the role of awareness, and processing in the geniculostriate pathway for dorsal action representations to be activated by manipulable objects has not been investigated. Here we study an individual with a right homonymous hemianopia caused by a stroke lesion that deafferented primary visual cortex of inputs from the lateral geniculate nucleus. Images of graspable objects (tools), fearful and emotionally neutral faces were shown in the intact and hemianopic visual fields. Replicating prior research, fearful faces differentially drive activity in the amygdala, even when the stimuli are presented in the hemianopic field. We also find that small manipulable objects continue to activate the anterior IPS. While aIPS activity for tool stimuli was present regardless of whether stimuli were presented in the visually intact or hemianopic visual fields, category-preferring effects in the ventral visual pathway were observed only when stimuli were presented in the intact visual field. These findings suggest a direct pathway to parietal grasp-related areas that bypasses processing in primary visual cortex, offering a new perspective on visual inputs to the dorsal visual pathway.

Topic Area: LONG-TERM MEMORY: Semantic

Searching for semantic knowledge: A vector space semantic analysis of the feature generation task

Poster C74, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Rebecca Cutler[1], Nate Klooster[2], Melissa Duff[1], Sean Polyn[1]; [1]Vanderbilt University, [2]University of Pennsylvania

A recent neuropsychological study found that amnesic patients with hippocampal damage (HD group; n=5) reliably produce fewer responses than healthy demographically matched comparison participants (NC group; n=15) in a semantic feature generation task (Klooster & Duff, 2015), consistent with the idea that semantic cognitive deficits are associated with hippocampal damage. Participants were presented with a target word and asked to produce as many features of that word as possible. We examined these data using a semantic vector space model to characterize semantic similarity between the target word and the response words comprising the features. Overall, HD patients generated features that were closer in semantic space to the target word, as compared to the wider range of features generated by the NC group. Both groups tended to initiate the search process with features close in semantic space to the target word, with a gradual decline in similarity to the target word over the first several responses. Adjacent features in the response sequence showed stronger similarity to each other than to non-adjacent features, suggesting that the search process follows a local trajectory in semantic space. Termination of feature generation in HD patients, but not the NC group, was preceded by a steady decline in similarity to the target word, suggesting that a patient's search process is disrupted when the search ranges too far in semantic space from the target word. We consider these results in terms of a model in which hippocampus supports the probing of semantic memory.

Topic Area: LONG-TERM MEMORY: Semantic

The Impact of Acetylcholine Blockade on Declarative and Motor Memory Consolidation Following a Night of Sleep or a Day of Wake

Poster C75, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Matthew Tucker[1], Kathryn Taylor[1], Rozina Merchant[1], Sharon George[1], Caroline Stoddard[1], Kevin Kopera[1]; [1]University of South Carolina School of Medicine Greenville

It is hypothesized that elevated acetylcholine (ACH) in the brain enhances initial learning of new information, while decreased ACH facilitates memory consolidation (the strengthening of long term memories that follows initial learning)(Hasselmo, 1999; Hasselmo & McGaughy, 2004). ACH is elevated while awake and decreased during sleep (especially slow wave sleep), implicating wake as a time for the acquisition of new information, and sleep as a time for memory consolidation. We examined whether decreasing ACH (scopolamine .4mg) in sleep and wake benefits memory consolidation of newly learned picture pairs and typing speed. Eighty seven college students trained on a visual paired associates task (hippocampus-dependent declarative memory) and a text passage typing test (motor memory) in the morning (9am) or evening (9pm). After training subjects were administered a

scopolamine or placebo capsule, which was followed by a night of sleep or a day awake. Subjects were retested on the same tasks 12hrs following the training session. We found that sleep had a beneficial effect on declarative memory processing. However, there was no benefit of scopolamine on declarative memory consolidation. Sleep and scopolamine had no impact on motor memory consolidation. As expected, the side effects of scopolamine, while mild, were significantly more pronounce in the wake subjects, who would have been conscious of those effects. The results of this study call into question the idea that acetylcholine blockade during the memory consolidation phase is beneficial for declarative memory processing.

Topic Area: LONG-TERM MEMORY: Semantic

Finding the baby in the bath water – evidence for training-specific changes in MRI measures of brain structure and function

Poster C76, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Cibu Thomas[1], Adam Steel[1], Aaron Trefler[1], Elizabeth Aguila[1], Gang Chen[1], Carlo Pierpaoli[2], Chris Baker[1]; [1]National Institute of Mental Health, [2]National Institute of Biomedical Imaging and Bioengineering

Firmly establishing the evidence for structural and functional plasticity in the human brain is challenging because training-related changes in MRI-measures of brain structure and function can be influenced by potential confounds such as time-of-day (TOD). Further, many previous studies have not shown compelling evidence for the specificity of effects, to both task and brain region. To address these issues, we scanned 19 healthy adults over four visits, a week apart. Each visit included scan sessions in the AM and PM. On visits 1 and 4, participants received no training allowing us to model diurnal changes in MRI measures. On visits 2 and 3, between the AM and PM scans, participants trained for 90 minutes on a right-lateralized visuospatial-learning and a left-lateralized motor sequence-learning task respectively. Participants showed significant improvement in behavioral performance in both tasks, after training. Analysis of MRI measures of brain structure (e.g. cortical thickness, fractional anisotropy) and function (e.g. resting state functional connectivity (rsFC)) revealed: significant fluctuations in MRI measures of structure and function that were related to physiological changes in CSF and/or blood flow dynamics due to TOD, rather than training. After controlling for the effect of TOD, we did not find strong evidence for task-specific changes in MRI measures of brain structure, but did find some evidence for functional changes as measured using rsFC. These results underscore the importance of controlling for potential confounds in MRI studies of training-related plasticity.

Topic Area: LONG-TERM MEMORY: Skill learning

EEG patterns reveal internal dynamics of sleep stage N3

Poster C77, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Achim Schilling[1], Patrick Krauss[1], Konstantin Tziridis[1], Maximilian Traxdorf[2], Holger Schulze[1]; [1]Experimental Otolaryngology University of Erlangen-Nuremberg, [2]Department of Otolaryngology University of Erlangen-Nuremberg

Classic visual sleep stage scoring is based on EEG frequency band analysis of 30s epochs and is commonly performed by highly trained medical sleep specialists using additional information from submental EMG and eye movements (EOG). We have recently provided the proof-of-principle in 40 subjects that sleep stages can be consistently differentiated solely on the basis of spatial 3-channel EEG patterns based on root-mean-square (RMS) amplitudes and without using classic EEG frequency band analysis or graphic elements such as K-complexes, spindles, vertex waves and posterior occipital sharp transients. We visualize the spatial cortical activity patterns based on RMS amplitude vectors using multidimensional scaling. It turns out that these patterns naturally divide into different clusters that correspond to visually scored sleep stages. As could be demonstrated, the clusters are highly reproducible between different subjects. Especially the cluster associated with the REM sleep stage seems to be extremely robust and very different from the one associated with the wake state. Furthermore, we found that the sleep stage N3 shows a characteristic dynamic behavior that is consistent across different occurrences during sleep within the same subject and also across different subjects: root-mean-square amplitudes first increase monotonically, then stay constant and finally decrease monotonically again, with each period lasting for several minutes. Interestingly, the described dynamics first start in occipital areas, then spreads to pre-frontal areas and finally reach the central sulcus, with a temporal delay in the order of magnitude of minutes.

Topic Area: METHODS: Electrophysiology

Test-retest reliability of ERP based Neurometrics

Poster C78, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Rachel Scrivano[1], James Cole[1], Paul Kieffaber[1]; [1]College of William and Mary

Neurometrics are becoming increasingly popular for use in clinical settings as a potential diagnostic aid. For example, quantitative EEG (qEEG) has been used to make inferences about functional dissociations between clinical populations and event-related potentials (ERPs) may be used to measure subtle differences in sensory/perceptual functions. However, little is known about the test-retest reliability of ERP components and/or qEEG measures to determine their stability over time. The present study utilized a 20 minute Brief Neurometric Battery (BNB) composed of auditory and visual computerized stimuli (80 dB sounds and pairs of numbers and letters) to measure both ERP and qEEG neurometrics. The battery was administered twice with each session separated by a one-week interval. Eight ERP components 10 measures of qEEG were recorded at each session. Five of the eight ERP components measured showed significant test-retest reliability using the intraclass correlation coefficient (P300b, P50diff, N2pc, MMN_frequency, MMN_ITI). Regional spectral power in alpha, beta, theta, and gamma ranges were also significantly reliable, as were several measures of oscillatory asymmetry. These results provide support for the use of EEG-based neurometrics in clinical applications.

Topic Area: METHODS: Electrophysiology

Neural correlates underlying statistical learning of adjacent and non-adjacent verbal sequential dependencies

Poster C79, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Leyla Eghbalzad[1], Joanne A. Deocampo[1], Gretchen N.L. Smith[2], Sabrina Na[1], Tricia Z. King[1], Christopher M. Conway[1]; [1]Georgia State University, [2]Indiana University School of Medicine

The ability to learn sequential dependencies is essential for language acquisition and other cognitive skills. Recent studies suggest there may be separate cognitive processes involved in learning adjacent (e.g., “A-B”) versus non-adjacent (e.g., “A-X-B”) dependencies, but the neural correlates accompanying such learning are under-specified. We developed a sequential learning task in which sequences of printed nonsense syllables containing both adjacent and non-adjacent dependencies were presented. After incidentally learning these grammatical sequences, eighteen healthy adults (age M=22.5, 9 females) made familiarity judgments about novel grammatical sequences and ungrammatical sequences containing violations of the adjacent or non-adjacent dependencies while in a 3T MRI scanner. Analysis of the BOLD activity showed that increased activation for adjacent dependency learning was associated with a distributed frontal –parietal and cerebellar network, whereas increased activation for non-adjacent dependency learning was associated with the anterior cingulate cortex (ACC). The frontal-parietal network is known to be associated with working memory while the ACC is proposed to be important for cognitive control, error/conflict detection, as well as allocation of attention and selection of appropriate responses. Furthermore, these networks were differentially correlated with distinct out-of-scanner cognitive measures such as working memory and processing speed. These findings provide the basis for understanding the neural underpinnings of sequential pattern learning of adjacent and non-adjacent structures and helps elucidate the possible mechanisms important for the processing and learning of language.

Topic Area: METHODS: Neuroimaging

Reduced Persistence of Spontaneous Brain Activity in Schizophrenia

Poster C80, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Huang Zheng[1,2], Jianbo Gao[1,2]; [1]School of Computer, Electronics and Information, Guangxi University, China, [2]Institute of Complexity Science and Big Data Technology, Guangxi University, China

Schizophrenia is a complex disorder comprised of widespread affective, cognitive, and behavioral disturbances and disruptions. We studied the dynamic properties of the blood oxygenation level-dependent (BOLD) time series of patients diagnosed with schizophrenia at resting state, by computing a key measure from complexity science, the Hurst exponent (H) using Adaptive Fractal Analysis (AFA). When $0<H<1/2$, a BOLD time series is considered to have anti-persistent correlation. When $H=1/2$, a BOLD time series is memoryless or only has short-term memory. When $1/2<H<1$, a BOLD time series is considered to have persistent long range correlation. 44 participants meeting the DSM-IV criteria for schizophrenia and 77 healthy controls underwent fMRI scanning at 3.0 T. Mean H for all the 116 brain regions extracted from Anatomical Automatic Labeling (AAL) template as well as the whole brain were generated and analyzed for each subject based on voxel by voxel time series. Statistically significant reduced persistences in brain activity were detected in schizophrenia patients compared to controls both at the whole brain level and the brain region level. To be exact, 103 of 116 brain regions showed significantly reduced persistence, suggesting overwhelmingly less persistent brain activity in patients with schizophrenia. The result provides evidence that brain activity of schizophrenia is associated with weaker persistence and more randomness in signal patterns compared to healthy controls. This property may constitute a potential biomarker of schizophrenia from Resting-State fMRI.

Topic Area: METHODS: Neuroimaging

A Novel Information Network Flow Approach for Measuring Functional Connectivity and Predicting Behavior

Poster C81, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Sreejan Kumar[1], Kwangsun Yoo[1], Monica D. Rosenberg[1], Marvin M. Chun[1]; [1]Yale University

Connectome-based predictive modeling (CPM) was recently developed to predict individual differences in behavior from functional brain connectivity (FC) (Finn et al., 2015; Nature Neurosci; Rosenberg et al., 2016, Nature Neurosci). In these models, FC was operationalized as the Pearson's correlation between brain regions' BOLD time-courses. However, Pearson's correlation is limited since it only captures linear relationships. We developed a more generalized metric of FC based on information flow. This measure represents FC by abstracting the brain as a flow network of nodes that send bits of information to each other, where bits are quantified through an information-theory statistic called transfer entropy. With a sample of individuals performing a sustained attention task and resting during fMRI ($n = 25$), we trained CPMs to predict attention from FC patterns measured with information flow. Models trained on n–1 participants' task-based patterns were applied to an unseen individual's resting-state pattern to predict task performance. Model predictions significantly correlated with observed performance ($r=0.639$, $p=5e-4$). For further validation, we applied our model to three independent datasets that included resting-state fMRI data and a measure of attention (Attention Network Task performance [ANT; $n = 41$], stop-signal task performance [SST; $n = 72$], or clinician-rated ADHD symptom scores [$n = 113$]). Our model significantly predicted individual differences in ANT and SST performance ($r=-.31$, $p=.049$; $r=.34$, $p=.004$). Thus, information flow may be a useful alternative to Pearson's correlation as a measure of FC due to its significant theoretical foundation and success in predicting individual differences in behavior.

Topic Area: METHODS: Neuroimaging

Quasi-Periodic Patterns of Intrinsic Brain Activity: Stability and Individual-Specificity

Poster C82, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Behnaz Yousefi[1], Eric Schumacher[2], Shella Keilholz[1]; [1]School of Biomedical Engineering, Emory University/Georgia Institute of Technology, Atlanta, GA, USA, [2]School of Psychology, Georgia Institute of Technology

Intrinsic brain activity, as reflected in spontaneous fluctuations of functional MRI signal in resting states, has shown to exhibit a quasi-periodic spatiotemporal pattern (QPP), roughly occurring every 20s in humans, and mainly revealing the course of activation and deactivation of the default mode network (DMN)[1,2]. Spatial extend of areas strongly anti-correlated with DMN in a QPP has shown to vary among individuals, based on which QPP can be coarsely categorized into two types: anti-correlated type and most-correlated type [2]. To examine stability and individual-specificity of QPP, we used Human Connectome Project resting state dataset, which is acquired on two subsequent days, and performed QPP analysis[2] for each day for 470 individuals with low to moderate head motion. We found: I) individuals with anti-correlated type QPP are more stable in their QPP type; out of 245 individuals with anti-correlated type QPP on day 1, 178 (~%73) exhibit the same type on day 2, and out of 225 individuals with most-correlated type QPP on day 1, 130 (~%58) exhibit the same type on day 2, II) QPPs are significantly more correlated between days within-subjects (median:0.78) than between-subjects (median: 0.65; pKolmogorov-Smirnov-test:1.4e-88); this result is unchanged by global signal regression, although medians are reduced (within-subject: 0.63, between-subject:0.42, pKStest:1.4e-88). Our findings show QPPs are reasonably stable and individual-specific hence could serve as markers of traits and we can further examine their behavioral correlates. Moreover, quasi-periodic spatiotemporal patterns might be rich enough to significantly enhance fingerprinting of individuals [3,4] and expand our insight into brain functionality.

Topic Area: METHODS: Neuroimaging

The Fronto-Insular Cortex Causally Mediates the Default-Mode and Central-Executive Networks to Contribute to Individual Cognitive Performance

Poster C83, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Rui Li[1,2], Juan Li[1,2]; [1]CAS Key Laboratory of Mental Health, Institute of Psychology, [2]University of Chinese Academy of Sciences

The triple network model that consists of the default-mode (DMN), central-executive (CEN), and salience (SN) networks has been suggested as a powerful paradigm for investigation of network mechanisms underlying various cognitive functions and brain disorders. A crucial hypothesis in this model is that the fronto-insular cortex (FIC) in the SN plays centrally in mediating interactions between the networks. Using a machine learning approach based on Independent Component Analysis and Bayesian network (BN), this study characterizes the directed connectivity architecture of the triple network and examines the role of FIC in connectivity of the model. Data-driven exploration shows that the FIC initiates influential connections to all other regions to globally control the functional dynamics of the triple network. Moreover, stronger BN connectivity between the FIC and regions of the DMN and the CEN, as well as the increased outflow connections from the FIC are found to significantly predict individual performance in memory and executive tasks. In addition, the posterior cingulate cortex in the DMN was also confirmed as an inflow hub that integrates information converging from other areas. Collectively, the results highlight the central role of FIC in mediating the activity of large-scale networks, which is crucial for individual cognitive function.

Topic Area: METHODS: Neuroimaging

Defining Cognition: Automated Generation of Cognitive Ontology by Text-Mining Literature

Poster C84, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Richard Gao[1], Thomas Donoghue[1], Bradley Voytek[1]; [1]University of California, San Diego

A key goal of cognitive science is to understand and map the relationship between cognitive processes. Previous works have manually curated cognitive terms and relations, effectively creating an ontology, but do they reflect how cognitive scientists and neuroscientists study cognition in practice? We set out to investigate relations between cognitive processes in a data-driven way by text-mining and automated clustering to build a cognitive ontology, or atlas, from existing literature. In particular, we explore whether literature from the areas of cognitive science and neuroscience are consistent in their conceptions of cognitive processes, such as learning and memory, as defined by their position in the ontological structure, i.e., how they relate to other processes. We find automatically generated relationships to be missing in existing ontologies, and that cognitive science does not always conceptualize cognitive processes in the same way that neuroscience does. Thus, our work serves as an efficient hypothesis-

generating mechanism, inferring relationships between cognitive processes that can be manually refined by experts. Furthermore, our results highlight the gap between theories of cognition and the study of their implementation in neuroscience.

Topic Area: METHODS: Other

The role of physical fitness components on overall and regional cortical thickness in overweight/obese children: preliminary results from the ActiveBrains Project

Poster C85, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Irene Esteban-Cornejo[1,2], Jose Mora-González[1], Cristina Cadenas-Sánchez[1], Oren Contreras-Rodriguez[3,4], Juan Verdejo-Roman[5], Pontus Henriksson[1,6], Jairo Migueles[1], Maria Rodriguez-Ayllon[1], Pablo Molina-García[1], Charles Hillman[2], Andrés Catena[5], Francisco B. Ortega[1]; [1]PROFITH "PROmoting FITness and Health through physical activity" research group, University of Granada, Granada, Spain, [2]Northeastern University, Boston, MA, [3]Bellvitge Biomedical Research Institute-IDIBELL, Barcelona, Spain., [4]Centro de Investigacion Biomedica en Red de Salud Mental (CIBERSAM), Barcelona, Spain., [5]Mind, Brain and Behavior Research Center (CIMCYC), University of Granada, Granada, Spain., [6]Karolinska Institutet, Huddinge, Sweden.

Aim: To examine the associations of physical fitness components (i.e. cardiorespiratory fitness, speed-agility and muscular fitness) with overall and regional cortical thickness in overweight/obese children. Methods: A total of 101 overweight/obese children aged 8-11 years were recruited from Granada, Spain. The physical fitness components were assessed following the ALPHA health-related fitness test battery. T1-weighted images were acquired with a 3.0 Tesla Siemens Magnetom Tim Trio system. Overall and regional cortical thickness was computed with FreeSurfer software (v 5.3). For overall cortical thickness, averages cortical thickness across the entire brain were calculated. For regional cortical thickness, we focused on specific frontal (i.e. right premotor cortex, right supplementary motor cortex and left inferior frontal gyrus), temporal (i.e. left inferior temporal gyrus and right parahippocampal gyrus) and occipital (i.e. right calcarine cortex) regions, as we have previously found that physical fitness was associated with greater cortical volume in these specific areas. All analyses were controlled for sex, peak high velocity offset, and parental education. Results: Cardiorespiratory fitness and speed-agility, but not muscular fitness, were related to overall cortical thickness (Beta's = 0.314 and 0.301, respectively; both $P < 0.01$). Only speed-agility was related to superior temporal cortical thickness (Beta = 0.294; $P=0.01$). No other associations were found between the physical fitness components and specific regional cortical thickness. Conclusion: These findings suggest that cardiorespiratory fitness and speed-agility might positively influence development of overall cortical thickness to counteract the potentially detrimental effect of excess adiposity on brain structure during childhood.

Topic Area: NEUROANATOMY

Adding insult to injury: Effects of cranial radiation treatment on structural volumes and associated memory performance in brain tumour survivors

Poster C86, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Ramy Ayoub[1,2], Kiran Beera[1], Ashley Ferkul[1], Jovanka Skocic[1], Cynthia de Medeiros[1], Eric Bouffet[1,2], Donald Mabbott[1,2]; [1]Peter Gilgan Center for Research and Learning, The Hospital for Sick Children, [2]University of Toronto

A long-term goal in biomedical sciences is to recruit endogenous repair mechanisms to promote tissue regeneration in response to brain injury. In animal models, metformin has been found to elicit neurogenesis, fostering brain repair. We are conducting a randomized clinical drug trial measuring effects of metformin on brain repair and cognitive restoration in paediatric brain tumour survivors treated with cranial radiation (CR). CR is associated with reduced brain volume (BV) and cognitive deficits. Here we analyzed baseline differences in BV and associated memory performance (MP) as a result of CR in this population to gain greater insight into neuroanatomical and cognitive changes over the trial period. We aim to examine whether a correlation between BV and MP exists and if different forms of CR (focal vs. craniospinal) result in differences in BV and MP. T1-weighted MR images were obtained in 24 participants (male=14). Measures of hippocampal, thalamic, putamen and corpus callosum volumes, and MP

were obtained. A partial least squares (PLS) model was used for regression analysis. Linear analyses were used to detect differences in BV and MP as a function of treatment type. PLS analyses revealed that differences in volumes accounted for 91% of the variance in memory scores, suggesting BV is a good predictor of MP. No significant volume or memory differences by treatment type were present, indicating that CR produced homogeneous effects in this population. Upon completion of data collection in December 2017, analyses will examine metformin-related differences in white matter structure, hippocampal volume and cognitive functioning.

Topic Area: NEUROANATOMY

Concurrent temporal channels for auditory processing: behavioral and neurophysiological evidence reveals segregation of function at different scales

Poster C87, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Xiangbin Teng[1], David Poeppel[1,2]; [1]Max Planck Institute, Frankfurt, Germany, [2]Department of Psychology, New York University, New York, NY

Natural sounds convey perceptually relevant information over multiple timescales, and the necessary extraction of multi-timescale information requires the auditory system to work over distinct ranges. The simplest hypothesis suggests that temporal modulations are encoded in an equivalent manner within a reasonable intermediate range. We show that the human auditory system selectively and preferentially tracks acoustic dynamics concurrently at two timescales corresponding to the neurophysiological theta band (4–7 Hz) and gamma band ranges (31–45 Hz) - but, contrary to expectation, not at the timescales corresponding to alpha (8–12 Hz) and beta (13-30 Hz). While undergoing magnetoencephalography recording, listeners heard synthetic acoustic stimuli with temporally modulated structures at timescales from ~30 to ~190 ms and performed a 3-IFC match to sample study with timescale as the critical variable. MEG analyses of evoked power and intertrial phase coherence illuminate the differential encoding – only theta and gamma bands, but not other frequency bands, show robust responses to sounds. Further analyses - classification, decoding, and mutual information – demonstrate that temporal dynamics of sounds can be only read out from theta and gamma bands but not others. Source-space analysis further shows that prominent entrainment of theta and gamma bands can be localized in functionally early auditory cortex. These result echo our previous behavioral findings and lend strong support to a discrete multi-scale coding scheme on the cortical level of auditory processing (Poeppel, 2003).

Topic Area: PERCEPTION & ACTION: Audition

Effect of listening environment on cortical entrainment to continuous speech in older adults

Poster C88, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Jacie R. McHaney[1], Benjamin D. Zinszer[1], Kirsten E. Smayda[1], Bharath Chandrasekaran[1]; [1]The University of Texas at Austin

As we age, understanding conversations in noisy environments (speech perception in noise; SPIN) becomes increasingly difficult. Enhanced cortical entrainment to the speech envelope is one mechanism supporting SPIN in young adults. However, the extent to which older adults use envelope cues to enhance SPIN is unclear. The goal of this project was to understand the extent to which neural encoding of the speech envelope in differing listening conditions predicts speech comprehension in older adults. We presented continuous English speech to 22 native-English older adults while recording electroencephalography in quiet (without background noise) and time-reversed speech masking conditions. To measure speech comprehension, participants answered multiple-choice questions after each 60-second interval of speech. Participants also completed a SPIN task with speech-shaped-noise masking. Comprehension was significantly higher in the quiet condition relative to masked condition ($t(13) = 2.9$, $p = 0.01$), suggesting SPIN performance is sensitive to listening condition. A linear model predicting comprehension indicated a significant interaction between condition and cortical entrainment ($p < 0.01$). When pure tone averages (PTA) and SPIN scores were included as covariates, cortical entrainment significantly correlated with comprehension in the masked condition ($r = 0.67$, $p < 0.01$), but not

in the quiet condition (r = 0.12, p = 0.68). Further, cortical entrainment greatly improved model fitness in the masked condition (Adj-R2 = 0.78) compared to PTA and SPIN alone (Adj-R2 = 0.46). These findings suggest that the magnitude of older adults' cortical entrainment to the speech envelope may predict participants' speech comprehension under noisy listening conditions.

Topic Area: PERCEPTION & ACTION: Audition

Abnormal resting-state EEG cross-frequency coupling in patients with tinnitus

Poster C89, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Byoung-Kyong Min[1], Min-Hee Ahn[1], Sung Kwang Hong[1,2]; [1]Korea University, [2]Hallym University College of Medicine

Tinnitus is the psychoacoustic phantom awareness of internally generated sound in the absence of external sound. We recently reported neurophysiological evidence for deficits in both bottom-up and top-down processing in patients with tinnitus. However, it is still uncertain whether tinnitus symptoms are also reflected in the resting-state brain. In the present study, we analyzed phase-amplitude cross-frequency coupling (CFC) to evaluate resting-state electroencephalographic (EEG) data in healthy participants and patients with tinnitus. Healthy participants exhibited robust frontal delta-phase/central high-gamma-amplitude CFC that was significantly absent in patients with tinnitus ($p < 0.001$). Since low-frequency phase and high-frequency amplitude coupling reflects large-scale communication during cognitive processing, the absence of frontal delta-phase/central high-gamma-amplitude CFC in patients with tinnitus may reflect deficient integration over inter-regional functional brain networks (particularly, impaired frontal top-down inhibitory control) in the resting state. Our observations are indicative of abnormal reorganization or maladaptive neuroplasticity in the auditory default mode network in tinnitus.

Topic Area: PERCEPTION & ACTION: Audition

Tablet-based gameplay identifies movement patterns related to autism spectrum disorder

Poster C90, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Anna Anzulewicz[1,2,3], Krzysztof Sobota[2,3], Jonathan Delafield-Butt[2]; [1]Jagiellonian University in Krakow, Poland, [2]University of Strathclyde, Glasgow, UK, [3]Harimata, Krakow, Poland

It has been recently proposed that one of the early markers of autism spectrum disorder (ASD) are abnormalities in the development of intentional movements, which can be observed from early childhood. Here, we aimed to identify differences in kinematics between children with ASD and their typically developing (TD) peers. In two studies, we utilized tablet devices' inertial sensors (accelerometer, gyroscope, and magnetometer) and touchscreen to record the movement dynamics made during gameplay. Thirty-seven ASD and 45 TD children (aged 3-6) participated in the first experiment, and 46 ASD children and 383 TD participated in the second one. Two experimental games were used: (1) 'Sharing' where the main task was to divide a piece of food and distribute it evenly among four children on the screen; and (2) 'Creativity' where gameplay was open, unstructured coloring of an object. Each game consisted of a two-minute training phase and five-minute test phase. Simple kinematic calculations of movements, e.g., gesture duration, acceleration, etc., were extracted. Machine learning algorithms (Random Forest, Regularized Greedy Forest) were used to classify movements. The results showed that the specific for ASD children movement patterns could be differentiated from the patterns of TD children with 93% accuracy in Exp.1 and 85% accuracy in Exp.2. The children with autism displayed larger and faster gesture kinematics and exerted higher pressure at a contact than the control group. These findings support the notion that autism spectrum disorder has a prominent motor component that can be identified from early childhood using smart device gameplay.

Topic Area: PERCEPTION & ACTION: Development & aging

Age-related declines in GABA levels in the auditory cortex are associated with neural distinctiveness and auditory perception.

Poster C91, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Poortata S. Lalwani[1], Holly Gagnon[1], Kaitlin Cassady[1], Molly Simmonite[1], Myria Petrou[1], Bradley Foerster[1], Rachael Seidler[2], Stephan Taylor[1], Daniel H. Weissman[1], Thad A. Polk[1]; [1]University of Michigan, [2]University of Florida

Normal aging is typically associated with decline in perceptual and fluid processing abilities, but preserved crystalized task performance. Previous studies have shown that age-related decline in the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) in frontal cortex is correlated with poor cognitive performance (J.BPSC 2016.06.004) . Similarly, studies show that neural patterns in ventral visual cortex in response to different stimulus categories (faces vs. houses) are less distinctive in older adults (PNAS 101:13091) and that lower distinctiveness is associated with poorer performance on fluid processing tasks (Jnl Neurosci 30:9253). Furthermore, application of GABA receptor agonists restores visual neural selectivity in older macaques (Science 300:812). We therefore hypothesized that age-related declines in GABA levels might contribute to reduced neural distinctiveness and associated cognitive declines. Healthy young (ages 18-29) and old adults (over 65) completed a functional Magnetic Resonance Imaging (fMRI) scan in which they listened to foreign speech and music. They also participated in a Magnetic Resonance Spectroscopy (MRS) scan in which GABA levels were estimated in task-activated regions of auditory cortex. Finally, they also complete a battery of cognitive tasks. Data collection is ongoing but preliminary results in 18 young and 17 old subjects suggests that both the distinctiveness of music vs. speech activation patterns and GABA levels decline with age in auditory cortex, that these GABA declines are associated with the decline in neural distinctiveness, and that GABA levels also correlate with performance on an auditory perception task but not on a visual perception task.

Topic Area: PERCEPTION & ACTION: Development & aging

Grasping Interferes with Visuospatial Working Memory during the Encoding: Neurophysiological Evidence

Poster C92, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Rumeysa Gunduz Can[1,2], Thomas Schack[1,2,3], Dirk Koester[1,2]; [1]Faculty of Psychology and Sport Science, Bielefeld University, Germany, [2]Cognitive Interaction Technology - Center of Excellence, Bielefeld University, Germany, [3]Research Institute for Cognition and Robotics, Bielefeld University, Germany

The present study focuses on the neuro-cognitive mechanisms of manual actions, specifically, on the neurophysiology of the functional interactions between grasping movements and working memory (WM). Here, we investigated the neurophysiological correlates of the grasping interference in separate WM domains (verbal, visuospatial) and processes (encoding, retrieval). Thirty participants were tested in a WM-grasping dual-task paradigm. Baseline single-task required performing a WM task (verbal or visuospatial version). Dual-task required performing the WM task simultaneously with a grasp-to-place task. This study rested on a 2 (Task: Single vs. dual) x 2 (WM domain: Verbal vs. visuospatial) within subject design. Event related potentials (ERPs) were analyzed separately for encoding and retrieval processes. Behavioral analyses showed that memory performance decreased for the visuospatial task, but not for the verbal task, when additional movement execution was required. That is, grasping interferes in WM in domain-specific pattern. ERP analyses showed for the visuospatial task that movement execution in the dual-task (compared to the single-task) changed the encoding-related ERPs. Therefore, ERP findings supported the domain-specific grasping interference in WM. More importantly, for the first time, ERP findings showed the process-specific (encoding) grasping interference in WM at the neurophysiological level. Generally, we provide a neurophysiological evidence for process- and domain-specific grasping interference in WM (encoding process of visuospatial domain). This study, therefore, provides an initial neurophysiological characterization of functional interactions between grasping movements and WM (domains and processes) in a complex dual-task setting, and contributes to a better understanding of neuro-cognitive mechanisms of manual action control.

Topic Area: PERCEPTION & ACTION: Motor control

Comparing Sensorimotor Oscillations during a Motor Task with a Robot or Human Partner

Poster C93, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Nathan Smyk[1], Staci Meredith Weiss[1], Jebediah Taylor[1], Peter Marshall[1]; [1]Temple University

Robots provide an opportunity to extend research on the cognitive, perceptual, and neural processes involved in social interaction. Our study examined how sensorimotor oscillatory EEG activity is influenced by the nature of a task partner: human or robot. Twenty participants gained experience with a semi-humanoid robot that could “perceive” incoming tactile stimulation through a haptic sensor on its hand; the robot responded to touch by moving a finger, indicating that it had received tactile stimulation. During EEG collection, participants sat behind a barrier and saw a cue indicating when they were able to press a button with their left hand, which then triggered a brief tactile stimulation to their partner’s right hand via an inflatable membrane; tactile stimulation occurred 1500 ms after the button press. We analyzed alpha and beta oscillations before, during, and after execution of the button press, comparing oscillatory activity when participants sent tactile stimulation to a robot or a human (counterbalanced). The extent of beta (14-20 hz) rebound at frontocentral electrode sites following the button press differed significantly between conditions, $F(1, 19) = 12.15$, $p = .002$, with a larger increase in beta power when participants were sending tactile stimulation to a robot partner compared to the human partner. Alpha and beta activity prior to the button press did not differ between conditions. Increases in beta power have been related to greater predictably in event outcomes, and may reflect decreased cortical excitability. This new paradigm and novel findings advance the neuroscientific study of human-machine interaction.

Topic Area: PERCEPTION & ACTION: Motor control

Dynamic shaping of the defensive peripersonal space through kinesthetic illusion

Poster C94, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Monica Biggio[1], Ambra Bisio[1], Piero Ruggeri[1], Marco Bove[1]; [1]University of Genoa, Italy

The Hand Blink Reflex (HBR) is a subcortical defensive response, elicited by the electrical stimulation of the median nerve. HBR responses dramatically increased when the stimulated hand moves inside the defensive peripersonal-space (DPPS) of the face, no matter what kind of movement (voluntary, passive or imagined). We aim to investigate whether the kinesthetic illusion of movement evoked by proprioceptive stimulation could modulate the HBR responses like other dynamic conditions. In 8 healthy subjects showing reproducible HBR responses we evoked the illusion of movement by vibrating biceps and triceps of the right arm to induce, respectively, the sensation to move the forearm down - far from the face, and up - towards the face. Electromyographic activity was recorded from the orbicularis oculi muscles while the HBR response was elicited in three starting hand positions, depending on the distance of the hand from the face (far, intermediate and near positions). Results showed that HBR responses during both kinesthetic illusion and voluntary movement conditions decreased with respect to static condition, showing an effect of sensory attenuation. However there were no significant differences between the down-moving illusion when the stimulation occurred inside the DPPS and the up-moving illusion with the arm standing in far position. Our data provide information about the neural mechanism that potentially modulates HBR: associative areas responsible for the illusory movement sensation might exert a top-down control on subcortical circuitry of HBR modulation.

Topic Area: PERCEPTION & ACTION: Motor control

Cortico-Cerebellar Pathways for Understanding Language Coordination

Poster C95, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Magda L. Dumitru[1], Laurens Van Calster[1], Marion Bouffier[1], Steve Majors[1]; [1]University of Liege

The cerebellum plays an essential role in both motor and cognitive aspects of human spatial navigation, contributes to sensorimotor integration, and directly affects thalamic and motor cortex activity. We investigated the role of cortico-cerebellar pathways in understanding brief language structures composed of two words linked by a coordinator ("gorilla and/or castor"). The volunteers were 22 right-handed adults scanned on a 3T Siemens Magnetom Prisma. We ran whole-brain univariate analyses using SPM12 (http://www.fil.ion.ucl.ac.uk/spm) and estimated brain responses at each voxel using GLM with event-related regressors. Group MVPA and functional connectivity analyses ran using the CONN Functional Connectivity SPM Toolbox (Whitfield-Gabrieli & Nieto-Castanon 2017) identified the cerebellum along with the middle temporal gyrus, the superior frontal gyrus, the paracingulate gyrus, and the lateral occipital cortex as key structures involved in understanding language coordination, suggesting that its mental representations are highly embodied and recruit sensorimotor structures routinely involved in concrete perception and action. We also explored differences in hemispheric contribution to understanding language coordination by calculating the average values of structure-function relationships for probabilistic cytoarchitectonic maps (the SPM Anatomy Toolbox - Eickhoff et al. 2005). The Laterality Index LI (Left - Right/Left + Right) was strongly negative for the "and>or" contrast and strongly positive for the "or>and" contrast in the same tasks.

Topic Area: PERCEPTION & ACTION: Motor control

Synesthesia and Statistical Learning: Redundant Cues Improve Segmentation

Poster C96, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Tess Allegra Forest[1], Alessandra Lichtenfeld[2], Bryan Alvarez[2], Amy Finn[1]; [1]University of Toronto, [2]University of California, Berkeley

For people with synesthesia, sensory experience in one domain is yoked to sensory experience in a second, unrelated domain. For example, hearing a certain sound might trigger the perceptual experience of seeing a specific color. As of yet, the impact of consistent, multimodal experience on automatic learning mechanisms, like statistical learning, has yet to be determined. To address the question of whether synesthetes' redundant multi-modal cues provide them an advantage in using statistical information to segment words in continuous speech, we exposed two groups of synesthetes and a group of controls to a stream of nonsense speech, and examined their ability to segment words from this stream. Results showed that grapheme-color synesthetes (for whom written or spoken graphemes trigger the experience of a particular color) show increased segmentation ability compared to controls, while sound-color synesthetes (for whom waveform properties of speech that are not consistent with statistical boundaries also trigger a color experience) did not show an increase in segmentation ability. This suggests that the improved segmentation in grapheme-color synesthetes was caused by a reliable, secondary cue to word boundaries provided by the consistent color and sound pairings they experienced during exposure. This work has implications for understanding the conditions under which statistical properties of the environment are successfully learned automatically. Particularly, they suggest that further experiments designed to illuminate the nature of statistical learning in multimodal environments will show that providing consistent multimodal cues to non-synesthetes will result in improved segmentation ability as compared to inconsistent multimodal cues.

Topic Area: PERCEPTION & ACTION: Multisensory

Changes in perceived peripersonal space following the rubber hand illusion

Poster C97, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Miranda Smit[1], Veerle Kurstjens[1], Chris Dijkerman[1], Ineke van der Ham[2], Maarten van der Smagt[1]; [1]Utrecht University, Department of Experimental Psychology, Helmholtz Institute, Utrecht, The Netherlands, [2]Department of Health, Medical, and Neuropsychology, Leiden University, the Netherlands

The peripersonal space (PPS) is the region immediately surrounding the body, and is essential for bodily protection and goal directed action. Since the PPS is anchored to one's own body, we investigated whether PPS could be modulated by changes in body ownership. The rubber hand illusion (RHI) is a way to manipulate body ownership and is induced by placing a fake hand next to one's own hidden hand and stroking them in synchrony. We hypothesized that after the RHI the perceived body midline shifted would shift to the right, suggesting a relocation in PPS from the real hand to the fake hand. Thirty-eight participants performed a landmark test before and after the RHI. Half of the participants experienced synchronous stroking, the other half experienced asynchronous stroking. In the landmark task, participants had to determine whether a landmark was left or right from the center of the screen. Each participant's data were fitted with a cumulative normal distribution function to generate estimates of the point of subjective equality (PSE). Results showed a shift in PSE, but only after synchronous stroking, which indicates that the perceived midline of the bodily space shifted to the right. Since the PPS is anchored to the body, these results suggest that the relevant action space becomes linked to the fake hand. Critically, subjective ownership did not correlate with this shift. This suggests that multisensory (e.g., visual, tactile, proprioceptive) integration of bodily information drives this shift in PPS and not experience of ownership per se.

Topic Area: PERCEPTION & ACTION: Multisensory

Everyday taxi drivers: Do gifted navigators have larger hippocampi?

Poster C98, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Steven Weisberg[1], Nora Newcombe[2], Anjan Chatterjee[1]; [1]University of Pennsylvania, [2]Temple University

Cognitive mapping – learning distance and direction relations between locations as opposed to stimulus-response associations for places – is supported by the hippocampus (O'Keefe & Nadel, 1978). Taxi drivers who undergo extensive training about the layout of and routes through London have enlarged hippocampi compared to bus drivers (Maguire, Woollett, & Spiers, 2006), presumably as a result of their training (Woollett & Maguire, 2011). But do these gross anatomical differences correlate with navigation ability in non-experts? On the one hand, individual differences in navigation ability are large in normal samples (Weisberg et al., 2014). On the other hand, experts who undergo extensive training may differ from people simply by being at the upper end of a normal distribution. We used a desktop virtual environment to assess navigation ability in undergraduate students. Participants learned names and locations of eight buildings. Learning was assessed with an onsite pointing task: participants were positioned at each of the eight buildings, then had to point at all other buildings. Structural MRI scans were collected in a separate session. We used a planned sequential analysis (Lakens, 2014), collecting 30 participants, analyzing the data, then expanding the sample by 20 participants three times (maximum N=90) if results were equivocal. After 70 participants, we find a small correlation between overall hippocampal volume and pointing accuracy, $r(70) = .20$, $p = .10$. Data collection will continue to 90, but, if this result holds, studies of experts may have exaggerated hippocampal structure-function relations to account for normal variability.

Topic Area: PERCEPTION & ACTION: Other

Fast fMRI with simultaneous EEG detects distinct thalamocortical dynamics underlying transitions in and out of sleep

Poster C99, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Laura Lewis[1,2], Jonathan Polimeni[2,3], Kawin Setsompop[2,3], Robert Stickgold[4], Giorgio Bonmassar[2,3], Bruce Rosen[2,3]; [1]Harvard University, [2]Massachusetts General Hospital, [3]Harvard Medical School, [4]Beth Israel Deaconess Medical Center

Sleep onset is a gradual process marked by changes in electrophysiological dynamics and a progressive decline in perception, consciousness, and behavior. Thalamus is a key regulator of cognition and neurophysiology in sleep, but thalamic activity cannot be measured through scalp EEG, so little is known about how dynamics in human thalamus contribute to the process of sleep onset. We aimed to track shifts in thalamocortical dynamics at high temporal resolution within the human brain during sleep onset. We developed a new approach to imaging local thalamocortical dynamics in the 0.1-1 Hz range by performing simultaneous EEG and fast (TR<400 ms) fMRI, allowing rapid imaging of local thalamic and cortical oscillations. We scanned 14 subjects with EEG-fMRI at 3 Tesla and 5 subjects at 7 Tesla during sleep. We found that declining arousal during sleep onset was marked by the appearance of slow (0.1-1 Hz) coherent thalamic and cortical fMRI dynamics. The phase of the fMRI oscillation was coupled to the spectral content of the EEG, suggesting a correspondence with oscillations in local neural excitability. In contrast, awakening was signaled by an early-onset thalamic activation and delayed cortical activation, suggesting a distinct, thalamus-mediated mechanism for arousals from sleep. We conclude that transitory shifts in the coherence of local slow thalamocortical dynamics predict moment-

to-moment arousal state. These results demonstrate that rapid changes in large-scale network function can be detected through new techniques for fast whole-brain neuroimaging, and identify distinct thalamic and cortical activity patterns that signal transitions into and out of sleep.

Topic Area: PERCEPTION & ACTION: Other

Consecutive TBS-fMRI on scene-selective cortex reveals non-specific effects in high-level visual cortex

Poster C100, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Edward Silson[1], Iris Groen[1], Chris Baker[1]; [1]Laboratory of Brain & Cognition, NIMH, NIH

Human visual cortex contains multiple category-selective regions, including scene-selective regions that respond more strongly to visual scenes than to objects or faces. It is unclear, however, how these areas causally interact as a dedicated network to support the perception of visual scenes. Here, we used consecutive TBS-fMRI to examine how causal interference with neural activity in a posterior scene-selective region, the Occipital Place Area (OPA), affected visual responses in OPA itself, as well as the downstream Parahippocampal Place Area (PPA) and Medial Place Area (MPA). Healthy volunteers were scanned in three separate counterbalanced sessions while viewing pictures of scenes, faces, buildings, and objects. Midway in each session, participants received 60 seconds of TBS (30% max output, 50Hz, 900 pulses) to either OPA, or to a face-selective region (Occipital Face Area, OFA; active control), or no stimulation via a decoy coil (non-active control). Univariate analysis of fMRI response magnitudes revealed that active TBS induced a focal reduction in activity within OPA, as well as a remote effect in anterior PPA (but not MPA) that generalized across stimulus category. Surprisingly, however, TBS to face-selective OFA induced similar reductions in fMRI responses in PPA. This lack of site specificity might reflect strong inherent connectivity with high-level cortex, possibly due to shared retinotopy. Follow-up functional connectivity analyses indeed indicated the presence of substantial background connectivity between multiple face- and scene regions. These data suggest that TBS effects on fMRI responses are localized to specific regions but not necessarily restricted to a single category-selective network.

Topic Area: PERCEPTION & ACTION: Vision

Perceptual and conceptual dimensions impacting animate items in the human ventral stream

Poster C101, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Griffin E. Koch[1], Marc N. Coutanche[1]; [1]University of Pittsburgh

The ventral stream of the human brain encodes multiple perceptual and conceptual dimensions for perceived items. Which of these dimensions impact our visual system? We report a study examining these questions of neural representations for perceived animals. We recorded brain activity during a functional Magnetic Resonance Imaging (fMRI) scan from twenty participants as they were presented with images of twelve animals. The animals were selected to vary on a number of dimensions, including taxonomic group, real-world size, and prior familiarity. We apply multivariate analysis methods, including representational similarity analysis (RSA) and machine learning classifiers, to probe the distributed patterns of neural activity evoked by these presentations. We find that an animal's taxonomic group strongly influences how their multi-voxel activity patterns are in turn affected by other dimensions, within ventral temporal cortex. Further, we find that the reliability of neural patterns varies by conceptual dimensions. For example, images of birds showed less distinctive activity patterns than items from other categories such as insects and mammals. Additionally, we find greater dissimilarity for real-world size comparisons between large and small animals, than between similarly sized animals. Furthermore, we show that patterns of activation within the ventral temporal cortex can be a reliable predictor of dimensions such as familiarity. We examine and discuss how these findings affect existing theories of animacy and the organization of the ventral stream, as well as current views of the interaction between perceptual and conceptual neural processing.

Topic Area: PERCEPTION & ACTION: Vision

A Number Signal in Early Visual Cortex

Poster C102, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Nicholas DeWind[1], Joonkoo Park[2], Marty Woldorff[3], Elizabeth Brannon[1]; [1]University of Pennsylvania, [2]University of Massachusetts Amherst, [3]Duke University

The ability to estimate the number of items in a visual array arose early in evolution, develops early in human development, and is correlated with mathematical ability later in life. For these reasons approximate number processing has been hypothesized to be a core cognitive domain and to provide a cognitive scaffold upon which symbolic representations of number develop. Previous functional imaging work with visually presented arrays indicates that the intraparietal sulcus (IPS) represents number. However, it is not clear if the number signal originates in IPS or is propagated from earlier visual areas. Previous work from our group has demonstrated a rapidly instantiated representation of number in low-level regions of visual cortex using the high temporal resolution of event-related electro-encephalography (EEG). Here, we use a rapid event-related functional magnetic resonance imaging (fMRI) paradigm and found convergent evidence for a number signal in low-level visual cortex (areas V1, V2, and V3). Employing a stringent set of stimulus controls, we demonstrate that this signal cannot be explained by the total visual area of the array, the density of the items in the array, the combined visual area of the items, the total luminance of the display, the size of individual items, the proportion of the array covered by items, nor the overall scale of the array and items. Our findings thus provide further support for the hypothesis that number is rapidly and directly encoded at the earliest stages of cortical processing.

Topic Area: PERCEPTION & ACTION: Vision

Ultra-rapid Serial Visual Presentation of Images Reveals Unconscious Perceptual Neural Signature of Memorability

Poster C103, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Yalda Mohsenzadeh[1], Aude Oliva[1], Dimitrios Pantazis[1]; [1]MIT

Not all images are treated equally within the visual system. Recent behavioral studies revealed that irrespective of subjective experiences certain images are consistently remembered whereas others are forgotten. The current study investigates this intrinsic image property, termed Memorability, by examining the neural circuitry subserving this normative memory. To capture neuronal traces of memorability, we used an RSVP paradigm (11 images presented with the speed of 34ms per picture). We collected MEG data while participants (N=15) viewed these sequences of images and performed a face detection task. Half of the trials include a random face image in the middle. When there was no face in the sequence, we embedded some specific scene images in the middle, half with high and half with low memorability scores. The distractors were randomly sampled from 150 scene images with mid-level memorability scores. After the RSVP experiment, subjects performed an unanticipated memory test on the middle scenes intermixed with a novel matching set of images. Analysis of the subsequent memory test showed that subjective memory performance was at chance level. Therefore, we isolated memorability from memory or attentional confounds. We used MEG pattern vectors at each time point to train a SVM classifier to decode each pair of scene images with a leave-one-out cross-validation procedure. MEG decoding time series were similar at early time points but high memorable scenes showed higher decoding starting at 150ms. This indicates high memorable scenes benefit from stronger initial representation in perception which results in their higher likelihood of memory encoding.

Topic Area: PERCEPTION & ACTION: Vision

tDCS-induced hemispheric asymmetry alters belief updating

Poster C104, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Nikki Marinsek[1], Michael B. Miller[1]; [1]University of California, Santa Barbara

Studies on various patient groups suggest that reasoning has a hemispheric asymmetry component. Previously, we proposed that neural networks in left frontal areas are driven toward increasing and maintaining certainty, while right frontal areas prioritize cohesion between beliefs and evidence. To test our proposal, we aimed to induce (or amplify) hemispheric asymmetry in healthy participants as they completed a probabilistic inference task. In the task, participants guessed which one of two possible U.S. states was selected based on the ethnicities of sequentially-presented residents from the selected state. Participants used a digital slider to indicate their beliefs and chose when to stop collecting evidence. Participants (N=21) completed the reasoning task before and during 20 minutes of 2mA High-Definition transcranial Direct Current Stimulation (HD-tDCS) in three separate sessions: a left hemisphere bias (LHbias) session, in which the anode was placed over the left inferior frontal gyrus (IFG; BA45) and the cathode over the right IFG, a right hemisphere bias (RHbias) session, in which the anode was placed over the right IFG and the cathode over the left IFG, and a sham session. As predicted, participants collected less evidence under LHbias stimulation than RHbias stimulation ($t=-3.48, p<0.01$) and became more certain in their beliefs early on during LHbias stimulation compared to RHbias stimulation ($t=2.56, p<0.01$). However, there were no significant differences in the Bayesian posterior estimates of the final observations, suggesting that LHbias stimulation drove participants to become certain more quickly, but did not change participants' level of certainty needed to make a final decision.

Topic Area: THINKING: Decision making

Are you thinking what I'm thinking? Theory of Mind activation in social dilemmas

Poster C105, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Justin M. Campbell[1], Nick Wan[1,2], Bradley Robinson[1], Kerry Jordan[1]; [1]Utah State University, [2]Cincinnati Reds

Theory of Mind (ToM) is the ability to anticipate and predict the actions of others. The capacity for ToM-reasoning is essential across many aspects of social cognition; it plays a crucial role in empathy (Koster-Hale, Saxe, Dungan, & Young, 2013), as well as decision-making and inhibition (Ahmed & Miller, 2011). The Chicken Game (Rapoport & Chammah, 1966) is a social dilemma used to model choices to cooperate or defect against another individual. Thus, to perform well in the game, a correct appraisal of the other player's choice is paramount. Mentalization abilities are studied in the form of choices made from the first-person ("self") perspective, and ToM-based predictions of the other player's choice within the Chicken Game. Here, electroencephalography (EEG) is used as a measure of activity and reaction time in cortical areas relevant to ToM processing (e.g., prefrontal cortex, temporoparietal junction). Both perspectives are analyzed using event-related potentials, particularly contingent negative variation (CNV); CNV activity has been associated with the expectation or anticipation of a reward (Judah, Grant, Mills, & Lechner, 2013). Past research suggests that defection choices may show greater negative variation due to their increased valence. Our results support this hypothesis, and highlight two novel findings: ToM-based predictions of other's choices were indistinct regardless of anticipated decision (i.e., cooperation vs. defection), and cooperation choices elicit the same CNV activity regardless of perspective (i.e., self vs. other). These findings challenge the assumption that identical mechanisms underlie ToM attribution of oneself and of others.

Topic Area: THINKING: Decision making

Identifying inter-relations between genetic polymorphisms and reinforcement learning: multivariate insights from behavior and computational modeling

Poster C106, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Carrisa Cocuzza[1], Jim Cavanagh[2], Michael Cole[1], Travis Baker[1]; [1]Rutgers University, [2]University of New Mexico

Background: Successful application of reinforcement learning (RL) is critical for daily decision-making. A neurocomputational theory posits that an individual's ability to learn from positive and negative reinforcement can be predicted by genetic factors related to the midbrain dopamine system. However, support for this claim remains highly controversial. The purpose of this study is to expand upon those findings and apply structural equational modeling to identify the inter-relationships between genetic factors related to striatal and prefrontal dopaminergic functioning and optimal RL in humans. Methods: Data were collected from undergraduate students in two studies and concatenated here to yield a total sample size of N=280, dramatically increasing statistical power. Single-nucleotide polymorphisms (SNPs) of interest include DRD2-957, DRD4-521, DARPP-32-rs907, and COMT, and participants' trial-to-trial training choices during a probabilistic reinforcement learning task were modeled using an algorithm (Q-learning) adapted from machine learning, which calculates separate learning rates associated with positive and negative prediction errors. Results: We identified significant bivariate differences between DRD4-allele groups on positive learning rate, and the interaction between COMT and DRD4 allele pairs significantly discriminated between positive and negative learning-rate parameters. No differences were observed for striatal dopamine SNPs. Conclusion: These findings point to a critical role for prefrontal dopamine expression in RL, which has been typically described in terms of subcortical mechanisms. Moreover, our structural equation model provided a theoretical framework for bridging the gap between genes, reinforcement learning, and psychiatric conditions, highlighting new directions into individuated and nuanced clinical assessment.

Topic Area: THINKING: Decision making

Seeing the forest or the trees? Evidence for differential information-seeking and updating in obsessive-compulsive patients and healthy controls

Poster C107, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Andra Geana[1], Christina L. Boisseau[1,2], Steven Rasmussen[1,2], Brianna Pritchett[1,2], Michael J. Frank[1]; [1]Brown University, [2]Butler Hospital

Obsessive compulsive disorder (OCD) is a highly debilitating neuropsychiatric condition, characterized by recurrent unwanted thoughts, images and impulses (obsessions) and repetitive stereotyped behaviors (compulsions). Despite its prevalence and significant impact on life, the mechanisms of OCD remain relatively undercharacterized, with mixed findings regarding the neurobiological source and degree of performance differences of OCD patients on tests of executive function, attention and learning. Building on clinical observations that OCD patients exhibit heightened sensitivity to uncertainty, we tested strategy differences in information-seeking and updating that we believe could underlie the persistence of compulsions in OCD. Specifically, we use a novel task and computational modeling to differentiate between the need to reduce uncertainty about local events (e.g., needing to check the stove repeatedly, despite sufficient evidence that it is off) versus the need to accumulate evidence from multiple sources to derive information about more global structure. In a small sample of nine patients and ten age-matched controls, we found evidence that OCD patients overvalue local information at the cost of building a less accurate world model. Moreover, this pattern was linked to differences in the update process, such as the weight of new information and the degree to which prediction error drives updating.

Topic Area: THINKING: Decision making

Integrating incomplete information with imperfect advice

Poster C108, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Natalia Vélez[1], Sajjad Torabian[1], Hyowon Gweon[1]; [1]Stanford University

Social learning—learning from others—can often help us make better-informed decisions. The present study combines behavioral, computational, and fMRI methods to examine how human learners combine their own knowledge with the knowledge hidden in other people's minds. Participants (N = 20) played a simple card game where they could choose to "stay" with a card of known value or "switch" to a card of hidden value. Participants received advice from an "advisor" whose information access varied in three within-subjects conditions: the advisor could see no cards, both cards, or only the card hidden to the participant. Behaviorally, we find that participants strategically used both the advice and their own knowledge (i.e., the known card) based on the advisor's access to information. Participants' choice behavior is well described by a Bayesian model of Theory of Mind that uses that advisor's advice and information access to infer the advisor's unobservable beliefs (i.e., the value of the hidden card). Consistent with prior work and model predictions, activity in brain regions that support both Theory of Mind (e.g., right temporoparietal junction) and reward-guided choice (e.g., dorsal anterior cingulate cortex, striatum, and frontopolar cortex) track the inferred value of the hidden card, even after accounting for the value of the visible card, the advisor's access to information, and the difficulty of the

decision. Our work provides novel insights into the neural and computational mechanisms that support learning from social information: human learners put “two heads together” by using mental-state inferences to guide value-based choice.

Topic Area: THINKING: Decision making

Everything you can imagine is real: Component processes and brain systems of imagination.

Poster C109, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Darya Zabelina[1], Jessica Andrews-Hanna[2]; [1]University of Arkansas, [2]University of Arizona

The ability to form abstract mental representations – the ability to imagine – plays an important role in a wide range of behaviors, including learning, empathy, psychopathology, and vocational training. Despite this, empirical research on imagination has historically been limited. Drawing from our previous work, this study uses neuroimaging techniques (fMRI) to examine neural basis of imagination. Participants either viewed images of faces and houses, or were asked to imagine entirely new faces and houses, not the ones they have previously seen. Results indicate that recruitment of imagination relies on the interaction between frontoparietal and default mode (DM) networks, while sustaining imagination relies on the activation in the regions of the DM network alone. Additionally we examined individual differences in the complexity of imagination, and found that people who report more complex imagination show increased activation in the frontoparietal control network regions (particularly in the pre-SMA and lateral PFC) while sustaining an imagined scene compared to people who report that their imagination is not very complex. Results are discussed in the context of existing literature on related processes, namely creative idea generation, and poetry evaluation, which are reported to similarly rely on dynamic interaction between the frontoparietal and the DM networks. Implications and future directions are discussed.

Topic Area: THINKING: Other

Increasing salience of competitors increases selective visual attention and induces more analytic problem solving

Poster C110, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Tiffani Ng[1], Mark Beeman[1]; [1]Northwestern University

Analytical problem solving requires more selective conceptual attention whereas insight solving requires less selective attention. A prior experiment demonstrated that even selecting global components of visual hierarchical stimuli increases analytic solving of verbal puzzles, putatively due to increased attentional selectivity. This experiment tested whether varying the salience of competing local stimuli, while participants responded to the global stimulus, directly modulated attentional selectivity in subsequent verbal puzzles. 44 participants completed Compound Remote Associates problems before and after a hierarchical letter task in which they assessed whether the global level was a target letter. Two groups judged equally-sized global letters comprised of either small local letters (global-salient group) or large local letters (local-salient group). Ignoring the larger and more salient task-irrelevant local stimuli should require increased selective attention, which should, in turn, increase subsequent analytic solving. Participants who judged global-salient stimuli did not reliably change their rate of insight or analytic solving following the letter task. In contrast, participants who judged local-salient stimuli solved reliably more problems analytically after the letter task than at baseline ($p<.05$), without changing insight solving. Compared to global-salient participants, local-salient participants showed reliable and consistent congruency effects (slower responses when the two levels conflicted) in two inductions (both $p<.01$), demonstrating the need to increase attentional selectivity. Thus, performing a visual task with salient and strongly competing irrelevant stimuli requires more selective visual attention and subsequently induces more analytic solving of verbal puzzles, compared to performing the same visual task with less salient irrelevant stimuli.

Topic Area: THINKING: Problem solving

Individual differences in IPS and PFC function predict fraction knowledge in children

Poster C111, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Priya B. Kalra[1], John V. Binzak[1], Yunji Park[1], Elizabeth Y. Toomarian[1], Percival G. Matthews[1], Edward M. Hubbard[1]; [1]University of Wisconsin--Madison

We have recently argued that humans have a ratio processing system (RPS) adapted to perceiving non-symbolic ratios (e.g. the ratio of two lines; Lewis, Matthews & Hubbard, 2015), that may support understanding of symbolic fractions (e.g. ¾). Consistent with this model, RPS sensitivity correlated with a pencil-and-paper measure of fractions knowledge (the Fractions Knowledge Assessment: FKA), in college students, even controlling for other skills (Matthews, Lewis & Hubbard, 2016). Here, we further test the RPS hypothesis by measuring brain-behavior correlations in 2nd and 5th grade children. Children took part in a battery of behavioral tasks, including an age-appropriate FKA and an fMRI fraction magnitude judgment task with three stimulus types: symbolic ratios, non-symbolic ratios, or mixed pairs. This task has consistently revealed a neural distance effect (NDE) localized to bilateral IPS and PFC (Binzak et al., 2017): comparison of close ratios (e.g., 5/6 vs. 4/7) leads to greater activation than comparison of far ratios (e.g., 1/8 vs 7/9). For 2nd graders, the NDE across all stimulus types was positively correlated with FKA scores in bilateral IPS (larger in the right) and right PFC. In contrast, 5th graders' FKA scores were positively correlated with the NDE only for non-symbolic ratios in a left hemisphere parieto-frontal network. Furthermore, the NDE for symbolic fractions was negatively correlated with FKA scores in bilateral IPS. These findings suggest that differences in IPS and PFC function support individual differences in fractions understanding, and that early math instruction may lead to progressive left lateralization for ratio processing.

Topic Area: THINKING: Reasoning

Collective Creativity: Exploring the Existence of Group-Level Creativity in Collaborative Teams

Poster C112, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Adam Weinberger[1], Natalie Gallagher[2], Nhi Dinh[1], Adam Green[1]; [1]Georgetown University, [2]Northwestern University

Research has generally found creativity to be a trait of which some people have more and others have less, but does the same apply to a group of people? That is, do groups display consistent levels of creativity across different creativity tasks? Prior research supports a dominant collective intelligence (CI) factor that can predict a group's performance on a battery of intelligence measures, but researchers have not yet extended this line of study to tasks with an emphasis on creative thinking. Here, we investigated whether groups of people exhibit a trait level of creativity, and examined what individual and group-level characteristics predict performance. Participants first completed individual assessments to evaluate creativity, emotional intelligence, personality traits, and level of comfort in a group setting. They were then randomly placed in three and four person teams and asked to work with their team members to complete different types of creativity tasks. Analyses were conducted to explore whether groups exhibited stable creative performance across the range of assessments. We also examined correlations between individual-level scores on personality and creativity measures with the group-level performance. Our findings represent an initial step towards improving our understanding of the mechanisms that allow teams to produce exciting and innovative ideas.

Topic Area: THINKING: Reasoning

Understanding the neural mechanism by which neurostimulation drives visual working memory: An inside view of neurostimulation decay

Poster C113, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Hector Arciniega[1], Marian Berryhill[1]; [1]University of Nevada, Reno,

Working memory (WM) permits the maintenance of information over brief delays and is an essential executive function. Unfortunately, WM performance declines with age. Some evidence indicates that pairing WM tasks with transcranial direct current stimulation (tDCS) improves WM in some participant populations after a single session. Yet, the neural mechanism(s) by which tDCS elicits these effects are poorly understood. Here, we tested two tDCS montages that we previously applied to healthy older adults, and included offline HD-EEG. We sought to clarify the neural mechanism by which different tDCS montages improved WM performance in participant subgroups. The first montage targeted right prefrontal cortex and posterior parietal sites (anode PFC-cathode PPC). Previously, this montage selectively improved WM performance in low WM capacity older participants. The second montage was right PFC alone (anode PFC – cathode contralateral cheek). Highly educated older adults showed WM benefit using this montage in previous work. Participants completed 3 counterbalanced sessions (PFC-PPC, PFC, sham; 20 minutes, 2 mA). After tDCS, participants performed a visual WM task while HD-EEG data was collected. Older adults with more education showed a tDCS-linked WM benefit after either tDCS montage compared to sham tDCS. However, the results revealed that behavioral effects dissipated quickly (~12 minutes). This made HD-EEG data analysis underpowered. We confirm that group differences are essential to consider in tDCS studies of WM. The quickly decaying effects prevented further clarification of mechanism from the HD-EEG data.

Topic Area: EXECUTIVE PROCESSES: Working memory

Suppressing lateral orbitofronto-striatal pathway improved the learning of delayed paired associative learning task in mice

Poster C114, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Cheng Qi[1,2], Hou Rui Qing[1], Chen Zhao Qin[1], Fan Hong Mei[1], T. Li Chengyu[1]; [1]Institute of Neuroscience and Key Laboratory of Primate Neurobiology, Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences, Shanghai 200031, China, [2]University of Chinese Academy of Sciences, Beijing 100049, China.

Working memory(WM) was an important cognitive function for our daily life. However, little was known about how to improve it when we were engaged in this cognitive process. To study this question, Mice were trained to learn an olfactory delayed paired associative learning task(DPAL). During the delay period mice must actively keep in mind the odor identity to successfully perform the task for water reward. By suppressing the lateral orbitofrontal(LO) cortex during delay with optogenetics, mice could learn the DPAL task better with blind designs. With extracellular recordings, we found that silencing LO could not improve the population coding ability of LO neurons for odor identity, which proposed the question about the mechanisms of the improved performance observed by suppressing LO. Based on the hypothesis of the distributed nature of working memory, we postulated that suppressing LO could works through its downstream pathways. We found that LO-striatum terminal inhibition with optogenetics mimicked the effects of the suppression of LO per se, while not the LO-vertral tegmental area, LO-perirhinal cortex and LO-secondary motor cortex axonal terminal inhibition. Our study gave some hints of the understanding of how to improve working memory, and the possible neural networks involved in this process.

Topic Area: EXECUTIVE PROCESSES: Working memory

Alpha Oscillatory Synchrony underlying Working Memory Maintenance in Children

Poster C115, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Julie Sato[1,2], Sarah Mossad[1,2], Simeon Wong[2], Benjamin Hunt[2], Benjamin Dunkley[1,2], Mary Lou Smith[1,2], Margot Taylor[1,2]; [1]The Hospital for Sick Children, [2]University of Toronto

Working Memory (WM) is a critical ability that supports a wide range of cognitive functions, and is highly associated with general intelligence and academic achievement. Although functional MRI studies have highlighted a network of regions involved in WM in adults, little is known about how these networks develop in children to support successful WM performance. Using magnetoencephalography (MEG), we examined the dynamic network structures underlying the maintenance of visual information in WM in 6-year-old children. We observed stronger and more stable connectivity in the alpha frequency band (8 to 14 Hz) during the retention interval associated with correct compared to incorrect trials. Importantly, this effect was found to be specific to the

alpha band, with no other frequency bands showing significant differences between correct and incorrect trials. This difference in connectivity may be attributed to fluctuations in attention that are necessary to sustain representations in WM. Additionally, our network analysis revealed elevated alpha synchronization during WM maintenance compared to baseline, in a distributed network of frontal, parietal, and temporal regions. Central hubs in the network were lateralized to the left hemisphere, including the middle frontal gyrus, middle temporal gyrus and superior temporal gyrus. Our results suggest that alpha inter-regional synchrony is an important mechanism for sustaining memory of visual stimuli and is already active in young children.

Topic Area: EXECUTIVE PROCESSES: Working memory

Fingolimod provides remarkable protection in Aβ-induced injury through central sphingosine-1-phosphate receptor-1

Poster C116, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Sanaz Nasoohi[1], Masoumeh Asle-Rousta[1], Zeynab Kolahdooz[1], Leila Dargahi[1], Abolhassan Ahmadiani[1]; [1]Neuroscience Research Center, Shahid Beheshti University of Medical Sciences

FTY720 (fingolimod), the sphingosine-1-phosphate (S1P) analogue, has been experimentally indicated to exert substantial ameliorating effects in animal models of Alzheimer's disease (AD). The present work aims to answer whether central S1P receptor type 1 (S1P1) plays significant role in the impact of fingolimod in AD. Aβ (2 μg/2 μl) bilateral intra-hippocampal injection was used to produce AD-like neurodegeneration in male adult wistar rats, as established by weak memory performance in morris water maze (MWM) test post Aβ infusion. After a recovery period of 24 h, animals were subjected to intraperitoneal FTY720 (1 mg/kg) treatment which led to remarkable improvement in animals' memory deficits. To verify the prominence of central FTY720 phosphorylation, the sphingosine kinase inhibitor N,N-Dimethylsphingosine (DMS; 2 μM) was administered freely moving through intracerebroventricular (i.c.v) infusion concurrent with systemic FTY720 dosing to prevent central formation of phospho-FTY720, as the established active ligand for S1PRs. The corresponding S1P1 modulation was then investigated using the pharmacological blockage of central S1P1 by daily i.c.v injections of W123 (25 μM) in a separate group of FTY720 receiving animals. Following the MWM probe trial, cerebral hippocampi were harvested immediately after animals' euthanization to prepare for COX-II and TNF-α immunoblotting. Based on our data, both DMS and W123 were efficiently capable of suppressing FTY720-ameliorating effects in AD animals, either on memory deficit or on COX-II and TNF-α expression. Our data conclude that experimental benefits of FTY720 in the context of AD depend on S1P1 modulation as well as on S1P kinase activity in the brain.

Topic Area: EXECUTIVE PROCESSES: Working memory

Are unattended memory items under cognitive control?

Poster C117, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Jacqueline Fulvio[1], Bradley Postle[1]; [1]University of Wisconsin - Madison

In two-item visual working memory, when memory is probed twice, both times preceded by a 100% predictive retrocue, a single pulse of transcranial magnetic stimulation (spTMS) influences the processing of the unattended memory item (UMI) in two ways: 1) it transiently reinstates the decodability of the UMI from the concurrently measured electroencephalogram (EEG); and 2) it increases false-alarm responses when the UMI is presented as the recognition memory probe (i.e., as a lure). We have interpreted the fact that these two effects are only observed during the first delay, and therefore only when the UMI remains potentially relevant for the trial, as evidence that the putatively activity-silent state of the UMI is under strategic control (Rose et al., 2016). However, it remains possible that the specificity of these "reactivation" effects to the first delay period is due to the fact that time-since-sample-presentation is necessarily different for the two delay periods. To address this, in the current study spTMS was delivered unpredictably to right-hemisphere intraparietal sulcus (IPS2) while subjects performed trials replicating Rose et al. (2016), plus single-delay trials (with a retrocue) that created the priority status for the UMI of second delay from Rose et al. (2016), but within the time frame of the first delay. Behavioral results revealed an elevated spTMS-related false-alarm rate only for UMI-lure probes occurring during the first delay period of two-probe trials. These results confirm that the ability to activate the UMI with spTMS depends on its priority status, not the latency from sample presentation.

Topic Area: EXECUTIVE PROCESSES: Working memory

Development of Spoken Language Comprehension in Hearing Children and Children with Cochlear Implants: Data from a Passive Listening Task

Poster C118, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Sharon Coffey-Corina[1], Kristina Backer[1], Laurie lawyer[3], Andrew Kessler[2], Lee Miller[1], David Corina[1]; [1]University of California, Davis, Center for Mind and Brain, [2]University of Washington, Seattle, WA, [3]University of Essex, U.K.

Profoundly deaf children often exhibit significant delays in spoken language development. While the use of cochlear implants (CIs) help many deaf children achieve normative language development, the neurocognitive factors that underlie success are poorly understood. We evaluated ERPs in hearing (n = 24) and deaf (n = 14) children collected during a novel passive listening paradigm. Notably, the paradigm does not require overt attention to the speech stream. We examined ERPs to open and closed class words, and nouns and verbs presented in sentential context and as a function of age and time in sound. For hearing children, a significant effect of word class was observed between 200-400msc. Open class words elicited a negative component, while closed class words elicited a positive component at ($p < .001$). Grammatical class also modulated responses, with nouns exhibiting a greater negativity than verbs from 300-600 ms ($p < .003$). These data indicate that even under passive listening conditions, young children are engaged in elaborative linguistic processing. Responses from deaf children with CIs largely mirrored these effects, but the observed waveforms showed component peaks in later time windows (open vs. closed class 300-500ms.; nouns and verbs, 500-700) with somewhat reduced amplitudes. In many respects, the waveforms of children with CIs appear to exhibit a less mature brain response, while still honoring word and grammatical class. Our data suggests that restoration of hearing ability in profoundly deaf children may permit the latent development of spoken language comprehension.

Topic Area: LANGUAGE: Development & aging

Relationships between Cortical Thickness and Reading in Typically Developing Children

Poster C119, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Gabrielle-Ann Torre[1,2], Guinevere Eden[1]; [1]Center for the Study of Learning, Georgetown University, Washington, DC, [2]Interdisciplinary Program in Neuroscience, Georgetown University, Washington, DC

It has been shown that groups with the reading disability dyslexia have differences in cortical thickness (CT) and surface area (SA) when compared to typical readers (Frye et al., 2010; Clark et al., 2014; Ma et al., 2015; Altarelli et al., 2013). However, it is unknown if CT and SA correlate with reading ability in the general population. It has been argued that dyslexia represents the lower end of the normal distribution (Shaywitz et al., 1992), whereas others have claimed that dyslexia represents a unique and qualitatively different group, i.e. more than just the lower end of the continuum (Rutter & Yule, 1975). The former suggests any relationship found between CT and SA with reading ability should extend across the entire population of all readers. To test this theory, we conducted correlation analyses (Pearson; p-level = .05, Bonferroni corrected) between CT and SA with single real word reading ability (Woodcock Johnson Word-Identification, 2001) in those regions previously shown to be different in dyslexia. Freesurfer was used to measure CT and SA in 49 typical readers (ages 15-22) from the NIH Pediatric MRI Database (Evans et al., 2006). We observed no significant correlations between CT or SA with reading in any of the nine regions of interest (using the Desikan-Killian atlas (2006)). Our results suggest that the reported CT and SA differences in dyslexia (and possibly other anatomical measures) are likely due to qualitative differences in dyslexia, and that dyslexia is not just the low-end of the reading continuum.

Topic Area: LANGUAGE: Development & aging

The Interhemispheric Relationship Between Chaos and Rigidity in Processing Global and Local Textual Information

Poster C120, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Scott Wittman[1], Shelby Smith[1], Kristin Ritchey[1], Caleb Robinson[1], April Mullen[1], Charles Jackson[1], Stephanie Simon-Dack[1]; [1]Ball State University

Both hemispheres of the brain serve different purposes in processing the meaning of language. Thus, semantic processing occurs on a cognitive continuum. A lexicon with low connectivity results in a heavy reliance on rigid, left hemispheric processing, whereas a lexicon with high connectivity results in a heavy reliance on chaotic, right hemispheric processing (Faust & Kennett, 2014). Semantically, humans need to be able to adjust their level of processing so as not to inhibit understanding of creative language (i.e., chaos) or conventional language (i.e., rigidity). The current study was designed to examine hemispheric contributions toward rigid semantic processing with respect to global and local processing and the role of interhemispheric transfer. For the current study, 47 participants completed a lateralized hierarchical letters task and a global lexical decision task in which participants read a target sentence followed by five unrelated filler sentences and a subsequently presented congruently or incongruently related word. Results demonstrated a correlation between reaction time identifying local features from congruent hierarchical letters presented in the left visual field and reaction time to reading words incongruent with the target sentence, $r(47) = .35$, $p < .02$. We speculate that our results are related to interhemispheric transfer, in that individuals whom rely more heavily on right hemispheric, or chaotic, semantic processing take longer to transfer information to the left hemisphere for further conventional processing.

Topic Area: LANGUAGE: Lexicon

Predictive entrainment of natural speech through two frontomotor top-down channels

Poster C121, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Hyojin Park[1,2], Robin, A.A. Ince[1], Gregor Thut[1], Joachim Gross[1,3]; [1]Institute of Neuroscience and Psychology, University of Glasgow, Glasgow, United Kingdom, [2]School of Psychology, University of Birmingham, Birmingham, United Kingdom, [3]Institute for Biomagnetism and Biosignalanalysis, University of Munster, Munster, Germany

Natural communication between interlocutors are enabled by the ability to predict upcoming speech inputs at a given context. In our previous studies, we showed that low-frequency brain oscillations in delta and theta bands in auditory and temporal areas track external auditory speech envelope when speech is intelligible compared to when it is not, and this mechanism was modulated by the same frequency activity in inferior frontal and motor cortices by top-down manner. However, the direct relationship between these frontal top-down signals and speech inputs still remains to be understood, particularly its temporal aspect of when these top-down signals predict upcoming speech streams that is to be received by primary sensory cortex. We obtained MEG data while participants were listening to intelligible and unintelligible continuous speech. By applying transfer entropy analysis, we identified low-frequency delta/theta (<7 Hz) phase information in left inferior frontal cortex predicts the same frequency phase information of upcoming speech signal with a time lag of 200-250 ms when speech is intelligible. Furthermore, beta (19-30 Hz) power in left supplementary motor area and superior/middle frontal cortex predicts delta/theta phase information of upcoming speech signal with the same time lag (200-250 ms). Interestingly, this temporal characteristic matches a typical turn-taking gap in natural human communication in which its temporal property represents one of important aspects of predictive comprehension of speech. This study identifies that top-down modulation from frontomotor areas is temporally structured at predicting upcoming streams of intelligible speech and this mechanism is implemented through two different frequency channels.

Topic Area: LANGUAGE: Other

Brain responses to morphologically complex words: an electrophysiological study on Swedish past tense forms

Poster C122, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Andrea Schremm[1], Mikael Novén[1], Merle Horne[1], Mikael Roll[1]; [1]Lund University, Sweden

Dual system models postulate two distinct neural mechanisms for the processing of inflected words: irregular forms (e.g. 'went') are assumed to be directly accessed as whole word representations, whereas regularly inflected items (e.g. 'played') might undergo rule-based decomposition (Pinker & Ullman, 2002). Irregular verb stems incorrectly carrying a regular inflectional suffix have been reported to elicit a left anterior negativity (LAN), commonly interpreted as indexing violation of morphosyntactic regularities, and thus indicating rule application associated with the regular inflection (e.g. Penke et al., 1997). In the first electrophysiological study on Swedish regular/irregular verb morphology, we recorded brain responses to correct versus incorrect past tense verbs visually presented in sentences. Irregular verb stems incorrectly inflected with the regular suffix generated an increased left-lateralized negativity, interpreted as a LAN for misapplication of the morphological inflection rule. No negativity was observed for regular verb stems incorrectly containing a stem vowel change on analogy to irregular verb patterns. These findings are in line with previous results suggesting that a rule-based processing route is available for regularly inflected items. Alternatively, the observed waveforms might be interpreted in terms of a decreased negativity for correct irregular verbs. Such verbs would then be directly accessed in the lexicon while the other conditions would involve morphological analysis, eliciting increased left-lateralized negativities, including incorrect regular verbs where rule-based processing might have been triggered by regularities in the stem vowel change. From this perspective, LAN might signal morphological rule application instead of detection of rule violation (Krott & Lebib, 2013).

Topic Area: LANGUAGE: Other

Emotional prosody modulates neural sensitivity to speech discrimination

Poster C123, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Yang Zhang[1], Chieh Kao[1], Erin Diamond[2]; [1]University of Minnesota, [2]North Memorial Health Care

Our recent cross-modal priming study on cortical mechanisms of speech processing revealed distinct patterns of hemispheric laterality and neural oscillation for the N400 and late positive response during phonetic vs. emotional congruency judgment. The present event-related potential (ERP) investigation employed a passive listening multi-feature oddball paradigm to examine whether phonetic processing interacted with emotional processing at an earlier stage independent of attention. The participants were 24 normal adults. The syllable /bab/ spoken in a neutral tone served as the standard for the oddball paradigm, and the five deviants were respectively /bab/ in a happy or sad tone and /gab/ in a neutral, happy or sad tone. For the three deviants with either phonetic or prosodic contrast, the phonetic contrast produced a robust mismatch negativity (MMN) response at approximately 300 ms, the sad tone elicited a MMN with similar latency, and the happy tone showed an earlier positive mismatch response followed by a negative response. For the two deviants with dual contrasts, both showed a much earlier MMN response (prior to 150 ms) and a late negativity (after 400 ms). These ERP data provide converging evidence that emotional prosody interacts with phonetic processing both at the early pre-attentive level and at later processing stages. Furthermore, neural sensitivity to speech discrimination can be modulated by variations in emotional prosody.

Topic Area: LANGUAGE: Other

Improved diffusion Magnetic Resonance Imaging reconstruction of the Arcuate Fasciculus

Poster C124, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Elise B. Barbeau[1,2,3], Kaija Sander[1,2,3], Shanna Kousaie[1,3], Thomas Liontis[3], Denise Klein[1,2,3], Michael Petrides[1,2,4]; [1]Cognitive Neuroscience Unit, Montreal Neurological Institute, McGill University, [2]Department of Neurology and Neurosurgery, McGill University, [3]Center for Research on Brain, Language and Music (CRBLM), Montreal, [4]Department of Psychology, McGill University

The Arcuate Fasciculus (AF) is a white matter tract connecting the posterior temporal region involved in the comprehension of language with the inferior frontal gyrus (Broca's region). Several studies have used diffusion Magnetic Resonance Imaging (MRI) data to reconstruct the AF using a method proposed by Catani et al (2005). In the present study, we aimed to improve the reconstruction of the AF which must be distinguished from the Superior Longitudinal Fasciculus (SLF) originating from the inferior parietal lobule and coursing parallel to the AF and, also, from temporo-occipital fibers and fibers originating in the anterior temporal lobe. This reconstruction was carried out in 50 right-handed healthy volunteers (mean age 23.9 yrs, range 18-34) who had been scanned with MRI (diffusion and anatomical) and who performed language behavioral tests. The diffusion MRI images were preprocessed using FSL and the AF was reconstructed with Diffusion Toolkit and Trackvis using Regions of Interests (ROIs) drawn on the diffusion and coregistered anatomical scans. The basic ROIs were comparable to those in the Catani AF long segment reconstruction, but we used exclusion ROIs to isolate fibers from the posterior temporal lobe from those originating in more anterior temporal areas, the temporo-occipital fibers, and those ending in the inferior parietal lobule and which belong to the SLF. The AF was successfully reconstructed in all participants by two independent raters. In line with Thiebaut de Schotten et al (2014), there was a correlation between the structural properties of the AF and speed of reading paragraphs aloud.

Topic Area: LANGUAGE: Other

Indirect impact of a foreign accent on cognitive processes with no spoken language.

Poster C125, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Alice Foucart[1], Hernando Santamaría-García[2,3,4], Robert Hartsuiker[1]; [1]Ghent University, Belgium, [2]Pontificia Universidad Javeriana, Colombia, [3]Instituto de Neurociencia Cognitiva y Traslacional, Argentina, [4]Centro de memoria y cognición intellectus hospital san Ignacio, Argentina

When a sentence like ‘Ants don’t sleep’ should be assessed as equally true (or false) independently of the speaker’s accent, it does not seem to be the case (Lev-Ari & Keysar, 2010). Using ERPs and pupillometry, we investigated the indirect impact of a foreign accent on cognitive processes that do not involve spoken language (sentence processing, credibility, memory and the visual perception of the speaker). To avoid interaction between accent and social status, prior to data collection, the social status of native and non-native speakers was set by means of a 2-minute video (the only time accent was heard in the whole experiment) and a visual discrimination game. In subsequent tasks, automatic responses associated to the high-status foreign-accented speaker consistently fell in-between those associated to the high-status native speaker and the low-status native speaker. For instance, sentences containing unknown information (i.e., when participants had to rely on the speaker’s knowledge) triggered different N400 amplitudes depending on the speakers. The results suggest that, despite having an equivalent social status, foreign-accented speakers seem to be considered inferior to native speakers. They also show that cognitive processes are affected by social status. Our findings are the demonstration of the indirect impact of the negative bias towards foreign-accented speakers previously observed with behavioural methods. The awareness of this bias is crucial to avoid daily discrimination in our multilingual society.

Topic Area: LANGUAGE: Other

Convergence of speech-print networks as a marker of language learning

Poster C126, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Pedro M. Paz-Alonso[1], Kshipra Gurunandan[1], Manuel Carreiras[1,2]; [1]BCBL. Basque Center on Cognition, Brain and Language, [2]Ikerbasque. Basque Foundation for Science

Learning a new language offers an excellent window to study neural plasticity. Developmental research, studies with adults learning a new language and studies on literacy acquisition have revealed functional and structural changes in the language areas of the brain. Standard literate monolingual adults typically exhibit well-integrated and highly convergent speech and reading networks. This overlap between networks is thought to be universal, being found across highly contrastive languages. However, it is not clear yet to what extent the convergence between speech and print networks differs in a new learned language. The present study was aimed at investigating the relation between speech and reading networks in adults who are at different stages of acquiring a new language. Thirty-four adult native speakers of Spanish, either at the intermediate or advanced learning levels of Basque, underwent functional MRI scanning while performing an animacy judgment task for speech and print stimuli in their native (L1) and second language (L2). Regional patterns of activation in the left inferior frontal gyrus (IFG) and left ventro-occipito-temporal cortex revealed group by language interactions. Within group differences in the speech-print overlap between L1 and L2 emerged, as well as a

between groups difference showing a larger speech-print overlap on semantic and phonological regions (IFG, inferior parietal cortex, lateral temporal cortex) in the L2 advanced versus L2 intermediate learning level groups. Our results suggest that the speech-print networks convergence is modulated by the learning level and it is an indicator of the level of mastering a new language.

Topic Area: LANGUAGE: Semantic

Instantiating new objects into the discourse: the role of hippocampus and prefrontal cortex

Poster C127, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Zachary Ekves[1,2], Pedro Paz-Alonso[3], Nicholas Hindy[4], Sarah Solomon[5], Gerry Altmann[1,2]; [1]University of Connecticut, [2]Connecticut Institute for the Brain and Cognitive Sciences, [3]Basque Center on Cognition, Brain, and Language, [4]University of Louisville, [5]University of Pennsylvania

We explore the potentially joint roles in language comprehension of the hippocampus – critical to encoding situation-specific episodic detail, and of left inferior frontal gyrus (LIFG) – critical for selection and inhibition. We analyzed functional connectivity in two prior fMRI studies (Hindy et al., 2012; Solomon et al., 2015). The first used sentences such as "John will chop the onion. And then he will weigh THE/ANOTHER onion" – these sentences manipulate whether the same token or a new token of the same type is referred to subsequently. We found increased connectivity between hippocampus and LIFG when instantiating a new token ("…ANOTHER onion"). This increased connectivity may reflect selection of canonical features associated with the new token, or inhibition of episodic features of the original token (i.e. the feature set in discourse focus), or both. To tease these possibilities apart we contrasted "John will chop the onion. AND THEN/BUT FIRST he will weigh the onion." If the previously observed increase in connectivity between hippocampus and LIFG was due to suppression of the prior episodic feature-set, we should see this also in this 2nd dataset, where "but first" also requires such suppression. In fact, no difference was observed in connectivity between hippocampus and LIFG. We conclude that the increased connectivity observed between hippocampus and LIFG in the 1st study was due to selection of canonical features associated with the introduction of new tokens into the discourse and was not due to suppression of the episodic feature set in the current discourse focus.

Topic Area: LANGUAGE: Semantic

Context modulates figurative language deficits

Poster C128, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Madhushree Chakrabarty[1], Eileen Cardillo[1], Anjan Chatterjee[1]; [1]University of Pennsylvania

Context critically guides language comprehension. For figurative language, context can increase the salience of non-literal interpretations and decrease the cognitive effort needed to derive them. In everyday use, figurative expressions are almost always embedded in a narrative context, be it a story, article or conversation. However, most studies on figurative language use minimal contexts like word pairs or individual decontextualized sentences. Moreover, some types of figurative language may rely on context more than others to be understood. Our goal was to test 1) whether comprehension deficits in patients with metaphor impairments are improved with context, and 2) whether metaphor impairments are dissociable from deficits in another form of figurative language – irony. To address these questions, we developed short vignettes and comprehension questions for four different conditions (literal, metaphor, simple irony and metaphorical irony) that were matched across conditions in accuracy and response times among control participants. Four focal lesion patients with metaphor deficits of different types and severity based on a single sentence comprehension task, showed distinct patterns when tested with vignettes. A patient with a mild impairment now showed none. Two patients with robust, selective deficits in metaphor comprehension responded oppositely: one patient's comprehension was no longer impaired, while the other's worsened. The fourth patient's pattern of impairment remained unchanged. No patients demonstrated impaired simple irony comprehension, but two showed impaired understanding of metaphorical-ironies. We conclude that metaphor and irony impairments are dissociable, and patients vary in whether they benefit from context.

Topic Area: LANGUAGE: Semantic

Discrimination and Prediction of Concreteness from Neuroimaging and Corpus Data

Poster C129, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Dominick DiMercurio[1], Chaleece Sandberg[1]; [1]Pennsylvania State University

The mechanisms underlying the semantic system remain a mystery in cognitive neuroscience. Particularly, concreteness is a remarkable phenomenon in semantics due to suggestions from previous literature that abstract and concrete words might be represented distinctly in the brain. Methods in neuroimaging, behavior, and corpora can be employed to probe concreteness and related effects; specifically, discrimination and prediction techniques with machine learning are rapidly emerging for doing so. The present study utilized neuroimaging data from participants who performed a concreteness judgment task while undergoing fMRI. The neuroimaging data, in conjunction with document or dependency corpus data in the form of word-specific semantic vectors, were analyzed with support vector machines (SVMs) and semantic space models (SSMs) to determine: i.) the performance of word type discrimination between neuroimaging and corpus data, and ii.) whether an interaction between type of semantic vectors and type of word exists to support the hypothesis of distinct representations. The performance of SVMs trained with neuroimaging data exceeds that of SVMs trained with corpus data; meanwhile, the comparison of SSMs defined with either documents or dependencies failed to reproduce better-than-chance performance with the neuroimaging data. The latter limits any conclusion that can be made regarding the existence of distinct representations for abstract and concrete words. These findings highlight the challenges in using corpus data to discriminate concreteness and the importance of task selection for the creation of reliable semantic space models. Future research will investigate how to improve these techniques and how to incorporate real or simulated clinical data.

Topic Area: LANGUAGE: Semantic

Top-down prediction and semantic facilitation in schizophrenia

Poster C130, Sunday, March 25, 1:00-3:00 pm, Exhibit Hall C

Victoria Sharpe[1], Ellen Lau[2], Nate Delaney-Busch[1], Kirsten Weber[3], Lin Wang[1], Gina Kuperberg[1,4]; [1]Tufts University, [2]University of Maryland, [3]Max Planck Institute for Psycholinguistics, [4]Massachussetts General Hospital

It is well established that schizophrenia is characterized by impairments in controlled semantic processing. Here, we used ERPs together with a relatedness proportion semantic priming paradigm to ask whether people with schizophrenia show specific impairments in top-down predictive semantic mechanisms. We covertly varied the proportion of semantically related prime-target pairs across two blocks, thereby manipulating the probability of encountering the same set of targets following the same set of primes. Replicating previous findings, control participants showed a significantly larger N400 semantic priming effect in the blocks with a higher (versus lower) proportion of related prime-target pairs. This suggests that they adapted to the higher predictive validity of the broader contextual environment by enhancing top-down semantic prediction. In contrast, people with schizophrenia showed no difference in the N400 priming effect between the higher and lower predictive validity blocks. This suggests that patients were unable to use the prime to predictively pre-activate the target, even under conditions of high predictive validity. In a previous ERP study carried out in young healthy adults using the same paradigm, we used a single trial approach to showed that trial-by-trial adaptation across the higher predictive validity block could be explained by a model of rational (Bayesian) updating. In the present study, we aim to use a similar approach to test whether, in schizophrenia, reduced semantic prediction results from a slower rate of trial-by-trial adaptation in comparison to controls, or from a failure to rationally adapt altogether.

Topic Area: LANGUAGE: Semantic

Acoustic Effects on Oscillatory Markers of Sustained Attention

Poster D1, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Psyche Loui[1], Emily Przysinda[1], Gonçalo Sampaio[1], Tedra James[1], Adam Hewett[2], Benjamin Morillon[3], Kevin Woods[4]; [1]Wesleyan University, [2]Transparent Corp, [3]Aix Marseille University, [4]Massachusetts Institute of Technology

Entrainment of neural oscillations is proposed to underlie sustained attention, which is required for the successful performance of everyday cognitive tasks. The ability to alter attention by modifying oscillatory neuronal activity has been demonstrated recently, but remains limited thus far to systems that rely on knowledge of brain state (i.e., neural recordings) or noninvasive brain stimulation. The auditory neuroscience startup company, Brain.fm, purports to enhance attention via acoustic stimulation designed to entrain neural activity. Here, we test the hypothesis that acoustic stimulation could affect performance on a sustained attention task. We recorded EEG from human subjects (N = 45) while they completed the Sustained Attention to Response Task. During the task, subjects listened to Brain.fm or one of three control conditions (silence, pink noise, or music from Spotify). Behavioral results showed that the slope of coefficients of variation in reaction time (RTCV_slope), an index of failures of sustained attention, was lowest during the Brain.fm condition. EEG showed strong SSEPs at the task frequency (0.91 Hz) and its harmonics, as well as localized (left-motor) increases in the beta range in the Brain.fm condition only. We further separated the subjects into Effective (n = 19) vs. Ineffective (n = 26) users based on their RTCV_slope. Effective users showed the strongest beta enhancement as well as higher SSEPs at harmonics of the task frequency, suggesting higher entrainment to the task. Results suggest that purpose-built acoustic stimulation can support the neuronal oscillations underlying sustained attention, thus boosting a listener's productivity and well-being.

Topic Area: ATTENTION: Auditory

Decoding natural continuous speech in native and non-native brain

Poster D2, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Shweta Soni[1], Matthew S Tata[1]; [1]Centre for Canadian Behavioural Neuroscience, University of Lethbridge, Alberta

Identifying the boundaries of speech events such as syllables, phonemes and words is crucial in order to comprehend speech and might be affected by the differential familiarity with spoken languages. Here, we attempt to investigate 1) how differently speech features are encoded in native and non-native English speakers during continuous speech perception, and 2) can the predictability of these speech features be gained over successive presentations of the same speech segment. In this study, non-native late learners of English were compared with native-English speaking Canadians. We found that non-native speakers showed significant differences in behavioral performance as compared to natives along with improvement in performance as a function of repetition of the speech sample. Furthermore, the mapping between different features of speech stimuli and neural responses was modeled using linear regression and then these models were examined on their ability to predict EEG data as well as stimulus (e.g., envelope). We found that non-natives were poor on reconstructing speech envelopes and encoding low-level spectrotemporal features than natives but improved over successive speech presentations. We suggest that the brain’s mechanisms of interpreting linguistic information might depend on familiarity with the deep structure of a language. We will also discuss the role of higher-level processes like phonetic feature processing in speech perception.

Topic Area: ATTENTION: Auditory

Hemispheric asymmetries in behavioral and EEG measures of visual short-term memory change with aging

Poster D3, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Iris Wiegand[1,2,3], Patrizia Maier[2], Natan Napiórkowski[4], Kathrin Finke[4,5], Thomas Töllner[4], Hermann J Müller[4], Myriam C Sander[2]; [1]Harvard University, [2]Max Planck Institute for Human Development, [3]Max Planck UCL Centre for Computational Psychiatry and Ageing Research, [4]LMU Munich, [5]Jena University Hospital

Changes in hemispheric asymmetry play a prominent role in theories of cognitive aging, however, the generalizability and functional implications of the age-related changes are not always clear. Here, we investigated age and task-specific differences in visual

short-term memory (vSTM) in two samples of younger adults (YA) and older adults (OA), measuring "K" and the contralateral delay activity (CDA) as behavioral and neurophysiological markers of VSTM capacity, respectively. The first sample performed a visuo-spatial change-detection task with colored squares. In this task, both age groups showed a higher CDA amplitude for stimuli processed in the right hemisphere, but only YA also showed a corresponding behavioral performance benefit. This finding is in accordance with a right-hemispheric dominance for visuo-spatial attention and indicative of an age-related reduction in the behavioral manifestation of this asymmetry. The second sample performed a whole report task with letter stimuli. In this task both age groups showed a behavioral performance benefit for stimuli processed in the left hemisphere, in accordance with a left-hemispheric dominance for processing verbal information. Notably, the behavioral effect was more pronounced in OA, and only OA also showed a trend to a left-hemispheric lateralization of the CDA. Together, our results indicate that lateralized processing of visuo-spatial content in vSTM is affected by aging, while lateralized processing of verbal content is spared. In contrast to a general hemispheric asymmetry reduction in age, our findings support the assumption of pronounced age-related decline in the right hemisphere pre-dominantly involved in visuo-spatial attention.

Topic Area: ATTENTION: Development & aging

The neural dynamics underlying unconstrained visuo-spatial and auditory mental imagery

Poster D4, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Lizzy Blundon[1], Yana Pertels[1], Lawrence Ward[1,2]; [1]University of British Columbia, [2]Brain Research Centre

The purpose of this study was to investigate the neural dynamics underlying unconstrained mental imagery. We adapted for EEG an fMRI imagery paradigm frequently used to assess awareness in behaviourally unresponsive patients diagnosed with a Disorder of Consciousness (DOC). Neuro-typical participants were asked to alternately imagine themselves walking from room to room in their own home (visuo-spatial imagery) and to imagine themselves singing happy birthday (auditory imagery). Using independent component analysis and single dipole fitting, we inferred dominant neural generators of the EEG signal for each imagery task, including motor, temporal, frontal, and visual regions. Notably, a single dipole was localized to Right Posterior Parietal Cortex (RPPC) and Left Ventromedial Prefrontal Cortex (LVMPFC) in at least 90% of participants, suggesting that these regions represent stable neural generators of mental imagery across participants. Because imagery tasks were unconstrained (unguided), individual differences in local spectral power at, and in functional connectivity between, ROIs prevented meaningful group-level analyses. Individual participant differentiability between imagery tasks based on local spectral power across seven ROIs and four frequency bands, however, was easily demonstrable, particularly in theta and gamma frequency bands. We also found a significant correlation between differentiability in functional connectivity (phase locking value) between RPPC and LVMPFC and overall differentiability in functional connectivity between conditions in the gamma frequency band. We also discuss possible adaptations of this study design and differentiability index to the development of a method of detecting awareness in behaviourally unresponsive (DOC) patients.

Topic Area: ATTENTION: Multisensory

Differential effects of phasic and tonic alerting on conflict resolution. Evidence from human electrophysiology.

Poster D5, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Dariusz Asanowicz[1], Mikołaj Compa[1]; [1]Jagiellonian University in Kraków, Poland

The time course of attentional alerting can be differentiated in two phases: a quick and automatic initial phasic alerting, and slower, more strategic tonic alerting. Recently, in a series of behavioral flanker task experiments, we have demonstrated that phasic and tonic alerting (induced by accessory cues with short and long SOA) have distinct effects on conflict resolution. Phasic alerting decreased the efficiency of conflict resolution both in time and accuracy of responses, whereas tonic alerting increased the accuracy of conflict resolution, but at a cost in speed of processing the conflict (Asanowicz & Marzecová, 2017, Acta Psychol). In

the present study, we recorded event-related EEG potentials to examine the brain mechanisms of these effects. Thirty-two participants performed an arrow flanker task with auditory alerting cues preceding target arrows with short (100 ms) or long (800 ms) SOA. We utilized N2pc components as indices of stimulus selection, LRP components as indices of response conflict, and frontal N2/P2 and P3b components as indices of control processes. Both behavioral and ERP results showed differential effects of phasic and tonic alerting on conflict resolution. The ERP results revealed that the alerting effects had different temporal dynamics, and affected stimulus processing and response conflict resolution at different stages of these processes. Presumably, as it has been previously suggested, phasic alerting inhibits executive control and redirects the allocation of attentional resources to facilitate responding to external events, whereas tonic alerting allows to endogenously increase readiness to process expected stimuli and thereby better response preparation.

Topic Area: ATTENTION: Nonspatial

Comparing objective and subjective measures of inattention that predict forgetting

Poster D6, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Cassandra Collins[1], McKinzey Torrance[1], Barry Eom[1], David DiStefano[1], Elizabeth Race[1]; [1]Tufts University

Fluctuations in attention can impact whether information is encoded into memory. However, it is currently unclear whether different behavioral and neural measures of inattention accurately predict forgetting (deBettencourt et al., 2017; Maillet & Schacter, 2016). The current study investigated whether different subjective and objective measures of inattention predict subsequent memory, and the degree to which these measures are modulated by individual differences in (a) trait levels of inattention (i.e., propensity to mind wander) and (b) electrophysiological trait markers of central nervous system function (individual alpha frequency; IAF). Participants performed an incidental encoding task and were periodically cued to self-report their subjective attentional state. Trait levels of inattention were measured by a battery of questionnaires and IAF was calculated from a resting-state EEG block. Subjective measures of inattention (off-task reports during memory encoding) positively correlated with trait levels of inattention across individuals, but did not correlate with IAF or predict forgetting on a subsequent memory test. In contrast, objective measures of inattention (response omissions, mean RT) did not correlate with trait levels of inattention, but did negatively correlate with IAF across participants. Objective measures of inattention also predicted forgetting, but only across participants and not for individual items within subjects. These results link objective measures of inattention to endogenous alpha oscillations and indicate that objective measures of inattention may be a stronger predictor of later forgetting than subjective measures across individuals. However, more sensitive neural, rather than behavioral, measures may better capture moment-to-moment fluctuations in attention that impair encoding.

Topic Area: ATTENTION: Other

The effect of cognitive load on conscious access to visual sensory inputs across tasks of varying precision

Poster D7, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Moriah Stendel[1], Mathieu Landry[1], David Milton[1], Amir Raz[1,2]; [1]McGill University, [2]Lady Davis Research Institute, Jewish General Hospital

Our conscious experience appears to be ineffably rich, yet certain paradigms consistently defy this intuition. This debate permeates the field of consciousness literature, with ample empirical support for both sides. Given that most evidence against a rich theory of consciousness is rooted in the notion that attention is requisite for conscious experience, the present study aims to examine how a cognitive load affects the richness of consciousness at both a cognitive and metacognitive level. Our study employs a modified Sperling task in tandem with a cognitive load; participants report on colours that appear in brief presentation while either remembering a string of characters (high- load condition) or not (no-load condition). We repeated this design across three tasks that capture conscious experience along a spectrum of sensitivity, from high precision responses to lower grain responses. Mixed linear models reveal that a cognitive load affects the quality of mental representations and not just access mechanisms. While our findings imply that a cognitive load impairs the richness of conscious perception in tasks that require goal-driven attention, rich

conscious experience is preserved in less precise, gist-based tasks, regardless of cognitive load. Metacognition appears to track the quality of the representation, as it is not impaired by the cognitive load. This suggests the existence of a phenomenal conscious experience that is available to gist and metacognitive reports, but that first-order reports with high spatial precision rest on attentional mechanisms.

Topic Area: ATTENTION: Other

Testing the Assumptions of the Thought Probe Method in Mind Wandering

Poster D8, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Jennifer Yip[1], Julia Kam[2], Todd Handy[1]; [1]University of British Columbia, [2]University of California - Berkeley

A common approach to studying the phenomenon of mind wandering involves experience sampling, where study participants are stopped at random intervals during task performance and asked to report whether or not they were just paying attention to the task at hand. Critically, an untested assumption of this paradigm is that after such experience sampling thought probes, participants' attentional states "reset" to a baseline state, such that the post-thought probe state is independent of recent attentional history. Our study re-analyzed a pre-existing event-related potential (ERP) dataset to test the validity of this assumption. Participants viewed images of peoples' hands in various contexts, some of which were in painful situations (e.g., getting a locker door shut on them) or neutral situations (e.g., next to a locker door). Participants then judged whether each image was painful or neutral as researchers recorded ERPs generated by the images. We expect painful images from the previous study to produce a greater P300 mean amplitude compared to neutral images, and the depth of cognitive analysis after a thought probe to be the same regardless of attentional state. Results showed that main effects of both attention and image type were significant between 300 to 500ms post-stimulus ($p < .05$), but only the main effect of image type was significant for 500 to 700ms post-stimulus ($p < .01$). The interaction between attention and image type for both time windows were not significant ($p > .31$). Overall, results suggest that previous attention state indeed does not influence subsequent attention states.

Topic Area: ATTENTION: Other

Alpha Power and 1/f Slope Provide Independent Decoding of Visual Spatial Attention

Poster D9, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Thomas Donoghue[1], Bradley Voytek[1]; [1]University of California, San Diego (UCSD)

The focus of visual spatial attention has previously been demonstrated to be predictable from the topography of posterior alpha oscillations (~8-12 Hz). Here we extend these findings by exploring how individual variation in alpha oscillations, as well as background 1/f activity relate to attentional focus. In the first experiment (n=15), participants completed a peripheral visual detection task with concurrent electroencephalography, in which pre-trial cues indicated which of two possible locations participants should attend (left or right). Examining the time period between cue onset and stimulus presentation, we replicate that the topography of posterior alpha oscillations is predictive of attentional focus, using a support vector machine (SVM) classifier. We demonstrate that predictions can be improved by taking the oscillation-specific power at subject-defined peak frequencies, and that 1/f background activity, as measured by the slope of the power spectral density, is also predictive of attentional focus, with the best decoding using a combination of alpha and slope features. In a second experiment (n=14), a variant of the detection task was used with four peripheral locations that could be cued with varying degrees of spatial specificity. Here we replicate that alpha and slope predict the spatial focus of covert attention, across multiple locations, and find that these physiological parameters additionally predict the spatial extent of attentional allocation. Collectively, these experiments expand upon prior work on how alpha oscillations relate to attention and demonstrate how 1/f slope adds additional information to the decoding of both the locus and extent of covert visual attention.

Topic Area: ATTENTION: Spatial

Truly Independent! Typologies of Attention at Different Levels of Processing

Poster D10, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Mathieu Landry[1], Jason Da Silva Castanheira[1], Amir Raz[1,2]; [1]McGill University, [2]Chapman University

The marriage of attention and consciousness sports a complex relationship. Whereas some findings emphasize the limitations of conscious perception for unattended events, other data intimate orthogonal effects—proposing independence. This conundrum has shaped prevailing views concerning the role of attention in higher-order cognition. An overarching caveat to this body of work revolves around the construction of attention as a unitary, monolithic process; however, different typologies of attention exist. For example, orienting of attention can occur in a stimulus-driven or goal-driven manner – two independent modes of orienting. And yet, few studies have explored the dynamics of these attention systems during higher-order processing. Here we combined a double cueing procedure alongside a target discrimination task with a backward masking strategy to test the independence of stimulus-driven and goal-driven attention systems across different levels of processing, including conscious perception and metacognition. Participants provided an objective response and made a subjective judgment for each trial. Confirming that both attention systems operate independently from one another across several layers of processing, our results show additive patterns across both objective and subjective responses. Moreover, our results also show that goal-driven attention improves ideomotor precision—as indexed by smaller variance for response time distribution—whereas stimulus-driven attention does not. These findings support the notion that both attention systems independently contribute to the processing of information, from low-level sensory processing to the emergence of higher-order cognition.

Topic Area: ATTENTION: Spatial

Age-related changes of interoception, insula cortex, and emotional sensitivity

Poster D11, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Yuri Terasawa[1], Satoshi Umeda[1]; [1]Department of Psychology, Keio University

Interoceptive accuracy is defined as the accuracy for detecting internal bodily sensations. The accuracy relates sensitivity to the emotions of self and others. Although a previous study reported that the accuracy declines with age, it is still unclear whether the declination associates with changes in emotional experience along with aging. In this study, thirty five older adults participated (mean 59.7 years ±6.1). 17 out of 35 participants were involved in an MRI study. 30 undergraduate and graduate students also participated as younger adults. When compared performance of the heartbeat perception task and the emotional sensitivity task between younger and older adult groups, the older group showed significantly lower interoceptive accuracy. Participants who showed higher interoceptive accuracy showed lower ability for detecting emotions from subtle facial expressions of emotion. Interestingly, adverse relationship was observed in younger group. In older group, we conducted Voxel Based Morphometry (VBM) analysis to examine the neural correlates supporting the relationship between interoceptive accuracy and emotional sensitivity. Insula cortex was set as the Region of Interest and negative correlations were observed between sensitivity to anger expression and gray matter volume of bilateral insula cortex after controlling for age. Our findings suggest to consider the change in interoceptive accuracy based on insular degeneration for understanding effects of aging on emotional experience.

Topic Area: EMOTION & SOCIAL: Development & aging

Brain activity and network interactions in the impact of internal emotional distraction: A multi-modal brain imaging investigation

Poster D12, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Florin Dolcos[1], Alexandru Iordan[2], Matthew Moore[1], Yuta Katsumi[1], Sanda Dolcos[1]; [1]University of Illinois at Urbana-Champaign, [2]University of Michigan

Despite a growing body of work investigating emotional distraction from external sources (i.e., the outside world), less is known about the neuro-behavioral mechanisms associated with the impact of emotional distraction coming from internal sources (i.e., our mind), and those involved in coping with such distraction. Particularly unclear is the link between the spatial (where) and temporal (when) aspects of the neural correlates of these phenomena. The present study investigated these issues using a working memory task with emotional distraction, where recollected unpleasant autobiographical memories served as internal emotional distraction. Emotion regulation was manipulated by instructing participants (N=29) to focus their attention either on or away from the emotional aspects of their memories. As expected, focusing away from emotion was associated with reduced impairing effect of internal emotional distraction on working memory performance, compared to focusing on the recollected emotions. Functional MRI data (N=17) showed decreased response in brain regions associated with the salience network. This was coupled with greater recruitment of executive prefrontal and memory-related temporo-parietal regions, and with increased fronto-parietal connectivity, when participants focused on non-emotional contextual details of their memories. Preliminary data from multi-modal brain imaging recordings (fMRI-ERP) extended these results and showed further spatio-temporal dissociations convergent across modalities, during internal distraction and as a function of focused attention. These findings provide novel evidence regarding the neural correlates of successfully engaging focused attention as an emotion regulation strategy to cope with distressing memories, which can be effectively captured by fMRI and ERP recordings.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Spatial distancing reduces emotional arousal to reactivated memories

Poster D13, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Natasha Parikh[1], Brynn McGovern[1], Kevin S. LaBar[1]; [1]Duke University

Memory modification research and theory suggest that a previously consolidated memory, when reactivated in a specific way, may be open to alteration if manipulated during a labile period. This application holds great clinical importance, as it could allow for an enduring change in the emotional impact of aversive memories. In this experiment, we investigated whether memory reactivation provides a window of opportunity to decrease emotional responses to negative memories. We introduce the novel application of cognitively-based emotion regulation -- specifically spatial distancing -- as the manipulation in a memory modification paradigm. Healthy young adult participants (N = 119) were exposed to negatively valenced, high arousal pictures from the International Affective Picture System across three testing sessions. After a partial reactivation of each picture, participants in the experimental group imagined that the viewed components were extremely far away from them. Control groups were given regulation-alone, reactivation-alone, or no intervening manipulations. Self-reported ratings of valence and arousal in response to the pictures were taken in sessions occurring two days before and two days after the manipulation. Comparison of pre-manipulation and post-manipulation ratings revealed a marked drop in arousal for the experimental group that was significantly greater than that observed in the control groups. On the other hand, task-induced changes in valence ratings to the pictures did not differ across groups. These results specify the affective dimension impacted by distancing and open up a new line of work that capitalizes on reactivation-based lability to reduce emotional arousal to existing memories.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Hierarchical Neural Representations Behind Naturalistic 'Social Norm' Perception In Autism and Controls

Poster D14, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Felipe Pegado[1], Hans Op de Beeck[1]; [1]KU Leuven

Humans show a unique capacity to integrate information from multiple sensory and higher-order cognitive systems. Here, instead of studying one level of representation at a time, we designed a fMRI paradigm aiming to capture multiple brain representations simultaneously, from low-level processing all the way up to higher-order social representations. Our goal was to address a controversial topic: In which levels of the brain hierarchy high-functioning autism (HFA) differs from controls ? By using a naturalistic audio-visual 'social norm' mentalizing task (infering how 'most people' would judge the appropriateness of vocal responses), and multivoxel pattern analysis (MVPA), we could investigate multiple levels of representations at once. Our results show striking similar neural patterns in both groups at low and high level visual and auditory processing, with two exceptions: more low level visual information in Precuneus (PC) and more heterogeneity (uniqueness) of neural representations in 'Voice Area' for auditory stimuli in HFA. Further we also found similar neural substrates for social information in both groups: PC, Temporo-Parietal Junction (TPJ), and posterior medial Prefrontal Cortex (mPFC) - a region often associated with allocentric mentalizing, but not in anterior mPFC, a region associated with self-related mentalizing. Despite that, at the behavioral level, HFA show much less ability to agree on the shared social norm representation, i.e., lower between-subjects correlation of response patterns across runs, while having the same level of intra-subject consistency (within-subjects correlations) as controls. These results shed light on the similarities and differences of HFA brain organization during 'social norm' inferences.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Task-dependent evaluative processing of moral and emotional content during reading comprehension: An ERP study

Poster D15, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Angelika Kunkel[1], Ian Grant Mackenzie[1], Ruth Filik[2], Hartmut Leuthold[1]; [1]University of Tübingen, [2]University of Nottingham

Recently, we showed that when participants read about daily moral transgressions like adultery or tax evasion, they implicitly engage in the evaluative categorization of incoming information. This was indicated by a larger event-related brain potential (ERP) positivity to immoral than moral scenarios (Leuthold, Kunkel, Mackenzie, & Filik, 2015). The present three experiments examined whether such a categorization process contributes to explicit judgments as well and whether it relates to the affective or cognitive processing of incoming information. Target sentences from negative vs. neutral emotional scenarios and from moral vs. immoral scenarios were presented using rapid serial visual presentation while ERPs were continuously recorded. In Experiment 1, participants merely read for comprehension. A larger posterior positivity (LPP; 300-500 ms) for negative and immoral compared to neutral and moral scenarios indicated the implicit affective processing of both emotion and morality materials. In Experiment 2 participants made moral judgments for morality materials and emotional judgments for emotional materials. Negative compared to neutral emotional scenarios elicited a larger LPP about 200 ms after critical word onset, whereas immoral compared to moral scenarios elicited a larger anterior negativity (500-1000 ms). In Experiment 3, where the same emotional judgments to both types of materials were required, a larger LPP was triggered for both types of materials like in Experiment 1. Together, the present findings suggest that the task undertaken by participants determines the focus for incoming linguistic information, with explicit moral judgment tasks requiring increased cognitive processing and emotional judgment tasks requiring increased affective processing.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Inter-subject synchronization of young adult brain activity reveals justification of gun violence in movies

Poster D16, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Azeez Adebimpe[1], Danielle S. Bassett[2,3], Daniel Romer[1]; [1]Annenberg Publ. Policy Ctr., Univ. of Pennsylvania, Philadelphia, PA, [2]Dept. of Bioengineering, Univ. of Pennsylvania, Bioengineering, PA, [3]Dept. of Electrical & Systems Eng., Univ. of Pennsylvania, Philadelphia, PA

Popular movies that involve gun violence now receive parental ratings that allow open access in theaters and attract large audiences. One concern about exposure to such movies is that the gun use by major characters will encourage imitation by youth. However, such gun use may not always be seen as acceptable, especially if it is seen as unjustified. Here, we computed inter-subject synchronization of 26 late adolescents' brain activity obtained with functional MRI while they watched a series of 4 90-sec segments of first character development and then violent action from movies with either justified or unjustified gun violence in

counterbalanced order. Synchronization of brain activity extended from the early projection cortices to areas involved in higher-order vision, emotion, and attention. We observed enhanced synchronization in frontal regions, including orbital frontal cortex (OFC), as well as sensory regions while watching violent action compared to discussion among movie characters, suggesting disapproval of violence. However, neural synchronization patterns differed between violence justification conditions. Justified violence elicited greater synchronization of limbic and subcortical circuity, suggesting more emotional identification with characters engaged in justified violence. Unjustified violence elicited more cognitive and emotional processing, suggesting that the action elicited more cognitive conflict in response to the unjustified behavior of the violent actors. The results reveal the existence of a common spatial organization while viewing violence in high-level cortical areas, and that neural synchronization patterns are related to the nature of the violent events. The brain responses we observed suggest that justified violence portrayed in popular films may be acceptable to audiences despite the activation of brain regions, such as OFC, that have been associated with moral disapproval

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Eye movements predict immediate and long-term effects of emotion regulation: An eye-tracking investigation

Poster D17, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Margaret O'Brien[1], Yuta Katsumi[1], Alexandru Iordan[2], JulieAnn Scherer[1], Alejandro Lleras[1], Simona Buetti[1], Sanda Dolcos[1], Florin Dolcos[1]; [1]University of Illinois at Urbana-Champaign, [2]University of Michigan Ann Arbor

Emotional stimuli tend to capture attention, and hence are typically remembered better than neutral ones. However, there may also be a downside to this mnemonic advantage, as excessive rumination on negative information may lead to symptoms of depression and anxiety. Here, we investigated the immediate and long-term impact of focused attention (FA) as an emotion regulation strategy, using an eye-tracking procedure in healthy young adults. We particularly focused on patterns of visual attention predicting immediate emotional experience and long-term emotional memory for pictures. Following instructions to focus on either emotional (Emotion Focus) or non-emotional (Context Focus) aspects of negative images, participants (N=37) rated their emotional response to each picture, using a 5-point scale (1=not negative at all, 5=very negative). Then, one week later, participants' memory for the images was assessed in a surprise recognition memory task (N=19). Regression analyses showed that FA was successful in reducing both the immediate and long-term impact of negative emotion. Regarding the immediate impact, longer time spent focusing on contextual aspects of negative images predicted lower emotional ratings for those images. Regarding the long-term impact, longer gaze-time on contextual aspects of negative images also predicted decreased memory for those images. Overall, these findings show that FA is an effective emotion regulation strategy in reducing both the immediate and the long-term effects of negative stimuli. This new evidence has important implications for counteracting negative affective biases linked to symptoms of depression and anxiety.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

The Brain Responses in Integration of Emotional information of Facial Expression and Emotional Prosody

Poster D18, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Shih-Tseng T. Huang[1,2]; [1]Department of Psychology, National Chung-Cheng University, Taiwan, [2]Center for research in Cognitive Science, National Chung-Cheng University, Taiwan

The present study investigated the brain activity in processing facial expressions and emotional prosody. Nineteen young adults participated (9 males and 10 females). In each congruous pair, an angry (or neutral) voice fragment accompanied with a congruous angry (or neutral) facial expression. In each incongruous pair, angry prosody was paired with a neutral face, or a neutral face paired with angry voice. Ten runs of 80 trials were presented with two kinds of percentage in combinations of the congruous and incongruous trials. Five of them presented 80% congruous trials and 20% incongruous trials. The other five runs with reverse percentage of congruency containing 80% incongruous and 20% congruous trials. The results found a sex difference of N170 at

PO8 indicating females were higher than the male participants. The analysis of mean amplitudes (MAs) of 300-500ms found higher activation at Pz than Cz and Fz, and Cz higher than Fz. It was also found that processing angry facial expression and prosody were higher in amplitudes than processing neutral expression and prosody at both F3 and F4. There was no significant congruency effect found. The results suggested sex difference at early stage of processing emotional facial and prosody. At 300-500ms, processing angry facial expressions and prosody were found higher than processing neutral faces and prosody, and higher activations in parietal lobes than at the central and frontal lobes. The results suggested that differentiation of the congruency of emotional and prosody might take place at an integration phase of processing.

Topic Area: EMOTION & SOCIAL: Emotional responding

Attenuated P3 and FPS During Social Support in Individuals with Psychopathic Traits

Poster D19, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Meghan Pierce[1,2], Stephen Benning[3]; [1]Translational Research Center for TBI and Stress Disorders (TRACTS), VA Boston Healthcare System, Boston, MA, [2]Harvard Medical School, [3]University of Nevada, Las Vegas

Psychopathy is a personality disorder that can be broken up into two factors: Fearless Dominance (FD) and Impulsive Antisociality (IA). Both factors are associated with maladaptive behaviors that negatively influence personal relationships. The goal of this study was to investigate the effects of physical support on the P3 event related potential and the Fear Potentiated Startle (FPS). Participants (n = 124) were presented with letter cues and were instructed that a higher probability of shock was associated with one of two letter colors. Participants were instructed to attend to the color of the letter during a threat focused (TF) condition or instructed to pay attention to the letter case in an alternative focus (AF) condition. During half of the task, the participant's friend placed his or her hand on the participant's shoulder. Physical support was associated with an attenuated P3 measured at Fz and FPS regardless of psychopathy factor. Participants also experienced an attenuated FPS during the CS- compared to the CS+ condition. FD was associated with an attenuated FPS during the AF condition but not during the TF condition. Both FD and IA were associated with a larger difference in P3 amplitude between the support and alone conditions. This study provides the first evidence that social support buffers the psychophysiological response to physical stress in individuals higher in FD and IA. Thus the development and incorporation of psychosocial interventions may assist in the rehabilitation of psychopathic individuals.

Topic Area: EMOTION & SOCIAL: Emotional responding

Neural mechanism underlying the suppressing effect of self-esteem on envy and schadenfreude

Poster D20, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Shohei Yamazaki[1], Motoaki Sugiura[1], Kelssy H. dos S. Kawata[1], Yukako Sasaki[1], Rui Nouchi[1], Kohei Sakaki[1], Shigeyuki Ikeda[1], Ryuta Kawashima[1]; [1]Tohoku University

Envy and the resultant schadenfreude, the sources of various negative social behaviors, are known to have a negative correlation with self-esteem. We investigated if boosting self-esteem suppress these negative emotions and sought to identify the neural mechanism underlying the effect. We employed 40 university students and divided them into an intervention group and a control group. The intervention group was administrated a five-minute semi structured interview and told to remember a situation in which they felt relaxed in a past social experience, which is known to enhance self-esteem (Hulme., 2012). And then a similar interview to remember a solitary situation in which they didn't feel relaxed was administrated to the control group. Subjective rating of their state self-esteem, envy and schadenfreude as well as the fMRI images during the task which induce envy and schadenfreude using a virtual scenario (Takahashi et al., 2009) were acquired before and after the intervention. Self-esteem rating increased and envy and schadenfreude rating decreased only in intervention group. Activation of the dorsal anterior cingulate and ventral striatum, previously shown to reflect envy and schadenfreude (Takahashi et al., 2009), during respective scenarios was reduced in the intervention group. Importantly, we used a 2(session: before, after) × 2(group: intervention, control) ANOVA and found that the functional connectivity between the medial prefrontal cortex(MPFC), previously shown to index self-esteem, and these regions

only increased in the intervention group. We thus demonstrated that boosting self-esteem suppresses envy and schadenfreude through enhanced functional connectivity of the MPFC and the affection-related regions.

Topic Area: EMOTION & SOCIAL: Other

Social perspective taking shapes both eye-movements and brain hemodynamic activity during viewing of drama movie

Poster D21, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Iiro P. Jääskeläinen[1], Mareike Bacha-Trams[1], Elisa Ryyppö[1], Enrico Glerean[1], Mikko Sams[1]; [1]Aalto University School of Science, Espoo, Finland

Putting oneself into the shoes of others is an important aspect of human social cognition. Here, we measured brain hemodynamic activity and eye-movements as subjects were viewing a shortened 24-min version of a drama movie ("My Sister's Keeper") from the perspectives of either of two main protagonists, to-be-organ donor, and recipient, sisters. Significant differences in inter-subject correlation (ISC) of eye-gaze fixations were observed in 50% of consecutive two-second time windows. In 60% of these time windows, the eye-gaze ISC was higher when subjects were watching the movie from the to-be-organ donor, rather than during to-be-organ recipient, perspective. Further, within-perspective analysis showed higher proportion of fixations on the to-be-organ-recipient than donor sister during both perspectives. ISC of brain activity was significantly higher during the to-be-organ donor vs. recipient perspective in dorsolateral and inferior prefrontal, lateral and inferior occipital, and inferior-anterior temporal areas. In the reverse contrast, stronger ISC of brain activity was observed in superior temporal, posterior frontal, and anterior parietal areas. Taken together, our findings indicate that perspective taking during watching of a moral dilemma shapes both eye-movement patterns and similarity of brain activity in both sensory and higher-order cortical regions. Overall, given that there were robust differences between the two social perspectives in both brain regions exhibiting ISC and in eye-gaze patterns, it seems that the social setting, as well as goals and relationships of the protagonists in the movie, dynamically modulate the set of brain regions involved in adopting one vs. the other social perspective.

Topic Area: EMOTION & SOCIAL: Person perception

Reliability of evoked responses varies as a function of autistic traits in healthy adults

Poster D22, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Meghan Puglia[1], Jessica Connelly[1], James Morris[1]; [1]University of Virginia

Evoked neural responses show greater variability among individuals with autism compared to neurotypical controls (Dinstein et al., 2012; Milne, 2011). As it is increasingly understood that autistic traits are expressed on a continuum in the general population, we examine whether variability in evoked response is also associated with the occurrence of autistic traits in healthy adults. Eighty-six neurotypical adults (49 males) passively viewed alternating blocks of point-light displays of biological or random motion while undergoing fMRI. Autistic traits were assessed with the Autism Spectrum Quotient Questionnaire (AQ) (Baron-Cohen et al., 2001). We first performed an independent component analysis (ICA) to identify regions of interest (ROIs) with a model-free, data-driven approach, resulting in 12 unique clusters encompassing posterior and prefrontal regions including bilateral superior temporal sulcus. Neural variability was quantified as the standard deviation of each time point within each individual's peristimulus timecourse for each ROI and stimulus type. AQ score and neural variability were significantly associated (all p-values <.0001). For the biological condition, variability of neural response across ROIs accounted for 5 to 28% of variance in autistic traits. For the random condition, variability of neural response across ROIs accounted for 7 to 59% of variance in autistic traits. These results demonstrate that healthy adults with a high occurrence of autistic traits show a similarly unreliable neural response to that seen in clinical populations. Neural variability has been associated with cognitive and developmental processes (Misić, et al., 2010), and may therefore represent a useful metric for informing differential neurodevelopmental trajectories.

Topic Area: EMOTION & SOCIAL: Person perception

Neural and cognitive/motivational mechanisms underlying the processing of gender stereotype roles

Poster D23, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Berry van den Berg[1,2], Jolien van Breen[1,3], Russell Spears[1], Monicque Lorist[1,2]; [1]University of Groningen, [2]University Medical Center Groningen, [3]University of Exeter

Stereotypes can help us rapidly identify the role of a person, notably when an actor is congruent with the role stereotype. However, encountering stereotypes can be threatening to some (e.g., women exposed to women in socially devalued roles). To gain insights into the underlying cognitive and motivational processes, we measured brain activity (EEG) while presenting female participants images of both female and male actors in neutral, stereotypical and, counter-stereotypical roles. Presentation of a female stereotypical image vs. female counter stereotypes, elicited in female participants a larger fronto-central P3, concurrent with increased fronto-midline Theta power (4-7Hz), followed by decreased posterior Alpha (8-14Hz) power. These effects were smaller/absent when the actors were males. In sum, the results suggest that when confronted with images of actors in a stereotypical role that could be threatening, the brain recruits fronto-central regions important for regulating attention and working memory followed by enhanced image evaluation - even when viewing images passively.

Topic Area: EMOTION & SOCIAL: Self perception

Differences in the peri-adolescent association of cognitive abilities and striatal intrinsic functional connectivity as a function of age and sex

Poster D24, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Rachel K Spooner[1], Nicholas Christopher-Hayes[1], Julia M Stephen[2], Vince D Calhoun[2], Yu-Ping Wang[3], Tony W Wilson[1], David E Warren[1]; [1]University of Nebraska Medical Center, [2]Mind Research Network, [3]Tulane University

The basal ganglia contribute to cognitive abilities such as skilled motor performance, executive function, and feedback-driven learning. While the maturation of intrinsic brain networks supporting these functions has been investigated, potential sex differences in the development of these abilities are not well-characterized. Here, we tested whether sex was associated with age-related differences in striatal intrinsic functional connectivity, cognitive abilities, and their association. Our sample included 110 healthy adolescents aged 9-14 years old from the Developmental Chronnecto-Genomics project (Dev-CoG). Cognitive abilities were assessed using several NIH Toolbox tasks (e.g., flanker, dimensional card sort, pattern comparison, and working memory). Resting-state fMRI (rs-fMRI) data were collected using identical multiband sequences (voxel size: 3.3×3.3×3.0 mm; TR: 460 ms; TE: 29 ms; 650 measurements) under eyes-open eyes-closed conditions (5 min. each). All fMRI data were aligned to the structural volume and transformed into Haskins Pediatric Atlas space. The relationship between behavioral performance and whole brain resting-state functional connectivity (RSFC) was examined as a function of sex using anatomically-derived striatal seeds for the caudate and putamen with covariates for variables such as age and task performance. We observed significant covariation between striatal RSFC, age, and performance. Further, our results indicated a significant difference in these relationships as a function of sex with increased age. These findings suggest that specific cognitive abilities are related to changes in striatal RSFC with other brain regions during adolescence, and that maturation of the networks serving executive functions and cognitive flexibility is significantly influenced by sex during development.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Characterizing the Impact of Aging on Automatic Inhibition

Poster D25, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Tzu-Ling Li[1], Erik Chang[1]; [1]National Central University

Inhibitory functions are crucial for keeping our behaviors under control, and it is prone to the influence of aging. In the current study, we carried out two experiments to explore the impact of aging on automatic inhibition. In Experiment 1, we adopted a location negative priming (LNP) task where the participant responded to a target (circle) in the prime and probe events, respectively, of a trial. The interval between the response to the prime and the probe onset (IRP) was randomly selected among 389, 931, 1463, and 1995ms to explore the time course of the NP effect in both an elderly and a young group. For the young group, the NP effect remained relatively stable across time as compared to the elderly and peaked at the 389-ms IRP. For the elderly group, the time course of the NP effect appears to be a reversed-U shape that peaked at 931ms, the NP effect is significant than others. In Experiment 2, we combined Go/No-go task with the LNP task where the participant does not respond to prime if a yellow target is presented. While the NP effect of Go primes is much larger than No-go primes in the younger group, no significant effect was found in the elderly group. To summarize, we found that aging impacts how automatic inhibition evolves over time. In addition, aging modulates both controlled and automatic inhibition but in different fashions.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Differences in Decline in the Subcomponents of the Unity-Diversity Model of Executive Functioning between Younger and Older Adults: A Meta Analysis

Poster D26, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Ted Maldonado[1], Joseph M. Orr[1], Jessica A. Bernard[1]; [1]Texas A&M University

Declines in fluid cognitive processes, including executive function (EF), occur in advanced age. Impaired EF can result in poor control of behavior and failure to achieve goals, negatively impacting quality of life for older adults (OA). Research using factor analysis has divided EF into 3 subcomponents—inhibition, set shifting, and updating—and these components are seen in both OA and young adults (YA). Subsequent work examining these three domains individually, however, does not always show age-related performance declines in EF subcomponents. Thus, examining these EF components in advanced age is of interest, as the subcomponents may be differentially impacted by aging, and may provide important targets for cognitive remediation. To investigate age-differences in the EF subcomponents associated with the unity-diversity model, we conducted a meta-analysis. We expect overall declines in EF in OA with specific declines in set shifting and updating; but age-related declines in inhibition are not likely to be as prominent. Further, all these declines might be influenced by processing speed changes. Using 229 effect sizes from 31 articles we found overall declines in EF with age. Additional subgroup analyses, using processing speed as a moderator, suggests that age negatively impacts EF for each subgroup and processing speed moderates this decline. Thus, future research should examine how specific interactions between these subgroups cause EF decline and further examine the influence of processing speed as a moderating factor in these interactions. This understanding can directly inform cognitive remediation procedures and early detection of EF decline.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Metacognitive Training Induces Neurodevelopmental Changes in Prefrontal Regions

Poster D27, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Kshipra Gurunandan[1], M. Rosario Rueda[2], Sonia Guerra[2], Manuel Carreiras[1,3], Pedro M. Paz-Alonso[1]; [1]Basque Center on Cognition, Brain and Language, [2]Universidad de Granada, [3]Ikerbasque - Basque Foundation for Science

Research evidence has revealed that high cognitive functions are susceptible to practice-related improvements, with strong empirical support showing the positive effects of some cognitive training programs on the specific functions being trained. In contrast, evidence for transfer effects to other non-trained domains is more mixed. Recently it has been shown that the use of metacognitive versus standard training protocols can boost the impact of training executive functions in children. Little is known, however, about the neurodevelopmental changes associated with training higher cognitive functions using metacognitive strategies in childhood. The present fMRI study was aimed at investigating neural changes induced by training executive functions in middle childhood children. A total of 55 children aged 8-10 years underwent 8 training sessions over 2-3 weeks, during which they were either presented with computer-based exercises of increasing difficulty to train attention and executive control using a

metacognitive protocol or an equally long control intervention wherein they performed the lower levels of difficulty of the same exercises. All participants underwent pre- and post-training fMRI sessions where they performed a block-design cognitive control task based on the hearts-and-flowers task. Metacognitive training improved participants' working memory, as well as fluid reasoning skills behaviorally. Neuroimaging data revealed that training exclusively enhanced the engagement of frontal regions (dlPFC, right IFG, anterior cingulate) associated with the core functions involved in the fMRI control task: working memory, response inhibition, and executive functioning. Transfer to fluid intelligence may rely on the overlapping neuroanatomy between this function and of the functions being trained.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Functional networks involved in creative planning while performing an ongoing task

Poster D28, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

David Maillet[1,2], Roger Beaty[3], Aaron Kucyi[4], Daniel Schacter[3]; [1]Department of Psychology, University of Toronto, [2]Baycrest Health Sciences, [3]Department of Psychology, Harvard University, [4]Neurology and Neurological Sciences, Stanford University

Dual-tasking refers to the simultaneous performance of two tasks that can be done independently of each other. Although many studies have examined the neural correlates of dual-tasking, these studies usually involve two tasks requiring externally-directed attention. Relatively little is known regarding dual-tasking that involves an internally-directed attention task. In the current fMRI study, 34 young adults performed an ongoing task in which they judged whether arrows pointed left or right, and then completed an alternate uses task (AUT). In the dual-task condition, participants were given the word cue from the AUT at the beginning of the ongoing task, so that they could plan their AUT responses, whereas in the control condition, they were given the word at the end of the ongoing task, removing the possibility for planning. Participants performed equally well on the ongoing task in the single and dual-task conditions; however, participants generated more ideas for the AUT in the dual-task versus the single-task condition, providing objective evidence of dual-tasking. We assessed task differences in connectivity, with a focus on default, salience, frontoparietal and dorsal-attention networks. Salience network was more coupled with dorsal attention network during single-tasking, and with default and frontoparietal networks during dual-tasking. Also, during dual- versus single-tasking, default network exhibited reduced within-network connectivity but increased between-network connectivity with all other networks. Thus, dual-tasking involving creative planning is accomplished by a shift in salience network connectivity away from dorsal attention network, as well as more widespread default-network connectivity.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Connectivity Patterns in Hierarchical Cascade of Prefrontal Networks Predict Multitasking Ability

Poster D29, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Tanya Wen[1,2], De-Cyuan Liu[3], Shulan Hsieh[4]; [1]Medical Research Council, [2]University of Cambridge, [3]Asia University, [4]National Cheng Kung University

Multitasking is a fundamental aspect of everyday life activities. During multitasking, a range of tasks are performed within a time period, and requires interleaving between different tasks while keeping the current progress in working memory. To achieve these task goals, the tasks must be subdivided into sub-tasks and executional steps, a critical function in the hierarchy of prefrontal networks. The prefrontal cortex is considered to be organized in a cascade of executive processes from the sensorimotor to anterior prefrontal cortex, which includes execution of specific goal-directed action, to encoding and maintaining task rules, and finally monitoring distal goals. In the current study, we used a virtual multitasking paradigm to tap into real-world performance and relate it to each individual's resting-state functional connectivity in fMRI. Our results show a positive trend of global network functional connectivity strength related to task performance in the frontoparietal network (FPN) that, however, did not reach significance. In contrast, multivariate connectivity patterns showed that within-network connectivity in the sensorimotor network (SMN) and between-network connectivity of the FPN and dorsal attention network (DAN) predicted individual multitasking ability and could be

generalized to novel individuals. Together, these results support previous research that prefrontal networks underlie multitasking abilities and show that connectivity patterns in the cascade of prefrontal networks may explain individual differences in performance.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Different control dimensions organize task-set representations in novel instructed behavior

Poster D30, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Ana F. Palenciano[1], Carlos Gonzalez-Garcia[2], Srikanth Padmala[3], Juan E. Arco[1], Luiz Pessoa[3], Maria Ruz[1]; [1]University of Granada, Spain, [2]Ghent University, Belgium, [3]University of Maryland

Humans' remarkable success in novel contexts is anchored in our ability to use complex instructions to guide our actions. This flexible skill has been linked to fronto-parietal cortices, which encode new task-sets both in activity levels (e.g. González-García et al., 2017) and connectivity patterns (e.g. Cole et al., 2013). Nonetheless, the organizational principles structuring the representation of complex verbal instructions, before their implementation, are not known. To address this issue, we acquired functional magnetic resonance data while 32 participants followed novel verbal instructions. We manipulated the complexity of task- and response-sets and the relevant stimuli category, and used multivoxel representational similarity analysis (RSA; Kriegeskorte, 2009) and a searchlight approach to explore whether these dimensions are reflected in the geometry of representational spaces during instruction encoding, before their implementation (cluster-corrected at FWE $p<.05$). The response-set complexity captured the distances between representations in the inferior parietal lobe (IPL), whereas stimulus category was reflected in the left inferior frontal gyrus (IFG), precuneus, temporo-parietal junction and fusiform gyrus. Task-set complexity did not exert an effect at this level, while it increased univariate activation in the IFG. Our findings confirm the role of the IPL on stimuli-response mapping reconfiguration, as well as the category specificity of preparatory mechanisms associated with the IFG and perceptual cortex. More importantly, they highlight how proactive control variables structure neural representations in fronto-parietal and perceptual regions, and open a window to further empirical testing of relevant theoretical models – in both local and distributed representational levels of analysis

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Activation and Connectivity at the Decision and Execution Phases of a Voluntary Task Switching Paradigm

Poster D31, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Derek M. Smith[1], Eric H. Schumacher[1]; [1]Georgia Institute of Technology

Recently voluntary task switching paradigms that separate the decision making and task execution phases of a trial have grown in terms of their representation in the literature. A simple version of such a task was carried out by subjects undergoing functional magnetic resonance imaging in order to evaluate task related activity and functional connectivity at the two phases. In order to separately model the decision and execution phases of the task both the interstimulus interval between the decision cue and the stimulus and the intertrial interval were jittered (50% 2 seconds, 25% 4 seconds, 25% 8 seconds). Significant reaction time switch cost and congruency effects were observed during the execution phase. Decisions to switch did not differ significantly in terms of decision cue reaction time from decisions to repeat. Contrasts demonstrated greater task related activation in anterior prefrontal cortex and the anterior cingulate cortex during both the execution and decision phases for switch relative to repeat trials. A beta series correlation analysis showed that during the decision phase the anterior prefrontal cortex was coupled with fellow members of the cingulo-opercular network, particularity the anterior cingulate, but it was also associated with some more posterior regions. These findings are marked by similar but distinct task related activity at different phases of a trial.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Does conflict adaptation affect stimulus or response selection?

Poster D32, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Melissa Moss[1], Atsushi Kikumoto[1], Ulrich Mayr[1]; [1]University of Oregon

The conflict-adaptation effect (reduced response-time costs of conflict resolution following high-conflict trials) suggests that the experience of conflict may drive subsequent increases in control by triggering goal representation to be actively updated, which would reduce sensitivity to subsequent conflict (Botvinick et al., 2001). This effect may be due to modulation of stimulus processing, or of post-stimulus response selection. With EEG, we investigated the temporal dynamics of conflict adaptation using a flanker-like task in which the distractor (flanker) appeared 400ms before the target (Weissman et al., 2014). In this task, alternating flanker-target pairs by trial eliminates the potential confound of low-level stimulus-response priming. Thus, our study was able to focus in on the top-down aspects of conflict processing. We predicted that conflict adaptation during stimulus selection would be reflected in reduced amplitudes of early visually evoked potentials (e.g., P1/N1 ERP components) in response to the flanker stimulus, following conflict. Preliminary findings showed a robust behavioral conflict-adaptation effect, in both response times and accuracy rate. However, we found no influence of previous conflict on ERP amplitudes in response to the flanker stimulus, indicating that stimulus selection is not affected by conflict-adaptation. Instead, our findings are consistent with the interpretation that adaptation affects response-selection processes and may result from episodic memory traces that encapsulate previous-trial control efforts.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Daily intermittent moderate-to-vigorous and vigorous physical activity is related to faster P3 latency in preadolescents

Poster D33, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Dominika Pindus[1], Lauren B. Raine[1], Eric S. Drollette[2], Daniel Westfall[1], Shih-Chun Kao[1], Naiman A. Khan[3], Arthur F. Kramer[1,4], Charles H. Hillman[1,5]; [1]1Department of Psychology, Northeastern University, [2]2Department of Kinesiology, University of North Carolina Greensboro, [3]Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, [4]Beckman Institute for Advanced Science and Technology, University of Illinois, [5]Department of Health Sciences, Northeastern University

Individual differences in brain function based on objective measures of children's daily physical activity (PA) behavior have not been investigated. In this study, we leveraged high temporal resolution of accelerometry and electroencephalography to investigate if children who regularly engaged in more moderate PA, vigorous (VPA) and moderate-to-vigorous PA (MVPA) showed better behavioral and neuroelectric profiles during the flanker task. PA volume (min/d) and pattern (number and time spent in bouts) were measured using accelerometers with 1 s epochs. Eighty-three 8-10 years old children (50% girls) performed a modified flanker task that included 84 congruent and incongruent trials with jittered inter-stimulus intervals between 1600-2000 ms. Children who accumulated more time in VPA bouts of ≥10 s had faster P3 latencies during both congruent ($b = -9.20 \pm 3.11$, $t = 2.96$, $p = .004$) and incongruent ($b = -6.06 \pm 2.71$, $t = 2.23$, $p = .03$) trials. Time spent in MVPA bouts of ≥10 s was also related to faster P3 latencies on congruent trials ($b = -2.51 \pm 0.95$, $t = 2.64$, $p = .01$). Greater time spent in 10 s VPA bouts was marginally related to more omission errors on congruent ($b = .062 \pm .031$, $t = 1.97$, $p = .052$) but not incongruent trials ($p = .10$). Our data reveals a novel association between time spent in intermittent VPA and MVPA bouts characteristic of children's daily PA and increased cognitive processing speed, which has potential implications for cognitive health and learning.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

The influence of predictability and parametrically varying conflict level on performance and cognitive control

Poster D34, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Harrison Ritz[1], Amitai Shenhav[1]; [1]Brown University

Previous research on cognitive control has shown that behavior is sensitive to conflict on the current trial, and that the conflict and feedback experienced on that trial will influence control allocation on the subsequent trial. However, less is known about how people adapt their control when conflict gradually and predictably changes over time, partly because this requires conflict levels to vary along a continuous scale. To address this question, we developed a novel task in which participants viewed an array of moving dots and provided a (left/right) response based on the color of those dots. The (left/right) direction of motion was task-irrelevant, but was either congruent or incongruent with the correct response side. Critically, we also varied the amount of motion information (coherence), resulting in parametric variation of conflict across trials, which we varied either randomly or predictably. We found that reaction time and accuracy varied linearly with conflict level, and that this conflict effect was moderated by predictability: in predictable blocks, participants were more facilitated by congruency, but demonstrated similar incongruency effects. We observed this both when we provided participants with simultaneous motion and color information (Study 1), and when the onset of motion information preceded the onset of color information (Study 2). Interestingly, while participants adapted control based on errors and conflict experienced on previous trials, these adaptations were insensitive to the predictability of the environment. Our findings suggest that predictable changes in conflict can alter strategic allocation of attention, without necessarily increasing control.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

The role of dorsolateral prefrontal cortex in error processing: a combined ERP-TMS study

Poster D35, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Fabio Masina[1], Vincenza Tarantino[1], Antonino Vallesi[1,2], Daniela Mapelli[1]; [1]University of Padua, [2]San Camillo Hospital IRCCS, Venice

Error processing is a critical step towards an efficient adaptation of our behavior in order to achieve a goal. Several studies have investigated behavioral and electrophysiological (EEG) indexes associated with error processing, such as post-error slowing (PES), a motor slowdown following an error commission, and the error positivity (Pe), an electrical potential evoked by an incorrect response. Many of these studies have attempted to find a relationship between PES and the Pe, and to identify their brain sources. Although they revealed two crucial brain structures that mediate PES and the Pe, the anterior cingulate cortex (ACC) and the dorsolateral prefrontal cortex (DLPFC), the evidence in support of the DLPFC is weak. The purpose of this study was to elucidate the structural-functional relationship among PES, Pe, and DLPFC, by combining Transcranial Magnetic Stimulation (TMS) and Electroencephalography (EEG). Fifteen participants (mean age 24 years, range 20-34) took part in three repetitive TMS sessions (20 minutes, 1 Hz). In each session, either the right DLPFC prefrontal cortex, the left DLPFC, or the Vertex (control site) was stimulated. Immediately after the stimulation, the EEG was recorded while participants performed a computerized task. The results showed that the stimulation of the left DLPFC only produced behavioral and electrophysiological effects. Specifically, a suppression of PES and a reduction of the Pe amplitude were observed. These findings proved a role of the left DLPFC in mediating error processing. Furthermore, for the first time, they provided direct evidence of a link among PES, Pe, and left DLPFC.

Topic Area: EXECUTIVE PROCESSES: Other

Functional Parcellation of the Temporo-Parietal Junction in Individual Subjects

Poster D36, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Kathryn Devaney[1], Emily Levin[2], James Higgins[3], David Somers[1]; [1]Boston University, [2]Brown University, [3]Northwestern University

Activation in the temporo-parietal junction (TPJ) has been reported for attentional capture, theory of mind (ToM), and interruption of a planned motor response (“Stop Signal” (SS)). Possibly, each of these tasks is implicitly recruiting a common cognitive component (e.g. expectation violation, contextual updating). Alternatively, the large area referred to as “the TPJ” could comprise discrete modules recruited separately, with distinctions lost by spatial blurring in group averages. Here, we investigate TPJ functional response properties by performing sustained attention, attention capture, ToM, and SS tasks in the same subjects (n=10, 2mm voxels) across two fMRI scan sessions. Within our subjects, sustained attention deactivation was evident in 12/20 hemispheres, ToM activation in 16/20, SS in 15/20 and attentional capture in 17/20. In individual hemispheres, ToM areas are located on the posterior dorsal segment of the TPJ in angular gyrus. Attention capture activation is located anterior and ventral to ToM, overlapping with the fundus of the superior temporal sulcus (STS) and extending into supramarginal gyrus (SMG). SS activation is localized anterior to the STS in the SMG. We find overlap between deactivation for sustained attention and activation for ToM (dice coefficient = 0.18 ± 0.04) and overlap in activation for attentional capture and SS (dice coefficient = 0.22 ± 0.04). These results demonstrate that 1) ToM regions overlap with default mode network regions and 2) SS and attentional capture recruit an overlapping area in the anterior TPJ, suggesting that these two processes recruit a common cognitive component, perhaps related to expectation violation.

Topic Area: EXECUTIVE PROCESSES: Other

tACS on, tACS off: entrainment of neural oscillations during WM

Poster D37, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Kevin Jones[1,2], Hector Arciniega[1], Jennifer Shepack[1], Carlos Carrasco[1], Marian Berryhill[1]; [1]University of Nevada, Reno, [2]Colorado State University

Efforts to improve working memory (WM) by pairing training with noninvasive neurostimulation reveal behavioral improvements in younger and older adults. We previously found that WM training paired with transcranial direct current stimulation (tDCS) was associated with pre-/post- changes in EEG signals. Specifically, we observed changes in both anterior-posterior theta (7 Hz) and posterior alpha (11 Hz) oscillations during WM maintenance, but only in those who received active tDCS. Here, we tested the hypothesis that directly modulating these frequencies using transcranial alternating current (tACS) might elicit behavioral change without requiring WM training. In Experiment 1 we applied 7 Hz in/out phase tACS targeting left or right frontoparietal networks during several 2-back WM tasks (verbal, object, spatial stimuli). In Experiment 2, we provided in phase 7 Hz or 11 Hz tACS targeting right frontoparietal sites using more difficult 3-back WM tasks (object, spatial stimuli). The results were mixed. Experiment 1 replicated previous findings, showing that tACS had a modest effect on WM performance on the tasks. A limitation was that the 2-back tasks were not sufficiently difficult for our young adult population. Experiment 2 revealed mixed effects depending on stimulation frequency and stimulus type. Surprisingly, 7 Hz tACS impaired WM performance across 3-back stimuli. In contrast, 11 Hz tACS improved performance on the spatial 3-back task and impaired performance for the verbal 3-back task. These data provide little support for the ability of single-session tACS to shortcut WM training paired with tDCS.

Topic Area: EXECUTIVE PROCESSES: Working memory

The Prefrontal Theta Activity During Thought Suppression Compared with Thought Free Predicts Lower Working Memory and Higher Worry Symptoms and Rumination in High Trait Anxiety

Poster D38, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Salahadin Lotfi[1], Maryam Ayazi[1], Ken Bennette[1], Lukas Dommer[1], Abel Mathew[1], Christine Larson[1], Hanjoo Lee[1]; [1]University of Wisconsin-Milwuakee

Anxiety is often associated with impaired cognitive function and an excessive allocation of attentional resources toward threat-related stimuli. This dysfunctional allocation allows unnecessary threat-related information to enter working memory (WM), maintaining irrelevant anxious cognitions and consuming cognitive resources which in turn interferes with ongoing behavior. Recent evidence shows cognitive control (CC) is a critical component of WM capacity as well of suppression of unwanted thoughts. Strong CC enables individuals to filter out irrelevant information during cognitive tasks. EEG studies have also shown that the increased prefrontal theta (PFT) is associated with occupied WM. The main aim of this study is to investigate the association between PFT

with WM and the suppression of unwanted thought in individuals with high trait anxiety. EEG recordings and cognitive tasks were collected from a sample of undergraduate students (N=35) who scored 44 or above on the STAI-Trait Anxiety Inventory. Results revealed a significant negative correlation between PFT during suppression of unwanted thoughts compared with thought free phase with WM capacity (r= -0.383). Results also indicate a significant positive correlation between PFT during suppression of unwanted thoughts compared with thought free with two measures of worry symptoms and rumination (r=0.388 & 0.427). Collectively, these data suggest that the increased activity of PFT during thought suppression may be neural markers predicting a failed attempt of filtering unwanted thought associated with low working memory performance in trait anxious individuals, further supporting the notion that anxiety is associated with poor WM abilities and impaired CC of intrusive thoughts.

Topic Area: EXECUTIVE PROCESSES: Working memory

Behavioral oscillations in multi-item visual working memory

Poster D39, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Jingtai Liu[1], Taosheng Liu[1], Susan Ravizza[1]; [1]Michigan State University

Neural oscillations play an important role in various aspects of working memory. Although previous researchers have reported correlations between brain oscillations and behavior, surprisingly, direct evidence for behavioral oscillations in working memory is still lacking. Motivated by previous studies which used a high time-resolved psychophysical measurement and found compelling oscillatory patterns in attention, our study examined if this rhythmic pattern also exists in working memory. In this task, participants memorized orientations of two Gabor patches followed by a retro-cue with different probabilities (i.e. 100%, and 50%) indicating the likelihood that the orientation would have to be recalled. Our results showed a performance increase in the predictive condition (i.e. 100%) than the non-predictive condition (i.e. 50%). In the non-predictive condition, participants performed better on cued condition than uncued condition. These results suggested that the retro-cue could effectively modulate memory performance by directing internal attention to cued items. More importantly, we observed compelling rhythmic patterns, mainly in the delta band, between 1-4 Hz in the behavioral time course. This finding revealed direct evidence of the dynamic nature of working memory maintenance and provided a direct connection with behavior.

Topic Area: EXECUTIVE PROCESSES: Working memory

Sex and Developmental Differences in the Oscillatory Dynamics Serving Verbal Working Memory: a MEG Study

Poster D40, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Christine M Embury[1,2], Alex I Wiesman[1], Amy L Proskovec[1,2], Elizabeth Heinrichs-Graham[1], Yu-Ping Wang[3], Vince D Calhoun[4,5], Julia M Stephen[4], Tony W Wilson[1,2]; [1]University of Nebraska Medical Center, Omaha, NE, [2]University of Nebraska Omaha, Omaha, NE, [3]Tulane University, New Orleans, LA, [4]The Mind Research Network, Albuquerque, NM, [5]University of New Mexico, Albuquerque, NM

Changes in the structure and function of the brain are evident throughout childhood and adolescence, shaping the development of executive functions like working memory (WM). Previous verbal WM studies in healthy adults have shown the importance of alpha oscillations in left occipito-temporal cortices during the encoding and subsequent maintenance of WM representations. In this study, we used magnetoencephalography (MEG) to examine such alpha oscillatory activity during a verbal WM task in 95 healthy youth (9-14 years-old) who were enrolled in the NSF-funded Developmental Chronnecto-Genomics project. The task consisted of a grid of six consonants that appeared for 2 s (encoding), followed by an empty grid for 3 s (maintenance), and then a probe letter (retrieval), when participants responded whether it was in the previous set. All MEG data were transformed into the time-frequency domain and imaged using a beamformer. We found significant alpha oscillations in the left supramarginal and superior temporal regions ($p < 0.000001$), which may reflect operations of the so-called phonological loop component of verbal WM, and in the left inferior frontal region ($p < 0.000001$) throughout the task. In addition, we observed the expected parieto-occipital alpha synchronization during maintenance, although the response was weaker and emerged later than generally reported in adult studies. Finally, behavioral performance improved with age, and we found sex differences with age in the recruitment of right

inferior frontal cortex during encoding and in the parietal and occipital cortices during maintenance, which may reflect an altered developmental trajectory between male and female youth.

Topic Area: EXECUTIVE PROCESSES: Working memory

Alpha and theta enhancement during self-ordered number generation

Poster D41, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Bobby Ruijgrok[1], Olga Kepinska[2]; [1]Leiden University, [2]University of California San Fransisco

Verbal working memory (VWM) capacity can be tested by means of self-ordered number generation. We report electrophysiological results of a VMW experiment consisting of a control task and a self-ordered task, based on a positron emission tomography study (Petrides et al., 1993). The authors examined differences in regional cerebral blood flow during the tasks. The self-ordered condition (compared to the control condition) generated bilateral activation within the mid-dorsolateral frontal cortex. Our goal was to connect this finding to neural oscillations. We recruited 94 participants and recorded their EEG using 32 cap-mounted electrodes. In the first session, participants counted aloud numbers from 1 to 10 at the rate of approximately one digit per second (upon presentation of a question mark). In the second session, participants randomly counted aloud numbers from 1 to 10 while monitoring that every number was only mentioned once in each trial, again being prompted by a question mark. Epochs, time-locked to the question mark onset, were extracted. The frequency bands for our power spectrum analysis were defined as 4-8Hz (theta band) and 8-12Hz (alpha band). Compared to the control task we found an increase of theta power at frontal electrodes in the self-ordered condition. The analysis of alpha oscillations showed a power increase at frontal, temporal and occipital electrodes. With these results we have replicated the finding of enhanced bilateral activity within the mid-dorsolateral frontal cortex. We further show that this activity is mostly underpinned by oscillations corresponding to the theta-band; alpha enhancement was distributed more broadly.

Topic Area: EXECUTIVE PROCESSES: Working memory

Oscillatory Synchrony within the Hippocampal-Thalamo-Prefrontal Circuit of the Rat During Spatial Working Memory-Guided Decision Making

Poster D42, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Andrew Garcia[1], Amy Griffin[1]; [1]University of Delaware

Spatial working memory-guided behavior in the rodent has been shown to be supported by oscillatory synchrony between the hippocampus and the medial prefrontal cortex (mPFC). However, anatomical connections between hippocampus and mPFC are limited to a monosynaptic pathway extending from hippocampus to mPFC. The nucleus reuniens (RE) of ventral-midline thalamus is not only reciprocally connected with both hippocampus and mPFC, but has also been shown to be necessary for spatial WM-guided behavior and hippocampal-mPFC synchrony. To further explore the contributions of RE to oscillatory synchrony within the hippocampal-mPFC circuit, we recorded local field potentials from hippocampus, mPFC, and RE during the delayed nonmatch-to-position task which requires encoding trial-specific information during the sample phase, maintenance across a delay period, and retrieval-guided decision-making during the choice phase. In line with previous reports, we observed higher hippocampal-mPFC theta coherence during the choice phase compared to the sample phase (O'Neill et al., 2013). Coherence between RE and mPFC showed increases in the delta/theta frequency range also specific to the choice phase. Furthermore, these choice phase-specific increases in synchrony were not observed when animals performed the task poorly. Although coherence between RE and hippocampus showed peaks at theta, they were similar in magnitude for sample and choice. Examination of cross-frequency interactions between theta phase and gamma amplitude within RE and between HC and mPFC also showed increases for the choice phase compared to the sample phase. These choice phase-specific oscillatory interactions suggest that distinct patterns of oscillatory synchrony are related to successful sWM-guided behavior.

Topic Area: EXECUTIVE PROCESSES: Working memory

Ortho-semantic learning of novel words in Grade 3 students: An ERP study

Poster D43, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Alena Galilee[1], Lisa Beck[1], Catherine Mimeau[2], S. Hélène Deacon[1], Aaron J Newman[1]; [1]Dalhousie University, Nova Scotia, B3H 4R2, Canada, [2]Université Laval, Quebec City, G1V 0A6, Quebec, Canada

Knowledge of spelling patterns and word meanings — ortho-semantic knowledge — is one factor explaining individual differences in children's reading abilities. At the same time, questions have arisen as to whether children's capacities in acquiring new ortho-semantic knowledge might be more important than existing knowledge (Deacon et al., 2012). The main objective of the present study was to examine how event-related potentials (ERP) change with ortho-semantic learning. Thirteen native English speaking students in Grade 3 completed a learning task in which they learned novel word spellings and meanings by reading short stories. Immediately after learning, participants completed a lexical decision task in which they were presented with real words, novel words from the stories, non-words, consonant strings, and false fonts. Two ERP components were investigated: the N170 (word recognition) and the N400 (lexical semantics). For the N170, false fonts were significantly different from the other four conditions, showing evidence for print tuning. For the N400, differences between real words and false fonts, as well as novel words and false fonts were found, while differences between other conditions were not significant. These results suggest that even after very brief exposure, the ortho-semantically novel words were processed similarly to familiar, real words. Additional analyses will examine relationships between individual differences in word reading, ortho-semantic learning, and the ERPs.

Topic Area: LANGUAGE: Development & aging

Language control network in trilinguals

Poster D44, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Jing Yang[1], Jiali Wu[2], Qi Zhang[3], Ruiming Wang[4], Ke Zhou[5]; [1]Bilingual Cognition and Development Lab, Center for Linguistics and Applied Linguistics, Guangdong University of Foreign Studies, Guangzhou 510420, China, [2]Bilingual Cognition and Development Lab, Center for Linguistics and Applied Linguistics, Guangdong University of Foreign Studies, Guangzhou 510420, China, [3]Bilingual Cognition and Development Lab, Center for Linguistics and Applied Linguistics, Guangdong University of Foreign Studies, Guangzhou 510420, China, [4]Guangdong Provincial Key Laboratory of Mental Health and Cognitive Science, Center for Studies of Psychological Application, School of Psychology, South China Normal University, Guangzhou 510631, China, [5]College of Psychology and Sociology, Shenzhen University, Shenzhen 518060, China

For multilinguals, every utterance requires a choice of language to use. A large body of previous neuroimaging studies on bilinguals suggests that this choice is completed by language control network, commonly regarded as part of the domain-general executive control. However, the neurobiology of language control in various contexts has not been validated. Additionally, learning a third (L3) language involves adapting the control structure of native language (L1) and non-native language (L2): speakers might create a non-hierarchical control system comprising separate branches for L1, L2 and L3, or they build a hierarchical control structure with distinct systems for native language (L1) and non-native language (L2, L3). The language control of multilinguals is not characterized and remains unclear. The present study used functional magnetic resonance imaging (fMRI) to investigate the neural mechanisms for language control in L1-L2, L2-L3 and L1-L3 contexts. Thirty Cantonese-Mandarin-English trilinguals, who were highly proficient in Cantonese (L1) and Mandarin (L2), and moderate proficient in English (L3), performed picture naming tasks in a language-switching paradigm. Our results showed more brain activation in bilateral middle occipital lobes, right fusiform gyrus and right lingual gyrus for switching in L1-L2 condition. Switching in L2-L3 context involved more neural responses in the left fusiform gyrus and left lingual gyrus. L1-L3 context didn't engage more cortices in switching trials compared to non-switching trials. In all, our findings indicate the important roles of bilateral fusiform gyri and lingual gyri in multilinguals' language control and suggest characterization of language control varies in native and non-native ranges.

Topic Area: LANGUAGE: Lexicon

Cortex can entrain to predictable sequences even in the absence of periodicity

Poster D45, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Geoffrey Brookshire[1,2], Daniel Casasanto[1,2]; [1]Cornell University, [2]University of Chicago

When people perceive quasi-rhythmic stimuli such as language or music, oscillations in the brain lock onto pulses in the stimulus. This phenomenon is called cortical entrainment. According to a standard view, cortical entrainment occurs when endogenous cortical oscillations resonate in response to periodic exogenous stimuli (similar to a wine glass vibrating when someone sings). Here we test an alternative account: Perhaps entrainment does not rely on periodic input, at all, but instead occurs whenever the brain can make temporally precise predictions about upcoming events. To test this proposal, we recorded electroencephalography (EEG) while human participants (N=11) watched sequences of images that varied in their periodicity and temporal predictability. Participants saw sequences that were (1) Predictable by virtue of being periodic [Predictable-Periodic], (2) Predictable but not periodic at the frequency of individual items [Predictable-Aperiodic], and (3) unpredictable and non-periodic [Unpredictable-Aperiodic]. We measured entrainment by computing cross-correlations between stimulus onsets and EEG activity in each electrode. The magnitude of the cross-correlation indicates how strongly the EEG signal predicts a stimulus onset at a given lag. In every participant, we found that pre-stimulus cross-correlations were strongest to Predictable-Periodic sequences, and importantly, that cross-correlations were stronger to Predictable-Aperiodic sequences than to Unpredictable-Aperiodic sequences. This result suggests that cortical entrainment does not rely exclusively on oscillatory resonance to rhythmic stimuli. Instead, cerebral cortex may entrain whenever sequences are predictable, even in the absence of periodicity.

Topic Area: LANGUAGE: Other

Task switching decomposed: MEG evidence from bimodal language switching

Poster D46, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Esti Blanco-Elorrieta[1,2], Karen Emmorey[3], Liina Pylkkänen[1,2]; [1]New York University, [2]NYUAD Institute, [3]San Diego State University

A defining feature of human cognition is the ability to quickly and accurately alternate between complex behaviors. This switching process minimally comprises of goal recognition, disengagement from the previous task and engagement in a new task. Previous studies have associated task-switching with prefrontal activity; however, it is unknown how the sub-computations of task switching individually contribute to these activities. This is largely because few natural tasks allow for full separation of disengagement and engagement processes during switching. Here we recorded magnetoencephalography (MEG) from ASL-English bimodal bilinguals who often sign and speak simultaneously. This offers a unique opportunity to dissociate engagement and disengagement. Our MEG recordings showed that turning a language “off” (switching from simultaneous to single language production) led to increased activity in the ACC and PFC, while turning a language “on” (from one language to two simultaneously) did not differ from non-switch trials. The distinct representational nature of the “on” and “off” processes was also supported by multivariate decoding analyses. Granger causality analyses additionally revealed that i) compared to turning-on, turning-off required stronger connectivity between left and right dlPFC and ii) dlPFC activity predicted ACC activity, consistent with models in which the dlPFC is a top-down modulator of the ACC. These results suggest that in language switching, the burden of task-switching lies in disengagement from the previous task as opposed to engagement in a new task, and that in the absence of motor constraints, producing two languages simultaneously is not more cognitively costly than only producing only one.

Topic Area: LANGUAGE: Other

Language-specific and domain-general regions jointly predict individual differences in sentence comprehension: Evidence from a network approach

Poster D47, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Qiuhai Yue[1], Randi C. Martin[1], Simon Fischer-Baum[1], Michael W. Deem[1]; [1]Rice University

Some researchers have claimed that the neural substrate for high-level language processes does not involve regions which are engaged in a wide range of domain-general non-linguistic processes (e.g., working memory, cognitive control), with domain-general regions only activated by complicated sentence structures (e.g., strong garden paths, object relatives) rarely encountered in natural conversation. The current study addressed these claims by examining whether individual differences in comprehension of unambiguous sentences with commonly encountered structures was better predicted by interconnectivity of a network comprised of both language-specific and domain-general nodes or interconnectivity within the language network. We used graph theoretic tool to estimate modularity for each of 42 subjects based on the correlation matrix for functional connectivity between nodes during resting-state fMRI. A sentence comprehension task administered to the same participants outside the scanner manipulated the degree of semantic and syntactic interference. Consistent with our previous findings relating lower modularity (i.e., relatively strong between-module connections) with better complex task performance, correlational analysis between behavior and brain network modularity indicated that better performance in comprehending more difficult sentences was associated with lower modularity derived from the network combining language and domain-general regions, but had no relationship with the modularity of the language network per se. Our findings support the claim that domain-general regions play a role as sentence complexity increases. The results provide a strong challenge to theories claiming the independence of the language network.

Topic Area: LANGUAGE: Other

fMRI Mapping of Language Areas in Bilingual Neurosurgical Patients

Poster D48, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Lok Wa Laura Leung[1,2], Prashin Unadkat[1], Luca Fumagalli[1,3], Laura Rigolo[1], Alexandra Golby[1], Yanmei Tie[1]; [1]Harvard Medical School, Boston, MA, USA, [2]The Chinese University of Hong Kong, Hong Kong, [3]Università degli Studi di Milano-Bicocca, Milan, Italy

An important issue of neurosurgical preoperative planning is the ability to achieve maximal resection whilst minimizing the risk of severe post-operative neurological impairment. Previous literature has suggested post-operative disparity in language ability of bilingual brain tumor patients. In this study, active cortical areas were mapped using functional MRI (fMRI) for bilingual neurosurgical patients in an attempt to localize language areas. Fifteen bilingual patients (range 23 to 59 years) with epilepsy and brain tumors participated in the study through consent with the Institutional Review Board (IRB). Subjects performed the antonym generation task in English and one non-English language. Acquisition of images was achieved using 3T scanners. Blood-oxygen-level dependent (BOLD) fMRI data were analyzed using Statistical Parametric Mapping software (SPM12). Task-induced activations were analyzed focusing on structurally-defined language regions of interests (ROIs) including Broca's and Wernicke's areas. Activation volume, laterality index (LI) and DICE coefficient (percentage overlap) were subsequently calculated. Our results revealed no significant differences between the two languages' fMRI results (English vs. non-English): (1) Activation volume: Broca's area: 8080.191 +/-3936.811mm vs 8732.119 +/-4293.954mm, Wernicke's area: 2081.375 +/-1401.422mm vs 2782.245 +/-2474.413mm; (2) LI: 0.542 +/-0.269 vs 0.559 +/-0.284. The DICE coefficient exhibited fair overlap (0.520 +/-0.171). Although results indicated similar activation extent and lateralization for both languages in bilingual patients, our result suggested that dual mapping could improve the sensitivity of pre-operative planning which is of great importance for surgical planning. Further studies with larger groups of bilingual patients are needed to support our conclusions.

Topic Area: LANGUAGE: Other

Auditory fMRI language 'localizer' study with epilepsy patients

Poster D49, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Beau Snoad[1], Phillip Gander[1], Matthew Howard III[1]; [1]University of Iowa

Language processing is supported by an extensive network including temporal, frontal and parietal regions. In surgical epilepsy patients, the localization of these areas is critical for postsurgical outcomes. We used a new passive auditory language 'localizer' task (Scott et al. 2016) to identify key cortical regions supporting language in 7 surgical epilepsy patients. We collected non-simultaneous fMRI and electrocorticography (ECoG) data in each patient. The task consists of 16 pairs of degraded and non-

degraded speech stimuli presented across two runs. Neural responses to non-degraded and degraded speech stimuli were contrasted to each other and to silence using SPM12. On a single subject level, we first contrasted responses to speech versus silence and found distinct activations in bilateral auditory cortex and planum temporale ($p<0.05$ uncorrected). When comparing degraded versus non-degraded speech we found that non-degraded stimuli elicited robust activations of primary auditory cortex and insula ($p<0.05$ uncorrected). In contrast, degraded stimuli activated the anterior cingulate, orbitofrontal cortex (OFC) and prefrontal cortex (PFC) ($p<0.05$ uncorrected). These activity patterns were similar across subjects. ECoG data is currently being analyzed for further comparisons between methods. These preliminary results identify a network of high-level language processing regions at the individual subject level and support findings from previous studies. More importantly, these findings show that the new passive auditory language 'localizer' is suitable for the pre-surgical evaluation of epilepsy patients.

Topic Area: LANGUAGE: Other

Differences in Resting State Functional Connectivity Between Early and Late Bilinguals

Poster D50, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Laura Mesite[1], Sibylla Leon Guerrero[1], Veronica Whitford[2], Gigi Luk[1]; [1]Harvard Graduate School of Education, [2]The University of Texas at El Paso

We compared seed-based resting state connectivity among young adults (mean age = 25 years) who acquired their second language (L2) before 8 years (early bilinguals, n = 14) and those who acquired after 8 (late bilinguals, n = 14). Given the longer persistent need to attend to multiple language systems, we expected that early bilinguals would demonstrate stronger functional connectivity at rest among key regions related to language and executive control. Bilingual participants spoke a variety of first and second languages with comparable L2 proficiency across groups. Functional magnetic resonance imaging data were acquired on a 3-Tesla Siemens Prisma scanner with a 32-channel head coil. Participants underwent a 6-minute resting state scan and the functional data were pre-processed using afni_proc.py. FWE-corrected group differences were investigated using 3dGroupInCorr in AFNI with seed regions related to language and executive control. Results showed that early bilinguals demonstrated stronger functional connectivity than late bilinguals between the right dorsolateral prefrontal cortex seed (x=30, y=54, z=22, MNI) and bilateral posterior cingulate, bilateral anterior cingulate, and bilateral insula. In addition, activity in the right inferior frontal gyrus seed (x=50, y=16, z=18, MNI) was more strongly correlated with activity in the bilateral anterior and posterior cingulate, bilateral posterior cerebellum, and the left middle temporal gyrus for early bilinguals. These findings suggest that age of L2 acquisition modulated functional connectivity at rest, demonstrating stronger functional coupling between regions responsible for language and domain-general cognition for early bilinguals.

Topic Area: LANGUAGE: Other

Rapid microstructural brain plasticity following a short word learning session: a combined TMS and diffusion kurtosis imaging study

Poster D51, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Nikola Vukovic[1], Torben Lund[1], Brian Hansen[1], Sune Jespersen[1], Yury Shtyrov[1,2,3]; [1]Center of Functionally Integrative Neuroscience (CFIN), Aarhus University, Denmark, [2]Saint Petersburg State University, Saint Petersburg, Russia, [3]National Research University Higher School of Economics, Moscow, Russia

Despite the clear importance of language in our lives, the neurobiological underpinnings of our ability to quickly and effectively learn new words and their meanings are poorly understood. Conventional studies typically focus on slow long-term processes accompanying language learning. Whereas language acquisition is indeed a laborious process, especially in adulthood, recent studies suggest that neurophysiological signatures of learning can be near-instantaneous. This raises key questions: is rapid functional learning of words underpinned by equally rapid micro-structural remodelling of the brain? If so, what is the neuroanatomical profile of such changes and can their causal role be established? We address these challenges by using a microstructurally sensitive diffusion MRI technique called diffusion kurtosis imaging (DKI) to identify cytoarchitectural remodelling after mere minutes of word learning. We used a virtual-reality training protocol, in which the learning efficiency in acquiring novel nouns and verbs was modulated by M1 TMS. Our findings show that a single learning session caused rapid plasticity in a number of key brain regions related to learning and language processing, including the hippocampus, anterior temporal cortex, and angular gyrus. Moreover, we demonstrate that the motor cortex is causally involved in the encoding of novel language, and not just retrieval, as was previously shown. Indeed, TMS-induced changes in M1 excitability predicted plastic reorganisation in high-level lexico-semantic regions, both immediately and after an overnight consolidation stage. In sum, our study reveals some of the earliest microstructural signatures of regional brain plasticity potentially indicating its causal relevance for fast word acquisition.

Topic Area: LANGUAGE: Semantic

Brain Response to Semantic Violations in a Miniature Artificial Language about Time

Poster D52, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Seana Coulson[1], Tania Delgado[1], Tyler Marghetis[2], Tessa Verhoef[1,3], Esther Walker[1]; [1]University of California, San Diego, [2]Indiana University, [3]Leiden University

Do people have a bias to learn some time-space mappings over others? Here we recorded EEG as participants learned an artificial language derived from a social communication game. The mini-language included 16 discrete 1.5-second movements of a round knob along a vertical bar, each corresponding to a particular temporal concept (e.g., day, second, year). The behavioral study revealed two strategies, (1) a duration mapping strategy, hypothesized to reflect a cognitive bias, in which participants used larger portions of the bar to refer to temporal intervals that were longer; and (2) an order mapping strategy, that relied more on social interaction, in which dyads used either the top or the bottom of the bar to refer to concepts in the future. Participants viewed each 1.5-second signal followed by a potential English translation of the signal (e.g. yesterday), and then pushed a button to indicate whether or not the translation was correct. Participants' response triggered a feedback tone that enabled learning. ERPs were time-locked to the onset of English translations. The mean amplitude of ERPs was measured 300-500ms post-stimulus onset to index N400, and 500-800ms post-stimulus to index P600. Analysis contrasted ERPs to matching versus mismatching translations. The duration violations elicited enhanced N400 in the first block, and an N400/P600 complex in the second block. Similar analysis of order mappings revealed no reliable ERP effects in the first block, and significantly larger amplitude N400 for order violations in the second block. Results suggest duration mappings were more rapidly learned than order mappings.

Topic Area: LANGUAGE: Semantic

How abstract concepts are neurally represented

Poster D53, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Robert Vargas[1], Marcel Just[1]; [1]Carnegie Mellon University

Abstract concepts are typically defined indirectly as the opposite of concreteness, failing to specify their neural or cognitive basis. Contemporary neuroimaging techniques were applied to more directly characterize abstractness. Neural representations of 28 abstract concepts (defined as activation levels across 120 voxels with a stable semantic tuning curve across concepts) were assessed using fMRI data in 9 participants. A classifier (Gaussian Naive Bayes) trained on neural signatures in a subset of the data for each subject decoded the concepts in an independent subset (mean rank accuracy was 0.82, chance threshold = 0.53, $p < 0.01$). Representational commonality across participants was indicated by successful identification of concepts when trained on all but a left-out test participant (mean rank accuracy was 0.74, chance threshold = 0.54, $p < 0.01$). Factor analysis revealed 3 semantic dimensions underlying the activation patterns, providing a brain-based ontology for this set of abstract concepts. The 3 dimensions are: Verbal Characterization (degree a concept is defined in terms of other concepts (e.g. faith [more verbal] vs. gravity [less verbal]); Externality/Internality of the concept to the perceiver (e.g. deity [external] vs. sadness [internal]); and the Social Content of the concept (e.g. gossip [social] vs. heat [asocial]). A cross-validated generative model, using behavioral ratings for the 28 concepts' along the 3 dimensions, provided converging evidence for the interpretation (mean rank accuracy = 0.71). In conclusion, representation of abstract concepts requires the activation of more complex neurocognitive functions (i.e. language, self representation, and social interaction) rather than separation from perceptual information.

Topic Area: LANGUAGE: Semantic

The unbearable lightness of meaning: Linking adjective informativity and flexibility

Poster D54, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Sarah Solomon[1], Sharon L Thompson-Schill[1]; [1]University of Pennsylvania

The informational content of individual words is flexible across contexts. Even simple adjectives vary in their informativeness when paired with different nouns: "dark" is more informative in "dark paint" than it is in "dark charcoal." The challenge is thus to propose a theory of conceptual structure and combination that is consistent with these flexibility effects. Entropy is a measure from information theory that reflects the information content of a signal; here we use it to reflect the informativity of an adjective with respect to a specific noun, and test whether this construct can predict adjective flexibility. We paired the scalar adjectives of "light" and "dark" with 45 object noun concepts which spanned the conceptual brightness range (e.g., "snow", "fur", "charcoal"), and collected darkness probability and entropy values for each concept. Explicit darkness value judgments were made by adjusting a slider above a visual bar that ranged from white to black. Some subjects reported the darkness value for each of the 45 unmodified concepts (e.g., "snow"); others reported the darkness value for 45 modified concepts (e.g., "dark snow", "light fur"). For each concept, we calculated the "dark" and "light" effect by calculating the extent to which darkness was modulated by each modifier, and calculated the general adjective effect for each concept. We found that entropy did predict the general adjective effects, suggesting that adjective informativity determines the amount of property modulation involved in the comprehension of adjective-noun combinations. This quantitative model facilitates the study of the neural underpinnings of conceptual flexibility.

Topic Area: LANGUAGE: Semantic

Systematic Variability in Language Related ERP Morphology

Poster D55, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Shannon McKnight[1], Donald Bell-Souder[1], Akira Miyake[1], Albert Kim[1]; [1]University of Colorado Boulder

ERP studies of language comprehension widely observe that semantic anomaly modulates a central-parietal negative-going wave ~300-500 ms after word-onset (N400), while syntactic anomalies elicit a positive-going wave ~500-800 ms after word-onset (P600). These ERPs illuminate neurocognitive processes, but their interpretation is complicated by variability in EEG activity often ignored in ERP studies. We characterized the consistency and variability of language processing ERPs in a large group of 159 participants, by repeatedly re-sampling into smaller groups of 20, 30, and 40 participants, simulating different runs of the same experiment. We observed classic N400 and P600 effects but also substantial variability in the morphology and antecedent conditions of those ERPs across samples. Semantic anomaly N400s sometimes extended beyond the classic time window to ~800-900 ms after word-onset. Across samples, extended N400s predicted smaller syntactic anomaly P600s, suggesting a tradeoff between N400 and P600 generators across sentence types. Syntactic anomalies sometimes elicited a left anterior negativity (LAN), and this was negatively correlated with a subsequent P600, suggesting that LAN and P600 within the same anomaly type also trade off. N400 effects were less variable in time than P600 effects, leading to consistently larger effect sizes for N400 than P600 effects. Overall, the results suggest important considerations for language processing ERP studies, including: 1) N400 effects will sometimes appear instead of, and obscure P600 effects, due to inter-individual differences in the population; 2) the LAN may be an artifact of component overlap between N400 and P600 activity within a group of participants.

Topic Area: LANGUAGE: Syntax

The Influence of Verb Bias on Online Mandarin Relative Clause (RC) Processing: an ERP study

Poster D56, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Jou-An Chung[1], Chia-Lin Lee[1], Chia-Ying Lee[2]; [1]National Taiwan University, Taiwan, [2]Academia Sinica, Taiwan

The preference of processing either subjective (SRC) or objective relative clause (ORC) in Mandarin has been extensively investigated; however, inconsistencies are found across theories and psycholinguistic experiments which might appear to arise from the fact that most of the studies focus on RC structure itself, but other factors such as context should be also taken into account. Hence, this study aims to investigate how verb bias which carries both syntactic and semantic information incrementally modulates RC processing in Mandarin, and further examines two language processing models: constraint-based and two-stage model. 41 verbs chosen from Sinica Corpus were classified into three types of biases: Direct Object (DO), Sentential Complement (SC), and Equilibrium Balanced (EQ). Each verb is followed by a ORC (1stnoun + RCverb + RCmarker DE + head noun). Relative to SC bias condition, several effects were seen in DO bias condition, including frontal positivity (630-1000ms) to the RCverb, indicating the difficulty of processing unexpected but plausible syntactic structure, N400 effect to DE, reflecting integration process, and late frontal negativity (650-850ms) to head noun, revealing the need of referential binding between DO bias verb and direct object. While verb exhibits clear tendency towards specific syntactic and semantic information, readers use verb's embedded information to predict upcoming structure, supporting constraint-based model. EQ bias condition showed a similar pattern with DO condition. When processing EQ bias verb, readers tend to expect simple syntactic structure, supporting two-stage model. In sum, this study provides ERP evidence that verb bias incrementally influences Mandarin RC processing.

Topic Area: LANGUAGE: Syntax

Multiple brain markers mediate age-related changes in cognition

Poster D57, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Trey Hedden[1,2], Hannah E. Nierle[1], Rodrigo D. Perea[1,2], Jennifer S. Rabin[1,2], Rachel F. Buckley[1,2,3], Aaron P. Schultz[1,2], Keith A. Johnson[1,2,4], Reisa A. Sperling[1,2,4]; [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]University of Melbourne, [4]Brigham and Women's Hospital

How do age-related changes in cognitive function follow from differences in brain morphometry, function, and disease-related biomarkers? Here, we examined how multiple brain markers mediate age-related changes in several cognitive domains. Methods: Cognitively normal older adults aged 62-90 from the Harvard Aging Brain Study (N=254) were characterized at baseline on MRI markers of gray matter thickness and volume, white matter lesions (WML) and fractional anisotropy (FA), resting state functional connectivity, and PET markers of glucose metabolism (FDG) and amyloid burden. Longitudinal change in the cognitive domains of processing speed, executive function, and episodic memory were assessed with follow-up of 2-6 years (mean = 4.2 years). Linear mixed models estimated subject-specific slopes. Mediation models examined which brain markers significantly mediated age-related change in cognition. Results: When all brain markers were simultaneously entered as mediators, approximately 80% of the age-related variance in cognitive change was mediated for all cognitive domains (but only <=34% of total variance in cognitive change was related to brain markers). Backward elimination models identified cortical thickness, FA, and FDG as significant mediators of age-related change in processing speed. Hippocampal volume and amyloid were significant mediators of age-related change in executive function. Hippocampal volume, amyloid, entorhinal thickness, and FDG were significant mediators of age-related change in episodic memory. Conclusion: These results suggest that the majority of age-related variation in cognitive change can be mediated by multiple brain markers, and that brain markers reflective of Alzheimer's disease pathology are among the most important mediators of cognitive change during aging.

Topic Area: LONG-TERM MEMORY: Development & aging

Reward learning in pre-symptomatic and symptomatic Huntington's disease

Poster D58, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Madeleine Sharp[1], Karen Marder[2], Daphna Shohamy[3]; [1]McGill University, [2]Columbia University Medical Center, [3]Columbia University

Striatal neurons are the earliest target of Huntington's disease and neuroimaging studies in humans have confirmed that striatal atrophy is detectable even in the earliest stages of the disease. This early, or pre-symptomatic stage of Huntington's disease is also characterized by subtle behavioural changes, but attempts to track early disease progression with behaviour have been largely unsuccessful, probably owing to the fact that the clinical scales used to measure behaviour and cognition are often non-specific. Remarkably, despite the extensive literature demonstrating the crucial role of the striatum in signalling reward, to our knowledge no studies have investigated specific striatum-dependent cognitive processes in patients with Huntington's disease. Here we aimed to address this gap by measuring reward learning in pre-symptomatic Huntington's patients, symptomatic patients and healthy controls. As expected, results show that learning rate and overall performance are impaired in symptomatic Huntington's patients but importantly, that they are also impaired, though to a lesser degree, in pre-symptomatic patients. These findings suggest that reward learning could be used as a marker of disease, even in the earliest stages. Ongoing work aims to determine whether reduced reward learning represents a cognitive mechanism underlying early behavioural symptoms such as apathy.

Topic Area: LONG-TERM MEMORY: Development & aging

I did it my way: Explaining age-related declines in inter-subject synchronization during naturalistic viewing

Poster D59, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Karen Campbell[1], Cam-CAN[2], Linda Geerligs[3]; [1]Brock University, [2]Cambridge Centre for Ageing and Neuroscience, University of Cambridge and MRC Cognition and Brain Sciences Unit, [3]Donders Institute for Brain, Cognition and Behaviour, Radboud University

When people watch the same naturalistic stimuli (movies), significant inter-subject synchronization (or correlation) between their fMRI timecourses can be observed, not only in primary sensory areas, but also in frontal and parietal regions. We have previously shown that this inter-subject synchronization decreases with age (Campbell et al.,2015-Neurobiol Aging). In the current study, we replicate this effect in a larger sample (N=585) from the Cambridge Centre for Ageing and Neuroscience (www.cam-can.com), and aim to determine its etiology. We show that while synchrony within primary auditory and visual regions is preserved with age, it declines within a number of higher-order regions, mainly the default mode (DMN) and frontoparietal control networks (FPCN). Cluster analyses confirmed that aging is associated with an increase in idiosyncratic (or individualistic) responding to the movie, rather than the emergence of distinct subgroups who respond to the movie in a similar way. Using a sliding window analysis, we show that synchrony within the FPCN and DMN increases throughout the course of the movie and that older adults' idiosyncratic responding increases over time. Finally, we show that (controlling for age) greater synchrony in the FPCN relates to greater functional connectivity (FC) within and between the FPCN and DAN, while synchrony in the DMN relates to FC within and between the DMN and inferior temporal cortex. Together, these findings suggest that age-related differences in FC may contribute to older adults' idiosyncratic responding, and this idiosyncratic responding appears to increase over time, possibly reflecting older adults' diverging interpretations as the narrative progresses.

Topic Area: LONG-TERM MEMORY: Development & aging

Self-Focus Encoding Increases Non-Diagnostic Recollection and the LPC Event-Related Potential

Poster D60, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

P. Andrew Leynes[1], Cristina Nardini; [1]The College of New Jersey, [2]The College of New Jersey

Prior work using word stimuli uncovered evidence that encoding focus (i.e., self-focus or other-focus) altered non-diagnostic recollection and the putative ERP correlate of recollection (i.e., the Late Positive Component, LPC; Leynes & Mok, 2017, Brain & Cognition). The present study examined the generality of these effects by using picture stimuli and varying the emotional encoding aspects. Participants studied product images presented with either a blue or yellow filter. Participants judged whether they liked the product in the self-focus encoding condition, whereas they judged the color of the picture filter in the other-focus encoding

condition. At test, participants made source judgments regarding the filter color of the studied image. Both the behavioral and ERP data replicated previous research that indicated encoding focus altered the amount of diagnostic recollection. Self-focus encoding produced more positive encoding ERPs, greater recognition measures, and a greater LPC amplitude. Relative to self-focus encoding, Other-focus encoding led to equivalent source memory, a greater FN400 component (the neural correlate of familiarity), and a smaller LPC amplitude. This evidence suggests that the LPC tracks non-diagnostic recollection, and emotion is not necessarily the factor that drives encoding focus effects as some have suggested. Additionally, source judgments appeared to be based on familiarity following other-focus encoding presumably because attending to the filter color increased unitization of visual features. These findings indicate that small differences in encoding processes can produce detectable changes in familiarity, diagnostic recollection, and non-diagnostic recollection.

Topic Area: LONG-TERM MEMORY: Episodic

Neural pattern classification tracks transfer-appropriate processing in episodic memory

Poster D61, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Mikael Johansson[1], Inês Bramão[1]; [1]Lund University

The transfer-appropriate processing (TAP) account holds that episodic memory depends on the overlap between encoding and retrieval processing (e.g., perceptual or conceptual). In the current study, we employed multivariate pattern analysis (MVPA) of electroencephalography to examine the relevance of spontaneously engaged processing during encoding for later retrieval. Participants encoded word-picture associations, where the picture could be a famous face, a landmark, or an object. At test, we manipulated the retrieval demands by asking participants to retrieve either visual or verbal information about the pictures. MVPA revealed classification between picture categories during early perceptual stages of encoding (~170 ms). Importantly, these visual category-specific neural patterns were predictive of later episodic remembering, but the direction of the relationship was contingent on the particular retrieval demand of the memory task: a benefit for the visual and a cost for the verbal. A reinstatement of the category-specific neural patterns established during encoding was observed during retrieval, and again the relationship with behavior varied with retrieval demands. Reactivation of visual representations during retrieval was associated with better memory in the visual task, but lower memory performance in the verbal task. Taken together, our findings provide novel evidence in favor of the TAP account and further demonstrate that processing of particular aspects during memory formation can have detrimental effects on later episodic remembering when other aspects of the event are called-for.

Topic Area: LONG-TERM MEMORY: Episodic

Age differences in neural pattern similarity associated with false recognition

Poster D62, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Caitlin Bowman[1], Christina Webb[2], Jordan Chamberlain[2], Nancy Dennis[2]; [1]University of Oregon, [2]The Pennsylvania State University

Older adults are more likely than young to endorse new information as old when it shares features with studied information. Such age-related increases in false recognition may be related to age differences in how retrieval lures elicit reactivation of information from study. Such reactivation may promote lure rejection by helping to detect mismatch between targets and lures, or it may promote false recognition when reactivated representations lack details necessary to make these distinctions. We used an encoding-retrieval pattern similarity analysis in young and older adults to compare the overlap in neural representations between retrieval lures and their respective targets at encoding, and then linked these similarity patterns to false recognition and correct rejection responses. Across age groups, we found greater encoding-retrieval similarity for targets and lures compared to completely new items in inferior frontal gyrus, middle temporal gyrus, and several visual regions. Within these regions, pattern similarity between lures and studied information tracked false recognition in inferotemporal cortex and middle temporal gyrus in both age groups, suggesting that memory representations in these regions lack the specificity necessary to distinguish between targets and related lures. We also identified age differences in lateral occipital cortex, where only young adults showed differences in target-lure pattern similarity based on how strongly the lure resembled the target. Representations in this region were linked to both target recollection and lure rejection, indicating that aging reduces reactivation of visual details from encoding that facilitate lure rejection, contributing to increased false recognition.

Topic Area: LONG-TERM MEMORY: Episodic

Neural mechanisms of episodic retrieval support divergent creative thinking

Poster D63, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Kevin P. Madore[1], Preston P. Thakral[2], Roger E. Beaty[2], Donna Rose Addis[3], Daniel L. Schacter[2]; [1]Stanford University, [2]Harvard University, [3]University of Auckland

Prior research has indicated that brain regions and networks that support semantic memory, attention, and cognitive control are all involved in divergent creative thinking. Kernels of evidence suggest that neural processes supporting episodic memory – the retrieval of particular elements of prior experiences – may also be involved in divergent thinking but such processes have typically been characterized as not very relevant for, or even a hindrance to, creative output. In the present study, we combine functional magnetic resonance imaging with an experimental manipulation to test formally, for the first time, episodic memory's involvement in divergent thinking. Thirty-two young adults completed a within-subjects design, and task analyses focused on whole-brain univariate regression models and multivariate independent component analyses. Following a manipulation that facilitates detailed episodic retrieval, greater neural activity in the hippocampus and stronger connectivity between a core brain network linked to episodic processing and a frontoparietal brain network linked to cognitive control were observed during divergent thinking relative to an object association control task that requires little divergent thinking. Stronger coupling following the retrieval manipulation extended to a subsequent resting-state scan with univariate seed-to-voxel connectivity. Neural effects of the episodic manipulation were consistent with behavioral effects of enhanced idea production on divergent thinking. The results indicate that conceptual frameworks should accommodate the idea that episodic retrieval can function as a component process of creative idea generation, and highlight how the brain flexibly utilizes the retrieval of episodic details for tasks beyond simple remembering.

Topic Area: LONG-TERM MEMORY: Episodic

Scene-specific cortically distributed activation patterns predict mnemonic reactivation

Poster D64, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Benjamin R Geib[1], Erik A Wing[1], Marty G Woldorff[1], Roberto Cabeza[1]; [1]Duke University

Early studies of memory reactivation during retrieval focused on region-specific univariate activation differences. With the advent of multivariate methods (e.g., representational similarity analyses), however, this type of approach has fallen out of favor. While multivariate methods are often more sensitive, a drawback of them is that they assume all stimuli are represented in a given region, a conclusion contrary to perceptual models that suggest some degree of cortical stimulus-specificity. The current fMRI study utilizes novel analysis techniques to address this discrepancy. During memory encoding, subjects were presented with 96 scenes with associated scene labels while making typicality judgements, and during retrieval the subjects were presented with the scene labels alone (e.g., beach). Subjects' encoding data was pooled to create 96 scene-specific activation maps. Representational similarity analyses revealed that semantically similar scenes had similar activation maps, and that a left-out subject's activation maps (for all scenes) could be predicted from the other subjects, confirming that distributed scene-specific patterns of activity exists across subjects. Additionally, and more importantly, scene-specific activity was reliably recapitulated in scene-specific regions during retrieval, with greater activity predicting better memory. These results suggest that while localized patterns of reactivation are predictive of memory, more distributed patterns of activity across the brain are also predictive. The relationship between these local and distributed activation patterns will be explored in future analyses.

Topic Area: LONG-TERM MEMORY: Episodic

Remembering with high fidelity: Evidence implicating sleep and sleep spindles

Poster D65, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Sarah Witkowski[1], Jessica Creery[1], Leonardo Dionisio[1], Ken A. Paller[1]; [1]Northwestern University

Current theories of sleep postulate that memories can be strengthened through replay. This replay is thought to be engaged spontaneously during sleep, and has tentatively been associated with fast sleep spindles in EEG recordings (brief increases in oscillatory activity at 13.5-15 Hz). In this study, we investigated EEG sleep physiology and memory using a difficult object-recognition test and a spatial-recall test. Participants first learned the locations of 64 objects on a grid. Each object was presented with a related sound. After a pre-nap test of this spatial knowledge, participants took a 90-minute nap, and 32 object sounds were presented softly during slow-wave sleep. Upon waking, participants were given a surprise recognition test with 96 objects, including 32 old (seen before), 32 similar (same category as one seen before), and 32 new objects. Participants attempted to identify each object as old, similar, or new, and then took a post-nap spatial recall test. A recognition specificity score was calculated as the sum of correctly recognized old and similar objects from the object-recognition task. Fast spindle density during sleep (spindles per minute) correlated with the specificity score, but not with spatial recall accuracy. Cues during sleep produced a relative improvement for top-half learners in spatial recall, as observed in previous studies of targeted memory reactivation (TMR). Recognition specificity wasn't influenced by TMR. Overall, these results provide further evidence that fast spindles play a role in memory consolidation during sleep, particularly for memory precision with respect to remembering which specific objects were seen before.

Topic Area: LONG-TERM MEMORY: Episodic

Transient and sustained processes involved in encoding emotional information

Poster D66, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Kyle A Kurkela[1], Rosalie Samide[1], Maureen Ritchey[1]; [1]Boston College

When considering the influence of emotion on memory encoding, we can distinguish between two types of processes: transient processes that support memory for the emotional significance of individual memoranda and sustained processes that support memory modulation by affective states. In past emotional memory studies, these two types of processes have often been intertwined and have focused primarily on event-related responses to emotional information. In this study, we sought to distinguish between the transient and sustained processes supporting emotional learning. FMRI data were collected while participants learned about neutral object images that were presented in blocks associated with distinct visual contexts. For each block, participants were cued to learn that the objects were “bombs” or “safe.” To imbue the bomb objects with emotional significance and to induce anxiety during threat contexts, bomb objects were accompanied by an unpredictable white noise burst on 25% of trials (compared to a non-aversive neutral tone for safe objects). Immediately after encoding, participants completed a retrieval phase that assessed item recognition and emotional source memory. We found that brain activity during encoding distinguished between the threat and safe contexts in areas previously linked to threat avoidance, such as the caudate nucleus. In contrast, MTL regions, such as the perirhinal cortex, were associated with transient changes in activity that predicted subsequent memory for item-emotion associations. Future analyses will assess the relationship between sustained and transient activity changes. These results will shed new light on how learning about emotional information is modulated by ongoing affective states.

Topic Area: LONG-TERM MEMORY: Episodic

Current sleep disturbance in older people with a lifetime history of depression is associated with increased connectivity in the Default Mode Network

Poster D67, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Andrew McKinnon[1,4,8], Ian Hickie[1], Jan Scott[1], Shantel Duffy[1,7], Louisa Norrie[1], Zoe Terpening[1], Ron Grunstein[5], Jim Lagopoulos[1,6], Jennifer Batchelor[4], Simon Lewis[1], James Shine[1], Sharon Naismith[1,2,3]; [1]Healthy Brain Ageing Program, [2]School of Psychology, [3]Charles Perkins Centre and Brain and Mind Centre, The University of Sydney, [4]Department of Psychology, Macquarie University, [5]Woolcock Institute of Medical Research, NSW, Australia, [6]Sunshine Coast Mind and Neuroscience - Thompson Institute, University of the Sunshine Coast, QLD, Australia, [7]Central Clinical School, Faculty of Medicine, The University of Sydney, [8]Cognition and Neuroimaging Lab, Department of Psychology, The University of Arizona

The present study investigated Default Mode Network (DMN) functional connectivity in subjects with a lifetime history of major depression, comparing those with and without current sleep disturbance. A total of 93 adults aged 50 years and over were recruited from the Healthy Brain Ageing Clinic at the Brain and Mind Centre, Sydney, Australia. The sample comprised two groups, including 22 controls and 71 participants with a lifetime history of DSM-IV major depression (with depressive episode current or remitted). 52 of those with a lifetime history of depression also met criteria for Mild Cognitive Impairment (MCI). Participants underwent resting-state fMRI along with comprehensive psychiatric, neuropsychological, and medical assessment. Subjective sleep quality was assessed via the Pittsburgh Sleep Quality Index (PSQI). Sleep disturbance was defined as a PSQI score>5. A total of 68% (n=48) of cases with a lifetime history of depression met criteria for sleep-disturbance. Relative to controls, those with lifetime major depression demonstrated significantly increased functional connectivity between the ventromedial prefrontal cortex and the temporal pole. Within the depression group (n = 48), those with current sleep disturbance had significantly increased connectivity between the anterior medial prefrontal cortex and both the parahippocampal cortex and the hippocampal formation, relative to those without sleep disturbance (n = 23). These results were present after controlling for MCI diagnosis. Current sleep disturbance together with depression is associated with distinct abnormalities in DMN functioning incorporating regions responsible for self-reflection and declarative memory processes. Impaired sleep is associated with increased connectivity between these regions.

Topic Area: LONG-TERM MEMORY: Episodic

Encoding Focus Does Not Affect Recollection of Action Memories: Event Related Potentials (ERP) and Modeling Evidence

Poster D68, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Cristina Nardini[1], Anna Abriman[1], Alex Batterman[1], Sabrina Bogovic[1], Nick Danduone[1], Suma Mallepeddi[1], Palak Patel[1], Tanushi Upadhyay[1], Kanza Tahir[1], P. Andrew Leynes1[1]; [1]The College of New Jersey

Prior work using word stimuli uncovered evidence that encoding focus (i.e., self-focus or other-focus) altered non-diagnostic recollection and the putative ERP correlate of recollection (i.e., the Late Positive Component, LPC; Leynes & Mok, 2017, Brain & Cognition). The present study examined the generality of these effects by using action stimuli. Participants viewed videos of either a male actor or female actor completing simple actions (e.g., Launch the Rocket; Climb the Stairs). Participants judged how much fun they thought they would have performing the action in the self-focus encoding condition, whereas they rated how much fun the actor had while performing the action in the other-focus encoding condition. At test, participants made source judgments regarding who (i.e., male or female) performed the action. Both the behavioral and ERP data indicated that encoding focus did not affect the amount of diagnostic recollection. Self- and other-focus encoding produced similar recognition and LPC amplitudes. This evidence differs from the effects derived from picture and word stimuli that indicate self-focus encoding increases non-diagnostic recollection. In this study, all actions (regardless of encoding type) promoted strong recollection, which are similar to other demonstrations that depth of encoding manipulations do not affect memory for actions. This is an important boundary condition for self-focus encoding, and it is additional evidence that action memory creates more vivid traces as compared with pictures or words that are typically used in lab-based memory tests.

Topic Area: LONG-TERM MEMORY: Episodic

Functional wiring of the human medial temporal lobe

Poster D69, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Ethan Solomon[1], Joel Stein[1], Sandy Das[1], Michael Sperling[2], Kareem Zaghloul[3], Cory Inman[4], Bradley Lega[5], Kathryn Davis[1], Gregory Worrell[6], Barbara Jobst[7], Daniel Rizzuto[1], Michael Kahana[1]; [1]University of Pennsylvania, [2]Thomas Jefferson University Hospital, [3]National Institutes of Health, [4]Emory School of Medicine, [5]University of Texas Southwestern, [6]Mayo Clinic, [7]Dartmouth Medical Center

Storing episodic memory is an inherently integrative operation, long conceptualized as a process that binds information about new experiences to a prevailing neural context. Neural synchronization, or the correlated spectral activity between different parts of the brain, has been proposed as a general mechanism for this binding process. However, the dynamics of neural synchronization in the human brain are largely unexplored, especially at the fine spatial scales of critical memory areas like the medial temporal lobe (MTL). Here, we characterize synchronization within substructures of human MTL that occurs during verbal memory encoding and retrieval. We leverage a large dataset of 87 subjects fitted with indwelling electrodes in the MTL and use connectivity measures which are resistant to electrical artifacts (the weighted phase-lag index). We find that, during successful encoding, MTL substructures tend to synchronize at low frequencies (theta/apha, 4-13 Hz). Particularly strong coupling was observed between the rhinal and parahippocampal cortices (PHC), but connections were also found between CA1, subiculum, and rhinal cortex. At higher frequencies (gamma, 30-90Hz), we observe strong desynchronizations of neural activity but note that synchronization is observed if volume-conduction artifacts are not considered, refuting longstanding notions of intra-MTL gamma synchronization. Moreover, we observe elevated spectral power in the gamma band during periods of enhanced theta/alpha synchronicity. Taken together, our results (1) highlight the PHC-rhinal junction as a locus of synchronous theta/alpha activity during memory formation, and (2) de-emphasize the importance of inter-regional gamma synchronization as a substrate of human memory.

Topic Area: LONG-TERM MEMORY: Episodic

Unique Frontal Activation Patterns Associated with Depression Severity during Memory Retrieval in Women

Poster D70, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Jennifer Sneider[1,2], Julia Cohen-Gilbert[1,2], Derek A. Hamilton[4], Carolyn Caine[1], Maya Rieselbach[1], Emily Oot[1,3], Anna Seraikas[1], Lisa D. Nickerson[1,2], Marisa M. Silveri[1,2,3]; [1]McLean Hospital, [2]Harvard Medical School, [3]Boston University School of Medicine, [4]University of New Mexico

Major depressive disorder (MDD) is a debilitating disorder that interferes with normal daily functioning, and which occurs at a markedly higher rate in women relative to men. Evidence of structural and functional alterations in hippocampus and the frontal lobe also have been reported in MDD, which likely contribute to the multifaceted impact of this condition. Functional magnetic resonance imaging data were acquired at 3Tesla during a hippocampal-based spatial memory task in 15 women across a clinical spectrum of MDD, from none to current MDD. Depression severity, assessed via the Beck Depression Inventory (BDI), was examined relative to brain activation. Greater activation was observed, regardless of depression severity, in right hippocampus, bilateral fusiform, left superior-parietal lobe and occipital regions during memory retrieval relative to motor control. In contrast, there were no significant areas of activation observed for motor control relative to retrieval. Notably, despite similar behavioral performance across participants, during rest relative to retrieval, activation in superior frontal gyrus and cingulate gyrus, regions of the default mode network (DMN), was significantly associated with depression severity (BDI). The observed lateralized activation of right hippocampus during spatial navigation is consistent with previous findings reported in women. In addition, failure to suppress activity in DMN as a function of depression is consistent with a frontal lobe inefficiency that may contribute to clinical state. Linking mood, brain activation, and cognition may help to better diagnose MDD in women, as well as inform prevention and treatment efforts targeting women, thereby alleviating suffering from this debilitating condition.

Topic Area: LONG-TERM MEMORY: Episodic

Late positive event-related potential tracks outcome of cumulative memory judgments

Poster D71, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Haopei Yang[1,4], Ken McRae[1,4], Stefan Köhler[1,2,4,3]; [1]The Brain and Mind Institute, [2]Rotman Institute of Philosophy, [3]Rotman Research Institute, Baycrest Centre, [4]Western University

Numerous studies have shown that the Late Positive Complex in event-related potentials (ERPs) tracks perceived item status in recognition-memory judgments. Recent findings suggest that it may reflect evidence accumulation relevant to the memory decision at hand. Extant research has primarily probed this ERP component with tasks that require judging whether an item was presented in a recent study phase. It is currently unclear whether the LPC also tracks response outcome in other types of memory judgments. Behavioral findings suggest that humans can accurately judge frequency of recent laboratory exposure and their cumulative lifetime experience with object concepts. The latter types of judgment display considerable consistency in a given culture, and are also known to have some external validity. In the current study, we asked whether the LPC tracks judgements about cumulative prior experience in a task-relevant manner. Participants were asked to perform cumulative memory judgements on concrete concepts selected from a normative database in two different memory tasks. One task required frequency judgements of exposure in an experimental study phase. The other task involved judgements of cumulative lifetime experience with object concepts. The LPC amplitude tracked judgement outcome in both tasks. By contrast, it was not sensitive to frequency of exposure in the study phase when no memory judgements were required. Moreover, it did not track normative ratings of lifetime exposure during frequency judgements of presentations at study. These findings suggest that the LPC tracks signals relevant to the outcome of the memory judgment at hand, beyond classic old-new responses.

Topic Area: LONG-TERM MEMORY: Episodic

Dopaminergic modulation of associative memory in healthy humans

Poster D72, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Erin Kendall Braun[1], Katherine Duncan[2], Ragy Girgis[3], Suzanne Wood[2], Madeleine Sharp[4], Camilla van Geen[1], Anissa Abi-Dargham[5], Daphna Shohamy[1,6,7]; [1]Columbia University, [2]University of Toronto, [3]New York State Psychiatric Institute, [4]Montreal Neurological Institute, [5]Stonybrook University, [6]Zuckerman Mind, Brain Behavior Institute, [7]Kavli Institute for Brain Science

For memory to be adaptive, the brain must prioritize memory for events that are motivationally relevant. It has been proposed that dopamine plays an important role in prioritizing memory for these motivationally relevant events by promoting long-term potentiation in the hippocampus. However, many open questions remain about the effect of dopamine on long-term memory in healthy humans and when these effects emerge. We examined the effect of a dopamine agonist (d-amphetamine) on hippocampal-dependent associative memory in healthy human participants (n=60). Participants encoded novel pairs of objects during two different sessions: once while on either drug or placebo and once with no drug. We tested memory both immediately after encoding and after a week delay; associative memory accuracy was determined by asking participants to indicate if object pairs were intact (a pair of objects studied together), rearranged (a pair of objects studied in different combinations), or new (at least one object was new). D-amphetamine levels during encoding were related to better associative memory accuracy when memory was tested both immediately and after a delay. These results complement cellular and physiological data and show that dopamine at encoding promotes the prioritization of events in memory, with implications for understanding the role of memory in adaptive behavior.

Topic Area: LONG-TERM MEMORY: Episodic

Hippocampal contributions to reward learning

Poster D73, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Daniela Palombo[1,2], Mieke Verfaellie[1,2]; [1]VA Boston Healthcare System Jamaica Plain, [2]Boston University School of Medicine, Department of Psychiatry

Recent evidence suggests that the human hippocampus—known primarily for its involvement in episodic memory—also plays a role in a host of motivationally relevant behaviors, including value-based decision making. However, less is known about the role of the hippocampus in value-based learning. Such learning is typically associated with a striatal system, yet a small number of

studies also show hippocampal engagement. It is not clear, however, whether this engagement is necessary for such learning. In the present study, we used both fMRI and neuropsychological methods to clarify hippocampal contributions to one form of value-based learning, namely reward learning. In experiment 1, healthy participants were scanned while learning reward-based contingencies (whether distinct players in a 'game' would win money or not) in the context of a probabilistic learning task. Here we observed recruitment of the hippocampus during learning. In experiment 2, we administered this task to amnesic patients with medial temporal lobe damage and healthy controls. Amnesic patients, including those with damage circumscribed to the hippocampus, failed to acquire reward contingencies, thus confirming that hippocampal engagement is necessary for task performance. Although future research is needed to determine the boundary conditions of hippocampal involvement in value-based learning, these findings elucidate the role of the hippocampus in learning and may clarify how the hippocampus contributes to goal-directed behaviors more broadly.

Topic Area: LONG-TERM MEMORY: Other

Consolidated-like memories through testing

Poster D74, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Jaione Arnaez-Telleria[1], Manuel Carreiras[1,2,3], Pedro M. Paz-Alonso[1]; [1]BCBL - Basque Center on Cognition, Brain and Language, Donostia-San Sebastián, Spain, [2]IKERBASQUE, Basque Foundation for Science, Bilbao, Spain, [3]Departmento de Lengua Vasca y Comunicación, UPV/EHU, Bilbao, Spain

Testing during encoding is more beneficial for long-term memory relative to strategies based on repeated-study. This benefit is known as the testing effect (TF). The retention interval (RI) between the encoding and the final test is a critical factor in this effect, showing bigger TFs with RIs longer than 24h. Thus, consolidation processes may be relevant in the TF and, therefore, manipulating sleep periods can give us a better insight on the role of consolidation in this beneficial effect. The present study was aimed at investigating the effects of sleep in episodic memory retrieval for information encoded via repeated retrieval (RR) or repeated study (RS). Eighty young adults encoded 120 Swahili-Spanish word-pairs either under RT or RS conditions. Participants took three cued-recall tests with 12 hours, 24 hours and 7 days RIs. Four groups were created by combining the encoding strategy (RT, RS) and having or not immediate sleep after the initial encoding (Sleep, Wake). Behavioral data revealed a beneficial effect of RR relative to RS in all three RIs, except for the shortest RI: RS-Sleep group performed similar to RR-Sleep. However, this null effect of sleep for the RS-Sleep group vanished in the longer RIs. Neuroimaging data revealed stronger hippocampal engagement for RS-Sleep versus RS-Wake groups during successful memory retrieval in the shortest RI. Interestingly this difference also vanished in the longer RIs. Our results suggest that information studied via RR lead to consolidated-like memories, while memories encoded via RS were more susceptible to benefit from regular consolidation processes.

Topic Area: LONG-TERM MEMORY: Semantic

Open arms and open minds: The effects of posture and modality on the recall of affect-related concepts

Poster D75, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Hannah M. Morrow[1], Gitte H. Joergensen[1], Eiling Yee[1]; [1]University of Connecticut

Sensorimotor-based theories of semantic memory make explicit predictions about how we represent object concepts, e.g., "dog". However, it is not clear how they accommodate concepts for which there is no external sensory input, e.g. "joy" or "power". There is evidence that representations of affect-related concepts are based in emotional states (Vigliocco et al., 2009). If true, body postures associated with emotional states may be involved in the representations of such concepts. We examined whether posture influences processing for words related to affect and/or dominance. Participants were randomly assigned to hold expansive or contractive postures under the guise that this would affect their heart rate. Subsequently, they completed a semantic categorization task that included words varying in valence and dominance. Next, they completed an old/new recognition task for the previously categorized words. In Exp.1 all words were presented visually. In the recognition task participants who previously held the expansive postures responded to positive valence and high dominance words faster than to negative valence and low dominance

words. In Exp.2 the words were presented auditorily in the semantic categorization task and visually in the recognition task. There was no influence of posture for either task. In Exp.3 all words were presented auditorily. We found the same pattern of results as observed in Exp. 1. These findings suggest that, like for object concepts, bodily experience plays a role in the representation of affective and dominance-related concepts. However, this is only the case when words across tasks are presented in the same modality.

Topic Area: LONG-TERM MEMORY: Semantic

Understanding “thunder” is more difficult than “rainbow” when performing a concurrent auditory task

Poster D76, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Roisin Healy[1], Jonathan Serino[1], Charles P. Davis[1,2], Gitte H. Joergensen[1,2], Eiling Yee[1,2]; [1]University of Connecticut, [2]Connecticut Institute for the Brain and Cognitive Sciences

Sensorimotor-based theories of semantic memory suggest that a concept’s representation is encoded in the same parts of the brain that are involved in experiencing that concept. Thus, a concept experienced auditorily (e.g., thunder) should be partially encoded in auditory cortex. This raises the question: Does occupying a particular sensory modality with a task that is incompatible with concepts mainly experienced in that modality make it more difficult to think about those concepts? That is, would having to keep in mind a sequence of tones make it difficult to think about the concept “thunder”? We examined the effect of auditory interference on processing auditorily and non-auditorily experienced concepts (e.g., thunder and rainbow). In the interference condition, participants had to keep in mind a sequence of four simple tones (for a subsequent same/different judgment) while making a semantic decision on a visually presented word (e.g., thunder or rainbow). In the no-interference condition, participants performed the semantic decision with no concurrent auditory task. The interference effect was measured as the difference in response times to the words in the interference vs. the no-interference conditions. For auditorily experienced, but not non-auditorily experienced concepts (e.g., for thunder, but not for rainbow) we observed a correlation between accuracy on the tone task and the interference effect, such that greater accuracy was associated with a larger interference effect. This supports the idea that processing auditorily experienced concepts is more difficult when neural resources required for processing auditory information are otherwise occupied.

Topic Area: LONG-TERM MEMORY: Semantic

The effects of deep breathing on EEG during a flanker distractor interference task in children: A comparison between a lo-res consumer-grade and hi-res medical-grade system

Poster D77, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Kiat Hui Khng[1]; [1]National Institute of Education, Nanyang Technological University

The recent years have seen increasing interest in educational neuroscience. However, the use of EEG outside of laboratory settings, such as in schools, has been limited by the costs and physical constraints of conventional hi-res medical grade EEG systems. The present study compares EEG results obtained using the consumer-grade Emotiv EPOC+ against the medical-grade Neurostyle system in a pilot study investigating the effects of deep breathing on inhibitory control of attention in children. Data was collected in schools from 46 right-handed 11-year-olds, split between Emotiv and Neurostyle groups. All participants completed a computerized flanker task twice, once with a deep breathing practice and once without. A subset of participants also wore a BioSemi respiration belt. Results indicated no behavioral differences (accuracy, RT) in task performance between the groups; differences in results from the two systems are not confounded by differences in performance. Deep breathing significantly lowered respiratory rate. Common sites across systems showed generally similar ERP waveforms, with more standard and distinct waveforms from the Neurostyle, and greater noise and peculiarities from the Emotiv. The typical N2, P3, and LPC components were respectively observed over the frontal, parietal, and the frontal/anterior-frontal area. Preliminary ERP analyses conducted on

the systems separately shows that the Neurostyle system was more sensitive at picking up the effects of the deep breathing intervention, although the Emotiv was also able to detect some effects, especially in the frontal/anterior-frontal area. Findings suggest that the lo-res consumer-grade EEG system may potentially be useful for school-based educational neuroscience research.

Topic Area: METHODS: Electrophysiology

Filtering improves skin-conductance response measures in the fMRI environment

Poster D78, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Anthony Privratsky[1], Keith Bush[1], Josh Cisler[2]; [1]University of Arkansas for Medical Sciences, [2]University of Wisconsin-Madison

Skin-conductance response (SCR) data is frequently sought as a measure of sympathetic arousal in psychological research for its ease of implementation and lack of suitable alternative measures. Yet, SCR data is prone to corruption, particularly in the fMRI environment. Artifacts may take the form of slow, nonlinear drift or rapid spikes. We provide evidence that 1) difficulties in SCR data quality control are frequent causes of data corruption and exclusion, 2) researchers frequently report insufficient filtering methods and low-frequency (high-pass) filtering is typically not discussed, 3) low and high-pass filtering remove the most significant sources of noise, and 4) high-pass filtering is necessary for accurate SCR convolutional model-based response measures and increases the sensitivity of traditional peak-scoring measures. Using SCR datasets from 44 women undergoing a two-part fear conditioning and extinction task, we demonstrate the effect of high-pass filtering on derived response measures for traditional peak-scoring analysis as well as model-based regression analysis. We regressed amplitude scores onto model-based regression coefficients within participants and found that mean variance explained increased from 32% to 37% in 87 datasets (session 1, $p = 9x10-4$) and from 50% to 61% in 88 datasets (session 2, $p = 0.003$), respectively, with filtering. We recommend implementation of a SCR data processing pipeline that includes high-pass filtering and suggest that standardization of this technique will minimize lost research productivity due to difficulties in data quality control, decrease sampling bias by reducing the need to exclude datasets, and increase the validity of SCR response measures.

Topic Area: METHODS: Electrophysiology

Presurgical fMRI for Aiding Electrode Implantation in Deep Brain Stimulation: Case studies of Treatment-Resistant Depression

Poster D79, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Layla Gould[1], Ivar Mendez[1], Chelsea Ekstrand[1], Marla Mickleborough[1], Tasha Ellchuk[1], Eric Lorentz[1], Ron Borowsky[1]; [1]University of Saskatchewan

Functional magnetic resonance imaging (fMRI) is becoming increasingly common in presurgical planning as it allows for noninvasive localization of function in order to inform neurosurgeons as they devise a surgical approach. Moreover, fMRI can be used to localize the target nucleus in deep brain stimulation (DBS). We report two cases of patients undergoing DBS for treatment-resistant depression, in which the neurosurgeon was targeting the subgenual anterior cingulate cortex (ACC; Brodmann Area 25). Previous research has shown that different versions of Stroop-like interference tasks activated dichotomous regions of the ACC, whereby a cognitive version activated the superior subdivision of the ACC, whereas an emotional/affective version activated the inferior subdivision (Bush, Luu, & Posner, 2000). Thus, our planning involved two Stroop-like interference tasks, namely, one cognitive (i.e., Stroop task with color words) and one affective (i.e., Stroop task with emotional words). All imaging was conducted using a 3T Siemens Skyra scanner. All preprocessing and statistical analyses for functional images were performed using Brain Voyager QX. In both cases, the fMRI results for the affective Stroop task showed deactivation in the subgenual ACC as predicted, and this helped guide the placement of the electrodes for the DBS procedure. These case studies confirm that cognitive and affective tasks selectively activate different regions of ACC, and highlight the utility of preoperative planning using fMRI for patients being treated with DBS for depression.

Topic Area: METHODS: Neuroimaging

Localized test-retest reliability of fMRI task activity

Poster D80, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Johan Jansma[1], Geert-Jan Rutten[1]; [1]ETZ Elisabeth Hospital, Department of Neurosurgery, Tilburg, the Netherlands

Introduction. Scientific applications of fMRI tend to focus on finding regions that show a significant difference. However, this approach may not always be optimal for clinical use of fMRI. Information about absence of a change in activation during a task can be as valuable to a clinician as a high increase or decrease. Furthermore, clinicians are typically interested in activation in small regions of interest. In this study we used a correlation method to estimate the pattern reproducibility of a well-known and often applied presurgical language protocol. Method. 17 subjects performed a verb generation protocol twice with a seven week apart. A GLM was performed to calculate percentage signal change per voxel, at unsmoothed resolution. We calculated a voxel by voxel correlation as well as intra class correlation value (ICC, consistence) within subject as well as with a apttern average over subjects, in a small 2x2x2cm region of interest (64 voxels)around Broca. Results. Subjects showed a within subject correlation value of r = 0.84 (sem: 0.1) and a ICC of 0.79 (0.03)Correlation with an average pattern was -0.03 (0.08). Discussion. Test-retest fMRI pattern reproducibility in a ROI with a relevant size for presurgical applications appears to be sufficient to produce valuable clinical information. In addition, single subject fMRI patterns in small ROIs appear to be unique, and cannot be reliably estimated using data from other subjects. These results support more extensive use of fMRI for clinical applications.

Topic Area: METHODS: Neuroimaging

Brain Activity Associated with Self-Injurious Thoughts and Behaviors: A Meta-Analysis of Neuroimaging Studies

Poster D81, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Kelly Rootes-Murdy[1], Xieyining Huang[1], Joseph C. Franklin[1], Derek E. Nee[1]; [1]Florida State University

Background: Neuroimaging studies have found abnormalities in a multitude of brain regions among individuals who experience self-injurious thoughts and behaviors (SITBs) including the orbitofrontal cortex (Mahon, Burdick, Wu, Ardekani, & Szesko, 2012; Jollant, Olie, Guillaume, & Courtet, 2011), the anterior cingulate cortex (Wagner et al., 2011), the midbrain/pons (Osuch et al., 2014), and the amygdala (Monkul et al., 2007). However, brain regions showing abnormalities vary considerably between studies making it unclear whether a single constellation of regions underlies SITBs. The present study aimed to provide a quantitative summary of the current literature via meta-analysis. Methods: A total of 57 studies were identified as examining structural and/or functional brain correlates of SITBs. Activation foci from the studies were subjected to quantitative meta-analysis using activation likelihood estimation (ALE). Separate ALE analyses were performed examining white matter integrity (e.g. diffusion-tensor imaging) and gray matter functional and/or structural abnormality, as well as analyses that separately examined different functional (task) groupings. Results: We found no statistically significant voxels associated with SITBs; these findings remain unchanged after considering a multitude of moderators. Discussion: The results indicate that current neuroimaging research has not found consistent brain abnormalities associated with SITBs. Future studies may require more extensive data (larger sample sizes, more scans per individual) to identify consistent neural correlates. Additionally, longitudinal designs that can show the time precedence of neural abnormalities will be required to identify biomarkers that can detect vulnerable individuals prior to the occurrence of SITBs.

Topic Area: METHODS: Neuroimaging

Dynamic transient brain networks overlap with regional gene expression in a single gene developmental disorder

Poster D82, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Erin Hawkins[1], Danyal Akarca[1], Mengya Zhang[1], Mark Woolrich[2], Kate Baker[3], Duncan Astle[1]; [1]MRC Cognition and Brain Sciences Unit, University of Cambridge, [2]Oxford Centre for Human Brain Activity, University of Oxford, [3]Department of Medical Genetics, University of Cambridge

Understanding of whole-brain networks has been advanced by recent methods characterising functional connectivity. However, little is known about the dynamic nature of these networks at fast time-scales, and the underlying cellular mechanisms that drive their variability. We aimed to address this by exploring dynamic transient brain states using magnetoencephalography (MEG) in a group of individuals with the ZDHHC9 gene mutation, which affects neuronal excitability and is associated with a specific profile of cognitive difficulties. We used Hidden Markov Modelling (HMM) to explore network dynamics at rest and during an auditory oddball task in MEG, in participants with the ZDHHC9 gene mutation and age-matched controls. The HMM is a data-driven method which identifies a sequence of brain "states" corresponding to unique patterns of amplitude envelope activity which recur at different time-points, and can identify networks on a ~100ms time-scale. The HMM identified frontoparietal, frontotemporal, temporal, and visual states in the data. We then examined network dynamics using the temporal characteristics of each state: the proportion of time spent in each state, the average duration, and the number of occurrences. These characteristics distinguished the two groups on the frontotemporal and visual states. Importantly, these states also overlapped significantly with the ZDHHC9 regional gene expression profile. These results suggest that a single gene mutation can alter the dynamics of large-scale brain networks, which are tied to regionally-specific gene expression profiles. We demonstrate a valuable method for understanding this association, which may provide insights into the neural pathways linking genetic mutations to cognitive difficulties.

Topic Area: METHODS: Neuroimaging

Characterizing the Effects of Transcranial Direct Current Stimulation on Frontal Lobe Activity Using Diffuse Correlational Spectroscopy

Poster D83, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Evangelia G. Chrysikou[1], Wesley Baker[2], Lin Wang[2], Arjun G. Yodh[2], Roy H. Hamilton[2]; [1]University of Kansas, [2]University of Pennsylvania

Transcranial direct current stimulation (tDCS) is a cost-effective and noninvasive neuromodulation method involving the application of weak direct currents through electrodes on the scalp. The technique has elicited promising but inconsistent effects across several cognitive neuroscience domains, including memory, language, attention, and executive functions. Our understanding of the mechanisms of tDCS is limited by a critical lack of knowledge about how tDCS influences brain circuits in real time. Here, we address this gap by developing a novel tDCS-integrated diffuse correlational spectroscopy (DCS) probe for the noninvasive, continuous measurement of local cortical cerebral blood flow (CBF) and cerebral metabolic rate of oxygen consumption (CMRO2) during tDCS over lateral prefrontal cortex. We have established a safe and robust protocol for combining DCS hemodynamic monitoring with administration of tDCS and examined the protocol in healthy adult subjects. To evaluate the steady-state effect of tDCS on cerebral hemodynamics, we computed the average CBF, StO2, and HbT changes across the final 5 minutes of tDCS administration. On average, although tDCS significantly increased CBF and HbT, there was no significant change in StO2. The constant StO2 rate indicates that the oxygen extraction fraction from the blood to the cerebral tissue also remains constant. Therefore, our results are consistent with the hypothesis that tDCS increases the cerebral metabolic rate of oxygen (CMRO2). Our method provides a novel way of examining how complex neural circuits interact in space and time in response to tDCS that can optimize the use of tDCS for further research and clinical applications.

Topic Area: METHODS: Other

Neural correlates of melodic prediction violations: similarities to language processing

Poster D84, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Allison R. Fogel[1], Gina R. Kuperberg[1,2,3], Aniruddh D. Patel[1]; [1]Tufts University, [2]MGH/HST Athinoula A. Martinos Center for Biomedical Imaging, [3]Massachusetts General Hospital

The concept of "prediction" is frequently evoked in studies of both music and language processing, and it has been suggested that predictive mechanisms may be shared between the two domains. However, very different paradigms are used to examine the neural correlates of prediction in music and in language. In ERP studies of language, the effects of violating certain predictions have recently been examined by manipulating sentence contexts. Predictions for a specific word occur when a context constrains strongly for a certain continuation; these predictions can be violated even when a sentence is continued with a different plausible word. These violations have been observed to elicit a late anterior positive ERP component. In contrast, studies of prediction violations in music have mainly used incongruent events (e.g., out-of-key notes) and have not manipulated the contextual constraint of sequences. Here, we created a musical paradigm that more closely resembles those used in language studies. Participants listened to short novel melodies that either did or did not lead to a strong prediction for a particular note to come next. Plausible (in-key) target notes that violated this strong prediction elicited a late anterior positivity compared to the same target notes in non-constraining melodies, with no trace of the early right anterior negativity that has often been associated with musical expectancy violations. The anterior positivity to melodic prediction violation strongly resembles the ERP effect seen in language studies of prediction violation, suggesting that prediction may be a process that functions similarly in the two domains.

Topic Area: OTHER

Expertise Matters in Evaluating Students' Organization of Neuroscience Concepts

Poster D85, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Noah C. Yeagley[1], Jennifer L. Stevenson[1], Joel P. Bish[1]; [1]Ursinus College

Evaluating learning is a pivotal part of the academic process, but most assessments are explicit measures, such as tests and quizzes. One form of implicit evaluation is the Structural Assessment of Knowledge (SAK) which examines the organization of knowledge structures or networks. The current study investigates undergraduate students' learning of structure-function relationships (n=38) and neuronal physiology (n=40) in introductory and advanced neuroscience courses. Students made pairwise rankings of 15 neuronal physiology (e.g., action potential, axon hillock) or 15 structure-function relationship concepts (e.g., Broca's area, language production) in terms of their similarity before and after learning. Using Pathfinder software, students' networks were compared to two types of expert networks: their individual professor and a group of four other neuroscience professors at the college. The type of expert (individual or group of professors) interacted with type of student (introductory or advanced) for both neuronal physiology ($F(1,38)=19.16$, $p<.001$) and structure-function relationships ($F(1,36)=23.15$, $p<.001$) concepts; however, the details of the interactions were reversed. For both types of concepts, students were equally similar to individual and group professors. However, for neuronal physiology, students were more similar to the group of professors than their individual professor ($t(15)=-5.64$, $p<.001$) and for structure-function relationships, students were more similar to their individual professor than the group of professors ($t(16)=5.82$, $p<.001$). These results suggest multiple factors such as type of student, type of expert, and type of knowledge are important when considering the expert for comparison in SAK. This may be more complex in interdisciplinary fields like neuroscience.

Topic Area: OTHER

Early visual cortex is recruited for executive functioning in congenital blindness

Poster D86, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Shipra Kanjlia[1], Marina Bedny[1]; [1]Johns Hopkins University

Recent evidence has shown that in congenital blindness, visual cortices are repurposed for higher cognitive functions, including language and mathematical reasoning. According to one hypothesis, "visual" cortices are taken over by multiple fronto-parietal networks in blindness. This hypothesis predicts that visual cortices may take on domain general executive functions. We asked whether executive functioning during a stroop task recruits visual regions in congenital blindness and whether these regions are

different from those previously shown to respond to math and language. While undergoing fMRI, nineteen congenitally blind (CB) and nine sighted (S) participants judged whether voices of speakers were male or female. On congruent trials, a female speaker said “female” or a male speaker said “male” and vice versa on incongruent trials. On neutral trials, male and female speakers said either “island” or “store.” Domain-general fronto-parietal networks of blind participants responded more during incongruent and congruent trials than neutral trials. An inferior parietal region showed a congruency effect across blind and sighted participants (main effect: $F(1,26)=4.64$, $p=0.04$; group interaction: $F(1,26)=0.08$, $p=0.77$). In congenitally blind but not sighted individuals, primary visual cortex (V1) responded more to incongruent than congruent trials (CB: $F(1,18)=4.52$, $p=0.04$; S: $F(1,8)=1.88$, $p=0.21$; group interaction: $F(1,26)=5.73$, $p=0.02$). Math-responsive visual regions showed a marginal congruency effect in CB individuals ($F(1,18)=3.20$, $p=0.09$). Language-responsive visual regions did not show a congruency effect in CB individuals (LO: $F(1,18)=1.69$, $p=0.21$; VOT: $F(1,18)=0.17$, $p=0.68$). These results provide further evidence for the hypothesis that visual cortices are repurposed for higher cognitive functions in congenital blindness.

Topic Area: OTHER

Neural correlates of rhythm induced trance: Evidence from fcMRI and EEG

Poster D87, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Michael Hove[1], Assal Habibi[2], Molly J Henry[3], Johannes Stelzer[4], B Rael Cahn[2]; [1]Fitchburg State University, [2]University of Southern California, [3]University of Western Ontario, [4]Max Planck Institute for Biological Cybernetics

Rhythmic drumming has long been used to alter consciousness and induce states of trance. Rhythm-induced trance is common in shamanism, humanity’s most ancient healing tradition. Despite similar techniques across cultures and powerful phenomenology, little is known about the mechanisms underlying trance. We examined the neural correlates of rhythm-induced trance in experienced shamanic practitioners. In the first study, we used fMRI to examine the neural patterns associated with trance. Shamanic practitioners (n=15) underwent 8 minute brain scans while they listened to rhythmic drumming and entered a trance state (or remained in non-trance in a control condition). In trance, brain networks displayed notable reconfigurations, including increased connectivity in regions associated with internal thought (the default mode’s posterior cingulate cortex) and cognitive control (dorsal anterior cingulate cortex and insula), as well as decreased connectivity within the brainstem and auditory pathway. This network configuration suggests perceptual decoupling and that the repetitive drumming was gated out to maintain an internally oriented stream of consciousness. In a follow-up EEG study, we used a similar design to examine auditory gating and network activity while shamanic practitioners (n=18) experienced rhythm-induced trance and a control state. In response to clicks embedded in the drumming, the N100 and P200 ERP components were decreased during Trance. This indicates decreased sensory encoding and elaborative processing during trance. Together this work suggests that repetitive drumming promotes an internally directed state via perceptual decoupling, and explicates why trance is a common way to promote insight across cultures.

Topic Area: PERCEPTION & ACTION: Audition

The effects of the amplitude envelope of speech on speech intelligibility

Poster D88, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Mako Ishida[1,2,3], Takayuki Arai[3], Makio Kashino[1]; [1]NTT Communication Science Laboratories, [2]Japan Society for the Promotion of Science, [3]Sophia University

The current study examines the intelligibility of speech by degrading speech signal by modifying the amplitude envelope of speech in two different ways. This study examines how our brain decodes spoken messages from degraded speech signal. In Experiment 1, participants listened to locally time-reversed speech where every certain length of speech signal was reversed on the time axis. Speech was locally time-reversed at every 10, 30, 50, 70, 90, or 110 ms. In Experiment 2, participants listened to speech in which the amplitude envelope of speech signal was modified by filtering modulation frequency components. The cut-off frequency was set as 1, 2, 4, 8, 16, or 32 Hz. The manipulation of local time reversal as well as modulation frequency filtering induced the change of amplitude envelope of speech from the gradual to the drastic level. Participants were native English speakers in the United States, and they transcribed English sentences they heard through headphones. The results suggest that speech is intelligible

when the reversed segment length is relatively short, and when the modulation frequency components are relatively preserved with higher cut-off frequency. However, speech becomes gradually unintelligible when the reversed segment length exceeds around 50-70 ms, and when the cut-off frequency is lower than 4-8 Hz. The results of two different experiments suggest that lower modulation frequency is critical for speech intelligibility and perceptual reconstruction of speech. It seems to suggest, that speech is decodable, by humans, when the lower modulation frequency components are preserved in the amplitude envelope of speech.

Topic Area: PERCEPTION & ACTION: Audition

Norepinephrine signals functional resetting: Evidence from human pupil dilation to pattern changes

Poster D89, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Sijia Zhao[1], Shigeto Furukawa[2], Hsin-I Liao[2], Frederic Dick[3], Maria Chait[1]; [1]Ear Institute, University College London, UK, [2]NTT Communication Science Laboratories, NTT Corporation, Japan, [3]Birkbeck-UCL Centre for Neuroimaging, London, UK

The statistics of natural scenes are highly dynamic, leading to constantly changing patterns of sensory input. Current theories suggest that perception is guided by internal models that continuously track the statistics of the unfolding sensory scene. Norepinephrine (NE) is assumed to play an important role in this process by reporting unexpected uncertainty (Yu and Dayan, 2005) and initiating functional resetting (Dayan and Yu, 2006; Sara and Bouret, 2012). However, most previous studies have used slowly-changing stimulus patterns and active-decision tasks, thus making it difficult to tease apart evidence accumulation from associated decision processes. To address this problem, we indexed NE release using pupillometry (Joshi et al, 2016) and used very rapidly changing stimuli to tap putatively 'pre-attentive' evidence accumulation. Human participants listened to sequences of abutting 50ms-tone-pips which contained transitions from randomly to regularly repeating frequency patterns and vice versa. To make sure participants attended to the auditory stream but not to the transition per se, they were instructed to detect occasional silent gaps within the sequence. This task encouraged attentive listening but was independent of sequence regularity. Despite the fact that both regular-to-random and random-to-regular transitions are clearly detectable behaviorally and evoke strong MEG (Barascud et al., 2016) and EEG (Southwell et al., 2016) responses, pupil-dilation responses were only evoked by transitions from regular to random sequences (unexpected uncertainty) and NOT by the emergence of pattern (precision increase). These results suggest that NE release may be involved in 'resetting' the brain's internal model of the ongoing sensory environment.

Topic Area: PERCEPTION & ACTION: Audition

Source localization of mismatch responses at 7 and 12 months in a multifeature auditory paradigm

Poster D90, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Katherine Wolfert[1], Silvia Ortiz-Mantilla[1], Teresa Realpe-Bonilla[1], April A. Benasich[1]; [1]Rutgers University-Newark

The multifeature paradigm (MFP) is useful for quickly testing multiple stimulus types within one electroencephalography (EEG) session. Few studies have examined the utility of this paradigm with infants under 12-months-of-age, a population that would benefit from shorter experiment times. To characterize how the infant brain responds to tone stimuli presented in a MFP, dense-array EEG was recorded from cross-sectional groups of 7 and 12-month-olds. Infants were exposed to a standard stimulus and four deviant types: frequency, duration, silent gap, and frequency sweep. Source localization analysis using age-appropriate brain templates revealed dipoles in the auditory cortices and two components (P1 and N2) were examined within the source waveforms. The P1 was defined as the first positivity that could be analyzed for each stimulus type; the N2 was defined as a negativity approximately 370-400ms after stimulus onset. Comparisons of the source waveforms between groups revealed morphological differences typical of auditory development at these ages, including smaller amplitudes, bifurcation of the first positivity, and faster P1 latencies for a subset of stimuli at 12 months. At 7 months, the standard N2 was of greater magnitude than the deviant N2, while the opposite was true at 12 months. This switch might represent a transition from a positive to a negative mismatch response.

Group differences and variations in responses to each deviant can shed light on how the sound representation of each stimulus type develops, and further, confirms that responses to multiple deviants can be assessed with the MFP at 7 and 12 months.

Topic Area: PERCEPTION & ACTION: Development & aging

Odor Familiarity and the Conversion from Mild Cognitive Impairment to Alzheimer's

Poster D91, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Paul Wheeler[1], Claire Murphy[1,2,3]; [1]San Diego State University, [2]SDSU/UCSD Joint Doctoral Program in Clinical Psychology, [3]University of California San Diego

The current study evaluated the utility of odor familiarity, a measure of remote memory that does not require odor naming, to differentiate healthy controls from those who convert from mild cognitive impairment (MCI) to Alzheimer's disease (AD). Odor familiarity deficits have been observed in AD however, its potential utility in signaling prodromal Alzheimer's disease in unknown. An archival sample of 249 participants with MMSE and odor memory data from the Alzheimer's Disease Research Center study at the University of California San Diego was used in the analysis. Two hundred twenty-two of the participants were healthy controls, and 17 converted from MCI to AD. Stimuli consisted of common household odors. Familiarity was assessed utilizing a visual analogue scale with participants being asked to rate a presented odor from "not at all familiar" to "very familiar." The receiver operating characteristic (ROC) / area under the curve (AUC) for prediction of conversion from MCI to AD utilizing the MMSE was .65 and odor familiarity was .68. The results suggest the potential utility of odor familiarity deficits in predicting those who convert from MCI to AD. Odor familiarity could also benefit clinical trials of disease modifying drugs as they become available. Supported by NIH grant # AG004085-26 from the National Institute on Aging to CM. We thank the participants and staff of the UCSD ADRC (P50AG005131).

Topic Area: PERCEPTION & ACTION: Development & aging

Auditory-motor Learning Drives Motor Activation in Subsequent Auditory Processing

Poster D92, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

John Myers[1], Jeffrey Mock[1], Edward Golob[1]; [1]University of Texas at San Antonio

When we learn to coordinate our speech or play musical instruments, the motor system is thought to modulate auditory processing to predict the sensory consequences of our actions. Previous studies have demonstrated that self-generated sounds evoke lower amplitude event-related potentials (ERPs) than identical sounds when passively listening. Less is known about the role motor regions play in auditory processing after auditory-motor learning. We recorded auditory ERPs from subjects ($n = 18$) in two passive listening conditions, pre- vs. post auditory-motor learning. To elicit auditory motor learning, visual cues (green 'L' or 'R') instructed subjects to use their left or right hand to generate pure tone feedback (600/700 Hz, 840 trials). Subjects were passively presented with identical stimuli (pre- vs. post auditory-motor learning; 120 trials each). We hypothesized that auditory-motor learning would drive the recruitment of precentral motor regions into auditory processing after learning. Results indicated a reduced frontocentral N100/P200 complex after auditory-motor learning ($p = 0.018$, $\eta p2 = 0.288$), mirroring the lower amplitude evoked responses to previously self-generated sounds. After auditory-motor learning, ICA components localized to precentral motor regions showed higher amplitude late-positive activation in 67% of subjects (150-400 ms; $p = 0.026$, $\eta p2 = 0.377$). We conclude that auditory-motor learning consists of precentral motor recruitment into subsequent auditory processing.

Topic Area: PERCEPTION & ACTION: Motor control

Assessment and Communication with Locked-in Patients Using A Vibro-tactile P300 and Motor Imagery Brain-Computer Interface

Poster D93, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Christoph Guger[1,2], Rossella Spataro[3], Woosang Cho[2], Rupert Ortner[2], Fan Cao[1], V. Labella[3]; [1]Guger Technologies OG, Graz, Austria, [2]g.tec medical engineering GmbH, Schiedlberg, Austria, [3]University of Palermo, Palermo, Italy

There is an increasing need for patients with locked-in syndrome (LIS) or complete locked-in syndrome (CLIS) to use a non-visual dependent brain-computer interface (BCI) system. We developed such a system, to assess and communicate 9 LIS and 3 CLIS patients. There are three different modes, vibro-tactile stimulation with 2 vibro-stims (VT2), with 3 vibro-stims (VT3), and with motor imagery (MI) paradigms. In VT2 mode, the stimulators were fixed on the left and right wrist, and the patient was asked to count the stimuli on the target hand to elicit a P300 response. In VT3 mode, an additional stimulator was placed on the shoulder, and in MI mode, the patient was instructed to imagine either left or right hand movement. VT3 and MI modes were also used for simple yes or no questions. The patients achieved a mean accuracy of 76.6% in VT2, 63.1% in VT3, and 58.2% in MI after 2 training runs. 9 out of 12 LIS patients could communicate with VT2 and VT3 (on average 8 out of 10 questions answered correctly), and 3 out of 12 could communicate with MI paradigm (4 out of 5 questions answered correctly). 2 out of the 3 CLIS patients could communicate with VT3 (70% and 90% accuracy respectively). It is the first study showing BCI-based communication with CLIS patients and was able to bring 9 out of 12 patients to communicate with high accuracies using non-visual evoked potentials and motor imagery, more importantly it was achieved within 20 min.

Topic Area: PERCEPTION & ACTION: Motor control

The impact of a cognitive-psychophysiological therapy on motor planning and execution in Tourette syndrome patients

Poster D94, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Simon Morand-Beaulieu[1,2], Marie-Ange Perreault[1,2], Kieron P. O'Connor[1,2], Pierre J. Blanchet[1,2], Marc E. Lavoie[1,2]; [1]Centre de recherche de l'Institut universitaire en santé mentale de Montréal, Montreal, QC, Canada, [2]Université de Montréal, Montreal, QC, Canada

In recent years, cognitive-behavioral therapies have made important progress among available treatment options for Tourette syndrome (TS). One of those therapies, the cognitive-psychophysiological (CoPs) therapy, aims at regulating the chronically heightened sensorimotor activation and elevated muscle tension in TS patients. It has been proved to effectively decrease tics, but can also improve motor skills. However, the neurobiological mechanisms underlying such changes are not fully understood. Therefore, this project aims at studying the impact of the CoPs therapy on electrocortical brain activity related to motor planning and execution in TS patients. Electroencephalogram (EEG) activity was recorded in 21 TS patients and 23 healthy controls during a Stimulus-Response Compatibility task. EEG data were processed into lateralized readiness potentials (LRP). The LRP are obtained through a double subtraction of event-related potentials, to eliminate any activity unrelated to motor processes. Both the stimulus-locked (sLRP) and response-locked (rLRP) LRP were measured. LRP onset and maximum peak were assessed before and after the therapy for the TS group. The control group was also tested twice with a similar interval between both assessments. Results showed that prior to therapy, sLRP onset was delayed in TS patients, compared to healthy controls. The CoPs therapy allowed an acceleration of the sLRP onset in TS patients. In healthy controls, the sLRP onset did not change over the 4-month interval, suggesting that the acceleration seen in TS patients is attributable to the therapy and not to repetition. Therefore, CoPs therapy appears to induce a modification of motor processes in TS patients.

Topic Area: PERCEPTION & ACTION: Motor control

Is a round shape integrated with a /bouba/ sound? Enhanced neuronal signals at the intermodulation frequencies of congruent audio-visual stimuli

Poster D95, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Hiu Mei Chow[1], Brianna Leonardo[1], Aleksandra Sabov[1], Vivian Ciaramitaro[1]; [1]University of Massachusetts Boston

Sound-shape crossmodal correspondence is the association between abstract shapes and seemingly unrelated sounds, such as associating a round shape with a /bouba/ sound and a spikey shape with a /kiki/ sound. Are the stimuli naturally paired in crossmodal correspondence integrated? We used steady state evoked potentials (SSEPs), to examine if and how audio-visual stimuli congruent with sound-shape correspondence are integrated. We focused on brain responses at intermodulation frequencies (IM), the sum and differences of frequencies at which the shapes and sounds were presented. Given that IM responses are often enhanced when parts of visual stimuli are integrated (e.g. Boremanse, Norcia & Rossion, 2013), we hypothesized that if corresponding crossmodal stimuli are integrated then IM responses should be enhanced for congruent compared to incongruent pairings. Participants viewed two shapes (one round, one spiky) flickering at different frequencies (5.45Hz, 7.5Hz) while performing a central fixation task (color change detection). Both shapes were presented under each auditory condition: no sound, /ba/ sound (3Hz), or /ki/ sound (3Hz). We compared SSEPs at IM frequencies for congruent (e.g. round shape with /ba/) and incongruent (e.g. spikey shape with /ba/) pairings, and found enhanced IM signals for congruent pairings in occipital electrodes. Surprisingly, we also found enhanced IM signals for incongruent pairings in central and anterior electrodes. These effects were specific to the type of IM (sum vs. difference) and the frequency of the shape. Our findings serve as a first demonstration of using frequency tagging to study multisensory integration and conflict monitoring in crossmodal correspondence.

Topic Area: PERCEPTION & ACTION: Multisensory

Rubber Hand Illusion enhancement induced by motor cortex inhibition

Poster D96, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Carlotta Fossataro[1], Valentina Bruno[1], Serena Giurgola[2], Nadia Bolognini[3,4], Francesca Garbarini[1]; [1]SAMBA – SpAtial, Motor & Bodily Awareness – Research Group, Psychology Department, University of Turin, Turin, Italy, [2]Department of Medicine and Surgery, University of Milano-Bicocca, Milan Italy, [3]Department of Psychology & NeuroMI – Milan Center for Neuroscience, University of Milano-Bicocca, Milano, Italy, [4]Neuropsychological Laboratory, IRCCS, Istituto Auxologico Italiano, Milano, Italy

A recent study showed that, while the subjects had been induced by the rubber hand illusion (RHI) to perceive a fake hand as part of their own body, their primary motor cortex (M1) excitability was temporarily decreased, so that they were less ready to move their real hand. Since an illusory body ownership triggers inhibitory effects on M1, here we aimed at investigating whether and to what extent modulating the excitability of M1 may affect the strength of the illusion. In the Main Experiment, off-line, sham-controlled, low-frequency (1 Hz) repetitive (r)TMS was applied over the left M1; the strength of the illusory experience was assessed by administering the RHI to the hand contralateral to the stimulated M1. In the Control Experiment, the RHI was performed in the hand ipsilateral to the inhibited M1. Results showed that 1-Hz rTMS over M1 significantly enhanced the illusory experience, as proved by a significant increase of both subjective (Embodiment/Disembodiment Questionnaires) and objective (Proprioceptive Drift) RHI measures as compared to Sham (Main Experiment). Moreover, the effect was specific for the hemisphere controlling the hand exposed to the illusion. These results provide evidence that, when the subjects are less ready to move their own body (as following M1-inhibition by rTMS), their sense of body-ownership is attenuated and they are more prone to incorporate an alien limb.

Topic Area: PERCEPTION & ACTION: Multisensory

Long-term tool-use changes body representation

Poster D97, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Lara Coelho[1], Jason Schacher[1], Jon Doan[1], Claudia Gonzalez[1]; [1]University of Lethbridge

Tool-use has been found to change body representation. For example, participants who used a rake for 15 minutes, perceived their forearms to be longer immediately after its use (Sposito et al, 2012 Neuropsych; they incorporated the rake into their perceived size of this body part). It remains to be examined if there are long-term effects of tool-use in body perception. To test this possibility, we recruited 18 elite baseball players (EBP) and 19 age matched controls to participate in a hand representation task. We included EBP because of their many years (10+) of training with a tool (baseball glove). We had two competing hypotheses: 1) that EBP

would show larger hand representations (to encompass the glove into their representation), or; 2) the representation would in fact be smaller because during testing the glove was not present (as if their hand was smaller without the glove). The task required participants to place their hands underneath a covered glass tabletop (no vision of their hands), and to point to where they believed 10 locations (the tips and bases of each finger) were on their hands (Coelho et al., 2017 Psych Res). Each point's XY coordinates was tracked using an Optotrak camera. From these coordinates we mapped out the participants perceived hand size. The results supported the second hypothesis; compared to controls, EBP underestimated hand width and finger length. This suggests that long-term tool use causes long-lasting changes in body representation. This result is discussed in relation to theories of altered body ownership.

Topic Area: PERCEPTION & ACTION: Multisensory

Biased tactile localization with an intact somatosensory system: A case study

Poster D98, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Yuqi Liu[1], Alexandria O'Neal[1], Jared Medina; [1]University of Delaware

We report the performance of an individual with a small, subcortical infarct in the right hemisphere that damaged white matter tracts including the superior and anterior corona radiata, while leaving both thalamus, primary somatosensory cortex and related somatosensory pathways intact. Using a staircase task, his tactile detection ability on both hands was well within the range of normal controls. However, he demonstrated a peculiar deficit in tactile localization on his contralesional (left) hand. When asked to localize suprathreshold tactile stimuli presented to his contralesional hand (by pointing with his ipsilesional hand, see Rapp, Hendel & Medina, 2002), he accurately detected all stimuli. However, he consistently mislocalized tactile stimuli to the left side of his hand (ulnar bias with palm down, radial bias with palm up). This pattern was highly consistent over multiple sessions, 90° hand rotation, and using different response modalities. Furthermore, this bias was specific to contralesional tactile localization, as he was normal at localizing ipsilesional tactile stimuli, visual stimuli on hand outlines, general pointing to targets, and did not demonstrate this bias in a finger movement task. Given normal tactile detection and intact somatosensory regions, along with highly impaired tactile localization, this suggests the role of additional pathways for localizing touch on the body. Furthermore, this bias was not somatotopic, providing evidence for processing tactile localization in a hand-centered, external frame of reference.

Topic Area: PERCEPTION & ACTION: Other

Spontaneous in-flight accommodation of hand orientation to unseen grasp targets: A case of action blindsight

Poster D99, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Emily K. Prentiss[1], Colleen L. Schneider[1,2], Zoë R. Williams[3], Bogachan Sahin[3], Bradford Z. Mahon[1,3]; [1]University of Rochester, [2]University of Rochester School of Medicine and Dentistry, [3]University of Rochester Medical Center

The division of labor between the dorsal and ventral visual pathways is well established. The ventral stream supports object identification, while the dorsal stream supports online processing of visual information in the service of visually guided actions. Here, we report a case of an individual with a right inferior quadrantanopia who exhibited accurate automatic rotation of his wrist when grasping a target object in his blind visual field. His accurate wrist orientation was observed despite the fact that he exhibited no sensitivity to the orientation of the handle in a perceptual matching task. These findings indicate that non-geniculostriate pathways process basic volumetric information relevant to grasping, and reinforce the observation that phenomenal awareness is not necessary for volumetric properties of objects to influence visuomotor performance.

Topic Area: PERCEPTION & ACTION: Vision

Unfolding of lateralized neural responses to facial information

Poster D100, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Sanne Brederoo[1,2], Berry Van den Berg[1,2], Mark Nieuwenstein[1], Monicque Lorist[1,2]; [1]Department of Experimental Psychology, University of Groningen, The Netherlands, [2]Department of Neuroscience, University Medical Center Groningen, The Netherlands

Face processing has been shown to be more accurate for facial information presented in the left (LVF) than in the right (RVF) visual field. To elucidate neural processes underlying lateralized face processing, we employed a visual EEG-paradigm in which faces could appear as standards or deviant half-faces in the LVF or RVF, while participants performed a task on a centrally presented series of symbols. During LVF-deviant face trials (vs. standards), we observed a negative deflection (~200ms) that was lateralized over right occipital electrodes. Following this initial negativity, both LVF- and RVF-deviants elicited an occipital, broad bilateral negativity compared to standards, starting at ~330ms for LVF-deviants and ~360ms for RVF-deviants. Finally, for both LVF- and RVF-deviants, following this mismatch negativity we observed a decrease in alpha power in the hemisphere contralateral to the visual field in which the deviant half-face appeared, which started earlier for LVF-deviants (~400ms post-stimulus) than for RVF-deviants (~450ms post-stimulus). No LVF/RVF lateralization effects were observed for word stimuli in the same paradigm, indicating that the lateralized processes are face-stimulus-specific. In conclusion, these results suggest that the right cortical regions detect deviances in facial information more rapidly than their left homologues. The timing differences in the observed changes in alpha power, reflecting an increase in cortical activity over the side that processed the deviant (i.e., changing) facial information, suggest a faster recruitment of cortical regions that are relevant to the processing of the deviant face information for the LVF-deviant compared to RVF-deviant.

Topic Area: PERCEPTION & ACTION: Vision

Neuroplastic and Neurovascular Contributions to Visual Recovery in Post-Stroke Cortical Blindness

Poster D101, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Colleen Schneider[1,2], Emily Prentiss[2], Zoe Williams[1], Bogachan Sahin[1], Bradford Mahon[1,2]; [1]University of Rochester School of Medicine and Dentistry, [2]University of Rochester School of Arts Sciences and Engineering

The underlying mediators of post-stroke recovery remain poorly understood. Previous studies suggest that cortical reorganization and perilesional repair are mediators of post-stroke recovery; however, none of those studies have been able to provide a clear, generalizable association between those changes and recovery of function across patients. The present study investigates the relation between post-stroke visual recovery and i) perilesional neurovascular re-coupling, and ii) changes in retinotopic organization. Patients with visual field cuts secondary to stroke were studied longitudinally with 24-2 Humphrey perimetry and fMRI at 1 week, 1 month, 3 months, and 6 months post-stroke. Perimetry and functional MRI measures were brought into register with each other by dividing the visual field into 12 wedges that matched the area of the visual field stimulated by 12 checkerboard wedges during polar angle retinotopic mapping. The response of perilesional voxels to a full-field visual stimulus was significantly delayed compared to the contralesional hemisphere at 1 week but recovered by 3 months post-stroke in most patients. In addition, there was a shift in the preferred retinotopic bias of perilesional voxels towards the original blind field. Normalization of the delayed response of perilesional voxels accounted for visual recovery in patients who were initially blind in a hemifield and whose blind field resolved to one quadrant, while shifts in retinotopy toward wedge locations that were originally blind were associated with visual recovery in those wedge locations. We argue that the neurovascular and neuroplastic, in conjunction, explain variability in visual recovery across patients.

Topic Area: PERCEPTION & ACTION: Vision

The Genesis of Visual Memory through Strong Perceptual Representations: Tracking the Spatio-Temporal Neural Trace of Memorability

Poster D102, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Caitlin Mullin[1], Yalda Mohsenzadeh[1], Dimitrios Pantazis[1], Aude Oliva[1]; [1]MIT

Not all images are perceived equally — some have a higher likelihood of sticking in your mind. How does the brain process these images compared to those that fade into oblivion? Here we test the hypothesis that more memorable images show a greater neural perceptual trace (robust and sustained brain signals) than those that are less memorable. In order to access both high spatial and temporal neural signals, we employed the novel approach of fusing MEG and fMRI data (Cichy et al., 2014; 2016) using representational similarity analysis (Kriegeskorte et al., 2008). From the LaMem Memorability image set (Khosla et al., 2015), we constructed a subset of more and less memorable images balanced for both low-level image statistics and high-level semantic categories (faces, objects, scenes, animates). Results revealed that more memorable images recruited the medial and lateral regions of the occipito-temporal processing stream to a greater degree than the less memorable images. By 100ms after image onset, we find a more robust representation for high memorable images in the fusiform gyrus, lateral occipital and parahippocampal cortices. In addition, the neural representations of memorable images were more sustained in time both during (online perception) and after (iconic memory) image presentation. This robust and sustained representation found in high level brain regions for more memorable images could point to the perceptual maintenance required to encourage the system to encode the information into long term memory.

Topic Area: PERCEPTION & ACTION: Vision

Individual differences in dopamine D2 receptors and neural representations of subjective reward value

Poster D103, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Jaime Castrellon[1], Linh Dang[2], Jacob Young[3], David Zald[2], Gregory Samanez-Larkin[1]; [1]Duke University, [2]Vanderbilt University, [3]University of California, San Francisco

Previous pharmacological and genetic studies have implicated the dopamine system in intertemporal decision making. However, there is almost no evidence for an association between direct measures of dopamine function and discounting in humans. Here, we directly examined how individual differences in dopamine receptors related to individual differences in neural representations of subjective reward value in healthy humans. Seventeen young adults completed a delay discounting task during a functional MRI (fMRI) scan. During the task, subjects made 96 choices between smaller-sooner and larger-later rewards. On a separate visit, participants completed a PET scan with the high-affinity D2-like receptor tracer [18F]fallypride to identify regional binding potential (BPND). For each subject, choice data were fit with a hyperbolic discounted value function and softmax decision function. Estimated time discount rates (k) were used to calculate the subjective value of the chosen and unchosen options for each trial. FMRI data processing was carried out using FEAT in FSL using standard preprocessing. Following autocorrelation correction, each subject's data was fit with parametric convolved regressors representing the subjective value of the chosen and unchosen options. In a whole brain analysis, BPND from an a priori region of interest in the midbrain (an index of autoreceptor availability) was negatively correlated with BOLD signal associated with the subjective value of the chosen option in the thalamus, putamen, and middle frontal gyrus (cluster-corrected at $z>2.3$, $p<0.05$). This suggests that lower autoreceptor binding, and presumably higher levels of dopamine release, are associated with stronger representation of subjective value during intertemporal choice.

Topic Area: THINKING: Decision making

What to choose? Goals determine the effect of set value on the speed of value-based decisions

Poster D104, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Romy Froemer[1], Carolyn K. Dean Wolf[1], Amitai Shenhav[1]; [1]Brown University

All else being equal, people are faster to choose between higher value options compared to lower value options. This finding is often attributed to the value of the options themselves (e.g., that higher reward invigorates a faster response). Here we propose an alternative hypothesis, that responses are facilitated by the congruence of a choice set with the task goal, which is always to choose the best option. We tested this hypothesis in two studies: In Study 1, participants chose the worst of 4 items. As predicted, we reversed the standard effect: participants were slower, not faster, with increasing choice set value. In Study 2, participants chose the best item on half of the trials and chose the worst item on the other half. We observed a significant interaction of goal with set value: RTs decreased with increasing set value for choose-best, but increased for choose-worst. To better understand the mechanism underlying this effect, we fit our data with a hierarchical drift diffusion model. We compared three alternative models, testing whether the interaction of set value with goal was driven by changes in (a) drift rate, (b) response threshold or (c) non-decision time. The threshold and non-decision time models outperformed the drift rate model, suggesting that goal-congruent set values drive faster responses without also improving choice accuracy. Our findings suggest that the influence of set value on the speed of value-based decisions is a function of its ability to facilitate one's choice goal, rather than how much reward it promises.

Topic Area: THINKING: Decision making

The Association Between Health and Component Decision Processes

Poster D105, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Alexis Porter[1], Regina Leckie[2], Kirk Erickson[2], Timothy Verstynen[1]; [1]Carnegie Mellon University, [2]University of Pittsburgh

Poor health, such as high obesity or low cardiorespiratory fitness, is associated with poor executive function, it is unclear what underlying component mechanisms of decision control are negatively associated with health measures. To investigate this a neurologically healthy sample of community dwelling adults, ranging from overweight to obese (N=110), were evaluated on several health measures: body mass index (BMI), maximum cardiorespiratory fitness (VO2), and body fat composition using dual-energy x-ray absorptiometry (DXA). Decision control was then evaluated using the color-word Stroop task, where the underlying component processes were modeled using a hierarchical drift diffusion model (Wiecki et al, 2013). Cue-conflict was found to modify the drift rate of the decision process but not other parameters such as threshold and boundary height. The incongruency effect on the drift rate process did not associate with any of the health measures even after controlling for age, gender, and education (all r's<0.3, all p-values>0.05). Our results suggest that individual variability in BMI, body fat, and VO2 does not directly associate with variability in underlying component processes that regulate decision making.

Topic Area: THINKING: Decision making

Drift-Diffusion Modeling of Reward Learning in Depression

Poster D106, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Victoria Lawlor[1], Christian Webb[1], Madhukar Trivedi[2], Maurizio Fava[3], Patrick McGrath[4], Myrna Weissman[4], Ramin Parsey[5], Maria Oquendo[6], Patricia Deldin[7], Gerard Bruder[4], Diego Pizzagalli[1], Daniel Dillon[1]; [1]McLean Hospital, [2]University of Texas Southwestern Medical Center, [3]Massachusetts General Hospital, [4]Columbia University Medical Center, [5]Stony Brook School of Medicine, [6]University of Pennsylvania Perelman School of Medicine, [7]University of Michigan

Major Depressive Disorder (MDD) has been associated with disrupted reward learning, but the underlying neurocognitive mechanisms are poorly understood. For example, relative to healthy controls, adults with MDD typically show poorer performance in the probabilistic reward task (PRT), but the reason for this group difference remains unclear. Therefore, we applied the Hierarchical Drift Diffusion Model (HDDM) to three PRT datasets. The HDDM decomposes behavioral data into component cognitive processes, and we sought to identify which processes are affected by MDD. PRT data from 104 healthy controls and 302 depressed participants were analyzed. The HDDM was used to extract three decision-making parameters: drift rate, decision threshold, and prepotent bias. The HDDM revealed slower drift rates and higher decision thresholds in depressed versus healthy adults. In all three samples, HDDM parameters mapped onto standard PRT outcome variables: drift rate and threshold explained discriminability, while prepotent bias explained response bias. Discriminability, the ability to differentiate between task stimuli, predicted the number of rewards received better than response bias.These findings indicate that the PRT is readily modeled as a perceptual decision-making task, and they highlight key roles for discriminability and drift rate (in addition to response bias) in task performance. Conceptualizing the PRT in this way may forge a link between studies of reward learning in depression and extensive

work on evidence accumulation in non-human primates. Most importantly, these results provide insight into aberrant decision-making in depression, by linking MDD to slow evidence accumulation and conservative threshold settings.

Topic Area: THINKING: Decision making

Investigating the cost of cognitive effort

Poster D107, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Ceyda Sayali[1], David Badre[1]; [1]Brown University

People tend to avoid cognitively effortful tasks. In general, effortful tasks tend to be associated with long response times and higher error rates. Harder tasks also tend to recruit cognitive control systems. In prior work, we associated activation of frontoparietal network (FPN) and default mode network (DMN) regions during execution of a task with avoidance of those tasks. Here, we test which regions or networks in the brain predict learning of effort costs. We parametrically manipulated the level of effort by increasing cognitive control demands across tasks. In the scanned Learning phase, participants associated virtual card “decks” with tasks of a certain effort level. In the Test phase outside the scanner, participants made selections between pairs of effort tasks. We fit a reinforcement learning model that assumes costs acquired during learning influence decisions during Test. Across alternative models, we computed the cost of effort from either the average time-on-task, error rate, or task-switching probability of an effort level. The error rate model explained effort selections better than time-on-task and task-switching probability. Consistent with prior work, FPN activity increased with increasing effort execution. Expected cost and negative prediction errors positively correlated with FPN, DMN, and bilateral caudate. These results indicate that control and reward systems of the brain track learning of effort costs.

Topic Area: THINKING: Decision making

Optimizing STEM skills: A baseline assessment of the neural correlates of mental rotation

Poster D108, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Steven Greening[1], Katherine Moen[1], Stephanie Saltzmann[1], Lauryn Burleigh[1], Leslie Butler[1], Jagannathan Ramanujam[1], Alex Cohen[1], Melissa Beck[1]; [1]Louisiana State University

Success in STEM courses and careers requires spatial reasoning skills. Students demonstrating lower spatial reasoning skills struggle in STEM courses (Hegarty, 2010). We designed a prospective study to determine both the predictors and the mechanisms for how best to optimize STEM skills, specifically spatial reasoning. The present results reflect the baseline from a larger project aimed at determining the neurocognitive predictors of successful STEM training. We tested the prediction that mental rotation would be associated with increased activation in a visuomotor network including the inferior and superior parietal lobes, and the premotor cortices (Logie et al., 2011). Students enrolled in Introduction to Chemistry classes completed behaviorally mental rotation tasks with 3-D blocks (Shepard & Metzler, 1971) at Day-1. On Day-2, they completed an fMRI scan during which they completed a modified version of the mental rotation task with 3-D Blocks. Using a block-design, two stimuli were presented side-by-side and students decided if the two stimuli were rotated versions of the same item or if they were mirror versions of each other (i.e., it would be impossible to rotate one to get it to look like the other). Participants complete 30 second blocks in which the images that were either not rotated, or were rotated 60°, 100°, or 140° from each other. Behavioral results replicated previous research in that accuracy decreased and response time increased as angular disparity increased (Stieff, 2007). To better understand the underlying neurocognitive mechanisms associated mental rotation, full brain imaging results will be discussed.

Topic Area: THINKING: Other

When “2 x 4” is meaningful: the N400 and P300 reveal operand format effects in multiplication

Poster D109, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Vanessa Cerda[1], Danielle S. Dickson[1], Rosemary N. Beavers[2], Andres G. Ruiz[3], Nicole Y. Y. Wicha[1,4]; [1]University of Texas at San Antonio, [2]University of Texas Medical Branch, [3]Texas Tech University Health Sciences Center, [4]University of Texas at San Antonio Neurosciences Institute

When people read the solution to 3x4 =12 versus 3x4 =15 the brain elicits a robust event-related potential (ERP) effect. Initially, this effect was interpreted as a negative voltage modulation to the incorrect solution – an N400, implying that accessing arithmetic facts relies on a semantic memory network. This was consistent with models that argued for verbal memory representation of arithmetic facts. Subsequent work suggested instead that it was driven by a positive-going response to detecting the correct solution – a target P300. In the current study, operand format was manipulated to differentially promote access to arithmetic facts in verbal memory. Adults verified the correctness of simple multiplication problems. Two operands were presented as spoken number words or sequential Arabic numerals. The solution was always an Arabic numeral; ERPs were measured from solution onset. In Experiment 1, solutions preceded by spoken operands showed larger N400 amplitude for incorrect than correct problems, whereas solutions preceded by Arabic numerals showed a large P300 for correct problems. In Experiment 2, using only spoken operands, the delay between the second operand and the solution was manipulated (150ms, 1000ms) to determine if additional processing time would result in a P300, as with digit operands in Experiment 1. With a longer delay, an earlier N400 and no P300 was observed. In brief, highly familiar digit operands promote target detection, whereas spoken numbers promote semantic level processing even when solution format was held constant. This implies that format affects access to arithmetic facts in semantic memory.

Topic Area: THINKING: Problem solving

Multivariate Prediction of General Intelligence from Patterns of Gray Matter Density

Poster D110, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Kirsten Hilger[1,2], Tim Hahn[3], Christian Fiebach[1,2], Ulrike Basten[1]; [1]Goethe University Frankfurt, Frankfurt am Main, Germany, [2]IDeA Center for Individual Development and Adaptive Education, Frankfurt am Main, Germany, [3]Universitätsklinikum Münster, Münster, Germany

General intelligence has been associated with individual differences in morphological characteristics of the brain such as gray matter density (for meta-analyses, see Jung & Haier, 2007; Basten et al., 2015). However, the majority of previous investigations focused on correlative associations, which maximize explained variance within a given sample, without considering generalizability. To demonstrate the predictive value of individual differences in morphometric patterns of gray matter density for intelligence, we applied voxel-based morphometry (VBM) on structural magnetic resonance imaging (MRI) data from 308 adult participants (Nooner et al., 2012). In a regression model controlling for effects of age, sex, and handedness, intelligence (Wechsler Abbreviated Scale of Intelligence) was significantly associated with gray matter density in inferior frontal gyrus, middle temporal gyrus, lingual gyrus, precuneus, hippocampal region, and cerebellum (subsample of $N = 200$ used for model development). Using linear regression, we demonstrate that the multivariate pattern of gray matter density within these brain regions significantly predicts individual intelligence scores in the remaining, i.e., independent sample used for model testing ($N = 108$; correlation between predicted and actual intelligence scores: $r = .36$). Significant prediction was also achieved with a machine learning approach, i.e., support vector regression with nested cross-validation applied to the whole sample (correlation between predicted and actual intelligence scores: $r = .28$). In conclusion, our study demonstrates that the multivariate pattern of individual differences in gray matter density is predictive of individual intelligence scores, even in previously unseen individuals.

Topic Area: THINKING: Reasoning

Neurocognitive Relationships between Nonsymbolic and Symbolic Ratio Processing in Children and Adults

Poster D111, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

John V. Binzak[1], Yunji Park[1], Elizabeth Y. Toomarian[1], Priya B. Kalra[1], Yun-Shiuan Chuang[1], Percival G. Matthews[1], Edward M. Hubbard[1]; [1]University of Wisconsin--Madison

Based on findings from neuroscience and educational research, we have recently argued that the brain contains a ratio processing system (RPS) adapted to perceiving nonsymbolic ratios (e.g. the ratio of two line lengths; Lewis, Matthews & Hubbard, 2015), and that this RPS provides an underappreciated neurocognitive startup tool upon which the meaning of symbolic fractions (e.g. ¾) can be built (Matthews, Lewis & Hubbard, 2016). To further test the hypothesis that processing symbolic fractions builds on the RPS, we collected behavioral and fMRI data in three groups of participants (adults, 2nd grade children and 5th grade children) while they made a series of magnitude judgments in three conditions: symbolic fractions, line ratios, or mixed pairs. Although previous fMRI studies have examined symbolic and nonsymbolic ratio processing separately, no study has measured both in the same participants nor contrasted how they change with development. In each group, participants were faster and more accurate as the numerical distance between pairs increased, and were faster for nonsymbolic ratio judgments than either condition containing symbolic fractions. Neural distance effects were observed in bilateral intraparietal sulcus (IPS), prefrontal cortex (PFC) and occipital-temporal cortex. Adults relative to children showed greater overlap in bilateral IPS and PFC for symbolic and nonsymbolic judgments, suggesting that these regions become specialized to support magnitude processing with ratios regardless of format. Additionally, 5th grade children, relative to 2nd graders, showed greater distance effects (stronger negative slope) in the IPS, indicating that specialization of these regions occurs during early formal math instruction.

Topic Area: THINKING: Reasoning

P300, dispositional affect and sentence processing

Poster D112, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Janahan Selvanayagam[1], Victoria Witte[2], Louis Schmidt[3], Veena D. Dwivedi[1]; [1]Brock University, [2]Heidelberg University, [3]McMaster University

We used event-related brain potentials (ERPs) in a dual task study to investigate modulation of the P300 ERP component by affective state. Using the paradigm of Dwivedi & Gibson (2017), we employed a 3x2 design where 25 participants read sentences presented in 1- and 2-word chunks (Berent et al., 2005; Patson & Warren, 2010). Sentences started with subject nouns that were either universally quantified or not e.g., (i) Every kid climbed a tree vs. (ii) The kid climbed a tree, and continued with a direct object which was either indefinite singular, see (i), (ii) above, or definite singular/plural, as in (iii)/(iv) Every/The kid climbed the tree and (v)/(vi) Every/The kid climbed the trees. Number judgments were required at tree(s), which was always presented alone (and never final). As in our previous work, all conditions elicited a P300 effect. However, clear individual differences were apparent in this study. Participants who scored high on Positive Affect (as measured by the Positive and Negative Affect Schedule (PANAS), showed P300 responses almost identical to what was found previously. In contrast, participants who scored low on Positive Affect (PA), showed P300 responses that were consistent not with meaning, but with target stimulus probability. We interpret these findings as follows: people with high PA scores are sensitive to heuristic meaning; they are sensitive to the semantic cue of number (singular/plural) during sentence processing. Individuals with low PA scores are less engaged with sentence interpretation and instead are more engaged with task performance.

Topic Area: LANGUAGE: Syntax

Neural networks of specific and general autobiographical memory retrieval in younger and older adults

Poster D113, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Aleea Devitt[1], Reece Roberts[2], Abby Metson[2], Lynette Tippett[2], Donna Rose Addis[2]; [1]Harvard University, [2]The University of Auckland

Healthy aging is associated with difficulty retrieving specific/episodic autobiographical memories (AMs), while retrieval of general/routine AMs – which tend to be reliant on semantic memory – is relatively preserved. While age-related declines in episodic memory are reflected in reduced activation of the default network when retrieving specific AMs, little is known about the effects of age on neural activation during general AM retrieval. The current fMRI study used Partial Least Squares to explore age-related changes in whole-brain networks during specific and general AM retrieval. We found that compared to a semantic control task, both younger and older adults engaged the default network during specific AM retrieval, but this pattern of activity was less pronounced with age. Younger adults engaged a subset of default regions during general retrieval, while older adults recruited a similar network for both specific and general retrieval. Lastly, younger adults activated additional non-default areas for the more demanding specific AM task, including regions of the dorsal and ventral attention networks. These regions were not utilized by older adults for specific retrieval, even though they did recruit these regions in the control task. These results provide further evidence of dedifferentiation of specific and general AM retrieval with age.

Topic Area: LONG-TERM MEMORY: Development & aging

Parietal and occipitotemporal cortical reinstatement differentially predict successful associative memory retrieval in older adults

Poster D114, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Alexandra N. Trelle[1], Valerie A. Carr[2], Scott Guerin[1], Wanjia Guo[1], Marc B. Harrison[1], Manasi Jayakumar[1], Jiefeng Jiang[1], Geoffrey Kerchner[1], Elizabeth Mormino[1], Natalie Tanner[1], Monica Thieu[3], Anthony D. Wagner[1]; [1]Stanford University, [2]San Jose State University, [3]Columbia University

In healthy younger adults, reactivation of encoding-related cortical activity patterns during memory retrieval is associated with superior episodic memory. Recent data suggest that, relative to activity patterns in occipitotemporal cortex, reinstatement in ventral parietal cortex may be differentially linked with behavioural memory outcomes. The present study examined this possibility in healthy older adults using high-resolution fMRI data collected during a paired-associate encoding and retrieval task. Participants studied a series of word-face and word-scene pairs, and subsequently made memory decisions on studied words intermixed with novel words. During retrieval, participants indicated the category of the paired associate (“face” or “scene”), responded "old" when recognizing the word without associative recollection (item memory only), or responded "new". An additional post-scan test probed whether participants could recollect the specific picture associated with each studied word. Encoding-retrieval pattern similarity (ERS) analyses revealed evidence for stronger reinstatement of item-level and category-level associative information in inferior parietal cortex (IPL), inferior frontal gyrus (IFG), and ventral occipitotemporal cortex (VOTC) during successful associative retrieval (word and correct category) relative to item recognition (“old” judgement). Mixed effect models revealed that, relative to reinstatement in VOTC or IFG, the magnitude of trial-level reinstatement in IPL better predicted behavioral measures of associative retrieval during scanning and recollection of the specific associate post-scanning. These results complement extant findings in younger adults, and provide novel evidence for a role of IPL in representing behaviourally relevant mnemonic content during memory retrieval across the lifespan.

Topic Area: LONG-TERM MEMORY: Development & aging

How do developmental shifts in attentional control influence memory encoding?

Poster D115, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Alexandra Decker[1], Amy Finn[1], Katherine Duncan[1]; [1]The University of Toronto

The capacities to strategically allocate attention and to form episodic memories increase radically across childhood. Little is known about how developmental shifts in attention and attentional control impact memory because these domains are often investigated

in isolation. Recent work, however, shows that endogenous shifts in sustained attention can directly impact memory formation in adults (deBettencourt, Norman, & Turk-Browne, 2017). We built off this work to investigate the interdependence of attention and memory development. We optimized a sustained attention task for children, in which participants could incidentally encode images of animals (n=32) and inanimate objects (n=300) while rapidly classifying each as ‘living’ or ‘nonliving’. We then assessed participants memory for the animals and objects in a recognition task. Crucially, we asked whether memory encoding depended on (1) endogenous shifts in sustained attention (measured by fluctuations in classification judgment reaction time) and (2) controlled shifts in attention (triggered by classification errors). Linear mixed effects modelling revealed that classification errors during encoding significantly affected later memory for the images immediately preceding and following the error ($p < 0.001$). Future work will extend this paradigm to developmental samples to investigate how shifts in attentional control and shifts in sustained attention—between ‘good’ and ‘bad’ states—influences memory in children.

Topic Area: LONG-TERM MEMORY: Development & aging

The ERP correlates of self-knowledge: Are assessments of one’s past, present, and future traits closer to semantic or episodic memory?

Poster D116, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Louis Renoult[1], Annick N. Tanguay[2], Lauren Benton[3], Lorenza Romio[1], Carolin Sievers[1], Patrick S. R. Davidson[2]; [1]School of Psychology, University of East Anglia, Norfolk, UK, [2]School of Psychology, University of Ottawa, Ontario, Canada, [3]Department of Neuroscience, Dickinson College, Pennsylvania, USA

Self-knowledge entails evaluative judgments of oneself, and includes knowledge of one’s own traits and preferences. Self-knowledge is a type of personal semantics, yet it is unclear how it relates to semantic and episodic memory. Here, we compared the event-related potential (ERP) correlates of self-knowledge to those of semantic and episodic memory, using N400 and Late Positive Component (LPC) as proxies for semantic and episodic processing, respectively. We considered an additional factor: time perspective. Temporally distant selves may be more semantic compared to the present self, but thinking about one’s past and future selves may also engage episodic memory. Twenty-eight adults answered whether traits (e.g., persistent) were true of most people holding an occupation (e.g. soldiers; semantic memory condition), or true of themselves 5 years ago, in the present, or 5 years from now (past, present, and future self-knowledge conditions). The study ended with an episodic recognition memory task for previously seen traits. Mean N400 amplitudes for the 3 self-knowledge conditions were smaller than for semantic memory at sagittal sites. Present self-knowledge produced mean LPC amplitudes at posterior parietal sites that fell between semantic and episodic memory. Crucially, mean LPC amplitudes for past and future self-knowledge were greater than for semantic memory, and not significantly different from episodic memory. Overall, our findings are consistent with a distinction between knowledge of others and self-knowledge, but the closeness of self-knowledge’s neural correlates to either semantic or episodic memory appears to depend to some extent on time perspective.

Topic Area: LONG-TERM MEMORY: Episodic

Generalization of associative item-memory EEG features to associative recognition

Poster D117, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Yvonne Y Chen[1,2], Jeremy B Caplan[1]; [1]University of Alberta, [2]Baylor College of Medicine

Item memory is known to be enhanced by associative processes. Accordingly, some electroencephalographic (EEG) features that are implicated in successful item memory have been thought to reflect associative processes. We test this interpretation by asking if these features explain memory success in the associative recognition task, for which item-memory alone cannot help with the memory judgment. Participants were shown lists of word-pairs (e.g., A-B, C-D,...) and later asked to distinguished intact (e.g., A-B) from recombined (e.g., C-B) probe pairs. At study, we found a significant difference between later-remembered and later-forgotten pairs (subsequent memory effect) at posterior Slow Wave ($t(58)=2.34$), thought to reflect elaborative processes. However, the difference observed in the posterior Slow Wave did not correlate with performance across individuals. At test, we found no significant difference between remembered and forgotten pairs (retrieval success effect) at the left parietal positivity, thought to

reflect retrieval of associative information that supports recollection; neither did the difference measure correlate with performance across participants. In contrast, theta oscillations (4-8 Hz rhythmic activity) showed a significant subsequent memory effect ($t(58)=2.23$) and retrieval success effect ($t(58)=5.64$). Furthermore, the differences in theta activity were correlated with participants' memory performance at both study ($r(58)=0.35$) and test ($r(58)=0.34$). Our results suggest that if ERPs reflect associative processes that influence item memory, they are quite different from ERPs that support item-item association memory. However, theta oscillations apparently reflect a cognitive state that drives memory success in both item and association memory tasks.

Topic Area: LONG-TERM MEMORY: Episodic

Enhancing spatial memory via auditory entrainment of theta oscillations

Poster D118, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Jessica Creery[1], Hadley C. Pfalzgraf[1], Ken A. Paller[1]; [1]Northwestern University

Memory processing in the brain has been associated with neural oscillations at specific frequencies. To investigate the putative causal roles of these rhythms, they can be manipulated using transcranial direct current stimulation (tDCS) or repetitive transcranial magnetic stimulation (rTMS). Alternatively, oscillatory auditory stimulation can function like oscillatory electromagnetic stimulation. We thus presented pink noise concurrently with pictures of objects, and systematically modulated sound intensity to include frequency-specific signals. We focused on neural entrainment at theta and beta frequencies based on (a) evidence showing neural responses from auditory stimulation at these frequencies and (b) evidence linking theta and beta with memory formation. Participants learned 60 object-location associations on a grid background. For each participant, one-third of the objects were randomly assigned to each of three conditions: 4-Hz theta oscillations, 15-Hz beta oscillations, or static noise. Each association was learned to a criterion and, after a 15-min break, location recall was tested for each object. Scalp electroencephalographic recordings showed that brain activity was altered as expected: theta amplitude was higher during 4-Hz stimulation, whereas beta amplitude was higher during 15-Hz stimulation. To the extent that stimulation enhanced theta, a memory improvement was found for objects presented with 4-Hz stimulation compared to objects with unmodulated noise. That is, this relative memory benefit was correlated with the increase in theta power during stimulation. Sensory entrainment is thus a powerful way to experimentally modify brain oscillations in order to understand their functions, in this case linking theta with effective memory formation.

Topic Area: LONG-TERM MEMORY: Episodic

Pre-stimulus EEG oscillations reflect a preparatory form of episodic retrieval orientation

Poster D119, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Mason Price[1], Emmitt Wright[1], Elizabeth Griffiths[2], Jeffrey Johnson[1]; [1]University of Missouri, [2]University of Surrey

Studies from both experimental psychology and cognitive neuroscience have provided substantial evidence that successful episodic memory retrieval depends on the degree of overlap between a retrieval cue and the targeted memory trace. Recently, ERPs have been extensively used to investigate how changes in retrieval cue processing, or orientation, can bias retrieval in service of enhancing the likelihood of such overlap. While the evidence for retrieval orientation has thus far come exclusively from post-stimulus differences in ERP amplitude, whereby effects onset by approximately 300 ms after stimulus onset and are relatively sustained, the requirement of baseline correction for amplitude analyses potential limits the true magnitude of these effects as well as their detection under certain conditions. The current study resolved this issue by analyzing the pre-stimulus period immediately preceding retrieval cue onset to test for a preparatory form of retrieval orientation. Participants encoded a series of picture and words, and then completed separate memory test blocks in which only one stimulus class was targeted at a time. Multivariate pattern analysis (MVPA) of the pre-stimulus EEG oscillations indicated above-chance performance at identifying the targeted class of items. These retrieval orientation effects were relatively constant throughout the pre-stimulus period, providing further support for the notion that orienting constitutes sustained and preparatory cognitive states intended to meet the demands of episodic retrieval tasks.

Topic Area: LONG-TERM MEMORY: Episodic

Long-term memory specificity for faces depends on inhibition of closely related items

Poster D120, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Brittany M. Jeye[1], Scott D. Slotnick[1]; [1]Boston College

We previously found that long-term memory inhibition occurred for distantly related abstract shapes. Related shapes were constructed by morphing old shapes from 50 to 200% (100% morphs were perceptually “different” from the corresponding old shapes). The “old” response rate was lower for 200% morphs than for new shapes, which can be attributed to inhibition of distantly related items. In the current study, we evaluated the specificity of long-term memory representations for faces. During the encoding phase, participants were presented with neutral Caucasian male and female faces. During the retrieval phase, old faces, related faces, and new faces were presented and participants made “old”–“new” recognition judgments. Related faces were created by morphing along a five step continuum (20–100%) between old faces and unique new faces (independent ratings indicated that the pairs of morphed faces were perceptually dissimilar). As expected, memory representations were very specific as the “old” response rate was significantly greater for old faces than 20% morphs. Moreover, the “old” response rate was significantly lower for 20% morphs than for 40% morphs, which likely reflects memory inhibition of closely related faces. These results suggest that long-term memory specificity depends on detailed memory for specific faces and inhibition of closely related faces. This may reflect an evolutionary advantage for recognizing specific faces, which may require inhibition of closely related faces (as compared to abstract shapes that have less specific category boundaries). We are currently designing a follow-up ERP study to investigate the brain basis of this long-term memory inhibition.

Topic Area: LONG-TERM MEMORY: Episodic

Individual Differences in Value-Directed Encoding

Poster D121, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Blake Elliott[1], Samuel McClure[1], Gene Brewer[1]; [1]Arizona State University

The ability to selectively encode important or valuable information is an essential aspect of human memory. Individual differences in this ability may derive from variability in stimulus valuation, memory encoding, or from variability in strategic abilities related to strategy selection and maintenance in working memory. The possibility that individual difference may segregate along these different dimensions is suggested by the fact that the brain reward system consists of multiple parallel networks (e.g. mesolimbic, mesocortical, and mesiotemporal pathways) that converge to support action control. We collected cognitive ability measures reflecting working memory capacity, episodic memory, and value-directed remembering from a large sample of participants (n=230). Individual differences methodology can be used to assess these dimensional contributions to value sensitivity in value-directed remembering tasks. Our results suggest that episodic memory ability, but not working memory capacity, was predictive of value-dependent memory. These results suggest that brain reward networks may be differentially related to value-based memory encoding.

Topic Area: LONG-TERM MEMORY: Episodic

Investigating neural signatures of visual encoding and recall using 7T fMRI

Poster D122, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Elizabeth H. Hall[1], Wilma A. Bainbridge[1], Chris I. Baker[1]; [1]Laboratory of Brain and Cognition, National Institutes for Mental Health

While previous work has implied a difference in perceptual processing of scenes and objects, until now, few neuroimaging studies have explored the relationship of visual free recall and encoding for objects and scenes, in both perceptual and memory-related regions. There is still a large open question of whether hippocampal-based memory processes differ based on visual content type, as different regions around the hippocampus have been separately implicated for perception of different stimulus categories (e.g., the perirhinal cortex for objects, the parahippocampal cortex for scenes). Additionally, most studies have depended upon tasks using verbal associative cues to trigger memory, while few have investigated recall memory for isolated visual events (with no verbal component). We conducted a visual free recall experiment where, for each trial, participants viewed (and encoded) a scene or object image, performed a visual distractor task, and then were asked to recall that original image and report the vividness of their memory. We used high-resolution 7T fMRI (1.2mm isotropic voxels) to investigate differential processing within hippocampal subfields, as earlier research has shown that that subdivisions within the hippocampus make distinct contributions to new memory formation. We find evidence for distinct processing of scene and object information during both encoding and recall in hippocampal and cortical regions. We also find distinct processing between encoding and recall phases. This study presents an important exploration of neural processing of encoding and recall and objects and scenes in perceptual and memory-related regions of interest.

Topic Area: LONG-TERM MEMORY: Episodic

Self-relevance underlies disgust salience in episodic memory

Poster D123, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

David Anaki[1], Hannah Tarder-Stoll[2], Morris Moscovitch[2,3]; [1]Bar-Ilan University, [2]University of Toronto, [3]Baycrest Centre for Geriatric Care

Emotional memory studies have shown greater memory for disgust over other emotions. The reason for this disgust memory-enhancement, however, is unclear. In the present study we examined the hypothesis that disgust-related stimuli are remembered better because of their relevance to the self. We reasoned that even touching pictures depicting disgust-related stimuli would increase the sense of self-contamination and enhance memory. Participants were visually presented with pictures of neutral, disgust-related and fear-inducing stimuli (the latter equated on arousal and valence), overlaid by pairs of digits. Participants were asked to select the numerically larger digit whose physical size was either congruent or incongruent with its numerical value (numerical Stroop task [NST]). Half of the participants responded by pressing designated keyboard buttons, while the others pressed the chosen digit on the touch screen. Following the completion of the NST participants were unexpectedly asked to recall the images. Recall accuracy of the disgusting and fearful images was higher than the neutral images in both response-type groups. However, while memory of disgusting and fearful stimuli was comparable in the keyboard condition, recall was greater for disgusting than fearful images in the touch condition. The disgust enhancement of memory in the touch condition could not be attributed to differential attention at encoding since the NST performance was similar across stimuli. We suggest that participants in the touch condition felt contaminated by the disgust but not the fearful images. As a result these disgusting stimuli became more relevant to the self and subsequently more salient in memory.

Topic Area: LONG-TERM MEMORY: Episodic

Dissociable cortico-hippocampal networks during the processing of time and space information in episodic encoding

Poster D124, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Saeko Iwata[1], Hikaru Sugimoto[1,2], Takashi Tsukiura[1]; [1]Graduate School of Human and Environmental Studies, Kyoto University, [2]Japan Society for the Promotion of Science

Episodic memory is defined as memory for personally experienced events with time and space contexts. Previous studies have demonstrated that a temporal context processed in the lateral prefrontal cortices (lPFC) and a spatial context processed in the parahippocampal (PHC) and retrosplenial cortices (RSC) are integrated in the hippocampus during episodic remembering. However, little is known about the functional dissociation in the cortico-hippocampal networks underlying the processing of time

and space information during episodic encoding. To investigate this issue, we scanned 42 healthy young adults to investigate neural activation by fMRI during the encoding of pictures, and then performed the picture retrieval task outside fMRI. During encoding, participants were presented with scene pictures, and judged how close the time in each picture was to the time when participants were performing this task (Time), how close the landscape in each picture was to a landscape of the place where participants were performing this task (Place), and the location of a dot in each corner of the pictures (Control). During retrieval, participants made old-new judgments for target and distracter pictures. In fMRI results, the lPFC showed significantly greater activation in Time, and PHC and RSC activation significantly increased in Place. The gPPI analyses revealed that activation in the lPFC, RSC and PHC was functionally connected with that in the hippocampus, but regions reflecting the functional connectivity were dissociable between Time and Place within the hippocampus. These findings suggest that temporal and spatial contexts in episodic memories could be represented in different cortico-hippocampal networks.

Topic Area: LONG-TERM MEMORY: Episodic

Inhibition of distantly related items in long-term memory depends on the number of repetitions at encoding

Poster D125, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Cassidy McCarthy[1], Brittany M. Jeye, Scott D. Slotnick; [1]Boston College

In a previous study, we found that long-term memory inhibition occurred for distantly related items following three repetitions at encoding. Related shapes were constructed by morphing old shapes between 50 to 200% (independent ratings indicated that 100% morphs were perceptually “different” from the corresponding old shapes). The “old” response rate was lower for 200% morphs than for new shapes, which can be attributed to long-term memory inhibition of distantly related items. In the current study, we evaluated whether long-term memory inhibition of related items was affected by the number of times each item was presented during encoding. During encoding, participants were presented with abstract shapes repeated five times. During retrieval, old shapes, related shapes, and new shapes were presented and participants made “old”–“new” recognition judgments. Preliminary analyses revealed that memory representations were very specific, as the “old” response rate was significantly different between old shapes and 50% morphs. However, unlike the inhibition effects that were observed in the three-repetition experiment, there was no difference in the “old” response rate between 200% morphs and new shapes ($t < 1$). These results suggest that inhibition of distantly related items in long-term memory depends on the number of repetitions at encoding. One explanation for the present null findings is that more deeply encoded items may not require inhibition to distinguish them from related items. In a future study, we will investigate the brain basis of long-term memory inhibition using the same abstract shape paradigm with three repetitions at encoding.

Topic Area: LONG-TERM MEMORY: Episodic

Depression and Anxiety Symptoms Influence Hippocampal Brain Activation during a Spatial Memory Task in Healthy Adolescents

Poster D126, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Anna Seraikas[1], Julia Cohen-Gilbert[1,2], Emily Oot[1,3], Derek A. Hamilton[4], Carolyn Caine[1], Maya Rieselbach[1], Lisa D. Nickerson[1,2], Sion K. Harris[5], Marisa M. Silveri[1,2], Jennifer T. Sneider[1,2]; [1]McLean Hospital, [2]Harvard Medical School, [3]Boston University School of Medicine, [4]University of New Mexico, [5]Boston Children's Hospital

Adolescence is characterized by significant structural and functional remodeling, particularly in brain regions influenced by symptoms of anxiety and depression. Accordingly, the objective of this study was to evaluate relationships between hippocampal activation, non-clinical levels of depression and anxiety, and memory in healthy adolescents. Functional magnetic resonance imaging data were acquired at 3Tesla during performance of a virtual water maze task in 32 (15 female) healthy adolescents. Participants were alcohol and drug naïve and recruited locally to participate in a three-year longitudinal study of adolescent brain development. Adolescents completed the Multidimensional Anxiety Scale for Children (MASC) and the State-Trait Anxiety

Inventory for Children (STAI-C) to assess clinical symptoms of anxiety, and the Center for Epidemiological Studies Depression Scale for Children (CES-DC) to assess clinical symptoms of depression. Data at baseline demonstrate significant hippocampal activation during memory retrieval relative to motor control. Notably, greater hippocampal activation was significantly associated with higher anxiety scores from the MASC ($p=.001$) and the STAI-state ($p=.020$), and higher depression scores on the CES-DC ($p=.006$). Elevated hippocampal activation in adolescents with higher symptoms of anxiety and depression may reflect later maturation and/or differential inefficiency of this brain region when performing a memory task, which will be examined in the longitudinal component of the study. Given that symptoms of depression and anxiety typically manifest during this pivotal stage of brain development, these findings may shed important light on normative interactions between brain regions involved in memory and mood regulation. Funding Source: R01 AA022493 (Silveri)

Topic Area: LONG-TERM MEMORY: Episodic

Structural Integrity Deficits of Uncinate Fasciculus Predict Medial Temporal Lobe Subfield Activity During an Emotional Pattern Separation Task

Poster D127, Monday, March 26, 8:00-10:00 am, Exhibit Hall C

Steven Granger[1], Stephanie L. Leal[2], Elizabeth A. Murray[1], Michael A. Yassa[1]; [1]University of California, Irvine, [2]University of California, Berkeley

The human medial temporal lobe (MTL) is well known to contribute to the storage and retrieval of episodic memories. Recent evidence shows that the dentate gyrus (DG) and CA3 subfields of the hippocampus contribute to a neural computation known as Pattern Separation which the brain uses to distinguish between highly similar items (known as “lures”) during recall. A similar paradigm, known as the Emotional Pattern Separation task has been employed to study the effects of emotional discrimination in both healthy and in those exhibiting depressive symptoms. We have previously shown that during this task, depressive symptoms drive an effect where DG/CA3 subfield activity decreases whilst amygdala activity increases during correct discrimination of negatively-valenced lure items. Although the MTL’s functional activity has begun to be categorized during these Pattern Separation tasks the role of the prefrontal cortex (generally thought to exert top-down influence over cognitive processes) is still relatively unclear. The uncinate fasciculus (UF) is one of the major white matter bundle connecting the prefrontal cortex and MTL. Further, deficits in the UF have not only been implicated in those exhibiting depressive symptoms but they also have been shown to correlate with memory performance in tasks involving highly similar items. Here we tested the hypothesis that deficits in UF would predict the emotional pattern separation signal observed in depression. We found that strength of connection of the UF predicted a decrease in both amygdala and DG/CA3 activity during correct lure rejection of emotional items.

Topic Area: LONG-TERM MEMORY: Episodic

The Auditory Contralateral Occipital Positivity Within Unimodal Versus Bimodal Stimulation

Poster E1, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Daniel Roberts[1], Steven Chong[1], Craig McDonald[1], Baldwin Carryl[1]; [1]George Mason University

A recently reported event-related potential component, the auditory-evoked contralateral occipital positivity (ACOP), has been suggested to reflect the influence of involuntary orienting to the position of a sound on subsequent visual processing. However, the ACOP has not been investigated in the context of concurrent bimodal stimulation. The present study investigated the ACOP in the context of concurrent bimodal stimulation, as well as how the component relates to objective vs. subjective estimates of spatial position. Participants completed a spatialization task, in which they were asked to estimate the spatial location of auditory and / or visual stimuli. On each trial, auditory and visual stimuli were independently presented from one of three spatial locations, or were absent. The four possibilities for each modality generated a grid of sixteen equiprobable stimulus combinations. These sixteen combinations included unimodal presentation for each modality at each position. Behaviorally, the presence of stimuli in one modality influenced their perception of the spatial position of the stimulus in the alternate modality, with visual stimuli influencing

auditory spatial responses to a greater extent than auditory stimuli influencing visual spatial responses. Within unimodal auditory trials, the position of the auditory stimulus generated the previously reported ACOP. The ACOP was absent from unimodal visual trials. Additionally, within bimodal trials, the ACOP was not present. As the ACOP was still present within the sum of unimodal trial combinations, the ACOP appears to be sub-additive within concurrent bimodal stimulation.

Topic Area: ATTENTION: Multisensory

A neural score for engineering concepts: predicting STEM learning with multivariate pattern analysis of functional neuroimaging data

Poster E2, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Joshua S. Cetron[1], Andrew C. Connolly[2], Solomon G. Diamond[3], Vicki V. May[3], James V. Haxby[1], David J. M. Kraemer[1]; [1]Dartmouth College, [2]Geisel School of Medicine at Dartmouth, [3]Thayer School of Engineering at Dartmouth

Learning in any conceptual domain can be described along a progression from naïve understanding to expertise. Behavioral tasks and tests of concept knowledge generate scores that can be used to assess the degree to which an individual learner has acquired expert-level understanding of a concept. In previous research on mechanical engineering concepts, we have shown that expert-level information is also represented in patterns of neural activity exhibited by participants over the course of a concept learning task. In the present study, we investigated whether those patterns of neural activity can be used to compute a "neural score" for an individual learner that would complement existing, behaviorally-derived scores of that individual's engineering concept understanding. Using representational similarity analysis and an expert model of mechanical engineering information, we successfully derived a neural score from patterns of activity across the brain reflective of expert-level knowledge. This score correlates with two independent behavioral scores of concept learning. Further, neural scores differentiated individuals across two groups of participants with different levels of prior experience with the learned concepts. More broadly, this neural scoring method could be applied to predict learning outcomes in additional content domains and over longitudinal neuroimaging studies of learning, most notably those involving classroom-based research on education.

Topic Area: THINKING: Reasoning

Visual vs. auditory attentional cueing and auditory spatial discrimination

Poster E3, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Norbert Kopco[1,2,3], Rene Sebena[1], Bernadeta Hrebenarova[1], Jyrki Ahveninen[2], Virginia Best[3], Barbara Shinn-Cunningham[3]; [1]Institute of Computer Science, P. J. Safarik University, Kosice, Slovakia, [2]Martinos Center for Biomedical Imaging, Mass Gen Hospital/Harvard Medical School, Boston, MA, USA, [3]Hearing Research Center, Boston University, Boston, MA, USA

Auditory spatial discrimination can be influenced by the direction of listener's gaze. Here, we performed behavioral and EEG experiments to examine 1) whether directing automatic auditory spatial attention affects listeners' performance in a task when the gaze direction is fixed, 2) whether the effect depends on the modality of the attentional cue (auditory vs. visual), and 3) how neuronal activity, measured by EEG, changes during task performance. While fixating on a neutral location, listeners made a judgment about the relative position of two click trains, which followed either a visual or an auditory cue. Behavioral results show that 1) subjects performed better overall following the visual cue, 2) an auditory cue presented from an incongruent location had a detrimental effect on performance, and 3) these effects were dependent on whether the direction of auditory position change was towards or away from the gaze fixation point. Analysis of ERPs showed that amplitudes of the auditory N1, P2, N2 and P3 components varied for different combinations of the cue modality, cue validity, and the direction of shift re. gaze fixation. Behavioral performance and auditory ERP components were also modulated by whether the targets were presented in the center or at peripheral locations. These results suggest a complex interaction between attentional and eye-gaze control mechanisms in auditory spatial processing. [Work supported by EU H2020-MSCA-RISE-2015 grant 691229, VEGA 1/1011/16, APVV-0452-12]

Topic Area: ATTENTION: Auditory

Limited attention facilitates learning of peripheral information in children

Poster E4, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Michael Paul Dubois[1], Theresa Pham[1,2], Danielle Lim[1], Amy Finn[1]; [1]University of Toronto, [2]University of Western Ontario

Adults are capable of narrowing their attention and filtering extraneous information to achieve particular tasks. Usually, this skill is highly useful, however, it can mean that when attending to particular task demands, adults are “blind” to patterns that are peripheral to those demands. In the present experiment, we explore whether children, who have limited filtering abilities (Finn, in preparation; Plebanek & Sloutsky, 2017) are less “blind” to peripheral information. Additionally, we explore whether this “blindness” occurs in adults and children when, unbeknownst to participants, the peripheral information can directly impact task performance. We therefore tested adults and children (ages 5-9), using a correlated flanker paradigm. Participants saw one of two target stimuli, and were tasked with indicating as quickly as possible which target appeared. On each trial, the target had a pair of other flanking stimuli, but participants were told to only respond to the targets. Unbeknownst to participants, some flankers were highly correlated with a particular target (consistent), while rarely appearing with the other target (inconsistent), or equally likely to appear with each target (neutral). We found that young children (ages 5-7) were sensitive to peripheral information, showing reduced reaction times for consistent trials, and increased reaction times for inconsistent trials. Conversely, adults and older children did not differ in reaction time for each of the trial types. These data suggest that children are less capable of restricting their attention to target information, and what they learn about the periphery can consequently impact task performance, for better and worse.

Topic Area: ATTENTION: Development & aging

The neural timecourse of the endogenous shifting of attention to objects

Poster E6, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Charles Giattino[1], Saikiran Gudla[1], Marty Woldorff[1]; [1]Duke University

Attention can be directed endogenously to spatial locations, as well as to features and objects in the environment. Attending to objects has been shown to modulate fMRI BOLD activity in object-selective cortical areas; e.g., attending to faces increases activity in the fusiform face area. However, fMRI cannot reveal the timecourse of such attentional modulations, nor the specific nature of the neuroelectric signals involved. We sought to elucidate the timecourse of object-based attention by recording EEG as subjects performed two different tasks. In a “localizer” task, subjects were centrally presented with a series of face and house images, one at a time, with the task to detect occasional blurred images in the series and respond as to their object category. We used the scalp topography of the face-selective (face-minus-house) N170 ERP effect in individual subjects in this task as a template for object-selective processing. In the main task, subjects were presented with both a face and house, one above and one below fixation. After 800-900 ms, subjects were cued to shift attention to either the face or house to detect a subsequent, transient blurring of the image. We found that shifting attention to faces (compared to houses) induced a highly similar pattern of voltages to the localizer-task N170, starting at ~400 ms post-cue and continuing until the end of the trial. We also found an N170-like pattern earlier in the trial, at ~200 ms post-cue, activity suggestive of a rapid, learned association that occurs before the endogenously controlled shift of attention.

Topic Area: ATTENTION: Nonspatial

Neural correlates of eye movements during naturalistic viewing

Poster E7, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Jessica Robin[1], Bradley R. Buchsbaum[1,2], Rosanna K. Olsen[1,2]; [1]Rotman Research Institute, Baycrest, [2]University of Toronto

Eye movements provide a sensitive measure of attention to visual stimuli and exploratory behaviour. Recent research has highlighted a link between increased viewing, hippocampal activity, and memory formation, suggesting that the hippocampus's role in forming lasting memory representations may be positively related to visual sampling. It is not known, however, how neural activity relates to eye movement measures during the viewing of naturalistic, dynamic stimuli. Behavioural studies have demonstrated that viewing patterns differ measurably between static and dynamic images, so it is important to determine how neural activity relates to eye movements in more naturalistic settings. In this study, we recorded eye movements while participants viewed short videos of varied content while undergoing fMRI scanning. We found increased neural activity in the visual cortex, and decreased medial prefrontal activity, when participants made more fixations to the videos. Increased spatial variability of the eye movements was associated with widespread increased activity throughout the visual cortex and dorsal and ventral visual processing streams. This study provides a novel method for examining the neural correlates of eye movements in a naturalistic setting, and suggests that eye movement variability is associated with neural activation throughout the visual system.

Topic Area: ATTENTION: Other

Investigating the Dynamics of Social Attention with a Gaze-Contingent Display using Recurrence-Quantification Analysis

Poster E8, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Aleya Flechsenhar[1], Lara Roesler[1], Matthias Gamer[1]; [1]Department of Experimental Clinical Psychology, University of Wuerzburg

The tendency to attend to other human beings is described as social attention. Previous studies have shown a bias towards attending such social features during free-viewing of naturalistic scenes. Furthermore, social attention seems to be reflexive and able to defy top-down demands in form of explicit search tasks. However, the question remains whether social features are in fact also voluntarily selected. Therefore, we established a gaze-contingent viewing paradigm, in which the visual field is constrained and updated in response to the viewer's eye movements. Hence, contextual information is masked and thereby limits bottom-up influence, allowing the examination of voluntary eye movement planning. In an eye-tracking experiment, 75 participants viewed 80 social and 80 non-social images that were randomly allocated to a free and a gaze-contingent viewing condition. Our results revealed comparable viewing patterns for both viewing conditions, namely a strong attention bias for social features. Physical saliency, as determined by the Graph-Based Visual Saliency algorithm, did not account for the selection of social elements. However, gaze-contingent viewing altered temporal and spatial dynamics of viewing behavior as compared to natural viewing. Interestingly, viewing dynamics differed significantly between social scenes and pictures that did not include human being. Recurrent fixations were more frequent and closer together in time, for the former as compared to the latter stimulus category in both viewing conditions. Taken together, this study implies a voluntary selection of social features and a general influence of social content on visual exploratory behavior, thus highlighting mechanisms of social attention.

Topic Area: ATTENTION: Other

Object-feature binding is maintained under dynamic shifts of spatial attention

Poster E9, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Emma Wu Dowd[1], Julie D. Golomb[1]; [1]The Ohio State University

Successful object recognition requires the binding of different visual properties (e.g., color, shape, location) into an integrated object-level representation. Theories of feature integration propose that spatial attention is crucial for binding—but attention is rarely static, instead dynamically shifting and splitting across multiple goals and locations. What happens to object-feature binding when attention must shift or split across multiple objects with multiple features? While maintaining central fixation, participants were briefly presented with four colored and oriented bars and instructed to reproduce both the color and orientation of the item at a spatially pre-cued location. Cueing of the target location was manipulated, either rapidly shifting from one location to another, or split across two locations simultaneously. Critically, the relevant locations were cued before array presentation, providing a strong test of how dynamic covert spatial attention impacts the active binding of multiple features to a single location. By probing color

and orientation on the same trial, we tested whether errors in recalling multiple features of the same object were correlated and thus bound together. Probabilistic modeling of feature errors revealed that while splitting attention across multiple objects degraded object integrity, rapid shifts of spatial attention maintained object integrity—even when those shifts were inadvertent (i.e., lapses of attention). Indeed, during lapses of attention, participants reported both of the features bound to the incorrectly-attended location. Together, these results emphasize the importance of a single focus of spatial attention in object-feature binding, even when that focus is dynamically shifting across multiple locations.

Topic Area: ATTENTION: Spatial

Facilitation and inhibition in selective attention: Two sides of the same coin?

Poster E10, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Heleen A. Slagter[1], Dirk van Morselaar[1]; [1]University of Amsterdam

A long-standing question in attention research has been if and how attention can suppress distracting information. Previous studies addressing this question often used paradigms in which the task-relevant location was known beforehand, so that observers could simply pay more attention to the relevant location to prevent distraction. This renders it unclear whether enhancement and suppression always co-occur, as two sides of the same coin, or whether they subserve independent mechanisms. We conducted two behavioural and one EEG experiment to examine whether observers can selectively suppress irrelevant locations and the underlying neural mechanisms. Search displays with repeating target or distractor locations across trials allowed observers to learn which location to selectively attend or suppress. Both learned attention and suppression resulted in more efficient search as indexed by faster response times. Crucially, suppression was observed without target-location foreknowledge, unaffected by the number of possible target locations, and could not be explained by priming. To determine how distractor-location foreknowledge facilitated performance, we applied a spatial encoding model to EEG data to reconstruct activity in neural populations tuned to the relevant or irrelevant location. Target-location foreknowledge increased neural tuning to the relevant location prior to stimulus presentation, indicative of enhanced attention. This sensitivity increased after target presentation. By contrast, distractor repetition only changed neural tuning to the distractor location immediately preceding visual stimulation, and subsequently reduced distractor processing, as reflected in a flattening of the tuning curve and the disappearance of the Pd ERP component. These findings suggest independent facilitatory and inhibitory attentional mechanisms.

Topic Area: ATTENTION: Spatial

Localizing six bilateral sensory-biased regions in human frontal cortex.

Poster E11, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Abigail Noyce[1], Sean Tobyne[1], Samantha Michalka[2], Barbara Shinn-Cunningham[1], David Somers[1]; [1]Boston University, [2]Olin College of Engineering

Previously, we identified four bilateral sensory-biased structures in human caudolateral frontal cortex (LFC; Michalka et al. 2015, Noyce et al. 2017). Visual-biased regions in superior and inferior precentral sulcus are interdigitated with auditory-biased regions in transverse gyrus bridging precentral sulcus and caudal inferior frontal sulcus. An analysis of functional connectivity between posterior sensory cortex and LFC suggested additional candidate sensory-biased regions extending rostrally along the inferior frontal sulcus and frontal operculum (Tobyne et al. 2017). Here, we collected fMRI while participants performed visual and auditory 2-back working memory (stimuli were face photographs and animal vocalizations, respectively). A direct contrast of visual and auditory working memory conditions within each individual subject confirmed an additional bilateral visual-biased region in middle inferior frontal sulcus and an additional bilateral auditory-biased region in frontal operculum. We hypothesize that multiple regions sharing a sensory bias are specialized for different cognitive computations. To test this, we measured fMRI activation (against passive sensorimotor control) in working memory and selective attention tasks. Using resting-state functional connectivity, we will also examine communication among sensory-biased LFC regions and posterior sensory cortex to further differentiate their functionality. Mapping sensory modality-specific preferences in human LFC has potential to effectively parcellate and characterize large portions of human frontal cortex.

Topic Area: ATTENTION: Multisensory

Continuing Development in School-Age Children with Perinatal Stroke: Differing Degrees of Neuroplasticity for Language and Affect

Poster E12, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Philip Lai[1]; [1]University of Nebraska-Kearney

Children with focal lesions due to a Perinatal Stroke (PS) provide a unique opportunity to understand developing brain-behavior relations. This study investigated how early brain damage affect the quality of language produced and the production of affective expression in school-age children (7-14 year olds). Twenty children with PS (9 with Left Hemisphere Injury (LHI), 11 with Right Hemisphere Injury (RHI)), and 26 typically developing (TD) children participated. For the formal aspects of language, variability especially in the LHI group, suggest morphology is still an area of deficit for a minority of children in this group. For the majority of children with LHI and RHI, they resemble their TD peers. For syntactic complexity, all three groups are comparable. For the expression of social and affective behaviors, eye gaze and the production of facial expression were broadly comparable in the three groups. The RHI group produced equivalent smiles compared to their peers, but produced more negative facial expressions. As such, the RHI group profile for affective expression is mixed. Lingering deficits are observed in negative facial expression while a greater degree of development is observed with positive affect as compared to younger children (ages 5-6) with PS from an earlier study. Taken together, the profiles in the PS group broadly points towards continued development where children with early brain insults show deficits and through time and development, perform within the range of their TD peers. The data suggests that plasticity for affect, as compared to language, may require more time to "catch-up."

Topic Area: EMOTION & SOCIAL: Development & aging

Amygdala activation as a predictor of fragile X-associated tremor/ataxia syndrome onset

Poster E13, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Emily Fourie[1], Annie Shelton[1], David Hessl[1,2], Susan, M Rivera[1,2]; [1]University of California, Davis, [2]UC Davis MIND Institute

Individuals with premutation alleles (55–200 CGG repeats) of the fragile X mental retardation 1 (FMR1) gene are at risk for developing a neurodegenerative disease, fragile X-associated tremor/ataxia syndrome (FXTAS). The disease has a variable penetrance, but prodromal markers have not yet been identified. The goal of this study was to determine whether differential activation in the amygdala can be predictive of conversion to FXTAS. We performed functional magnetic resonance imaging during an emotion-matching task on a group of 30 adult male premutation carriers and 13 age- and IQ-matched controls at two longitudinal time points. The carriers were further divided into three subgroups: those who had FXTAS at time 1—T1 converters (N=9); those who developed FXTAS by time 2—T2 converters (N=10); and those who showed no signs of FXTAS at either time, non-converters (N=11). We extracted the mean amygdala activation using a region of interest approach (6 mm spheres around the foci of the right and left amygdalae) and performed a repeated measures group x time ANOVA. Results show a significant group by time interaction, $F(3, 37) = 4.12$, $p = 0.013$, and pairwise comparisons revealed significant differences between T1 converters and both non-converters and controls at time 1. Furthermore, both non-converters and controls showed a significant decrease in activation between time 1 and time 2, while T1 and T2 converters did not. These findings suggest that non-converters show similar activation patterns to controls and that differences in activation may indicate which premutation carriers are at risk for conversion of FXTAS.

Topic Area: EMOTION & SOCIAL: Development & aging

Evidence for Individual Differences in Emotionally-Driven Pupillary Reactivity

Poster E14, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Connor Mckee[1], Paola Tirado[1], Justin Litvin[1], Ivan Carbajal[1], Anthony Ryals[1]; [1]University of North Texas

A long-standing assumption is that pupillary dilation occurs in response to emotional versus neutral stimuli regardless of valence/arousal covariance. Evidence from our lab suggests the majority of individuals express global pupillary dilation, while a subset of individuals express pupillary constriction specifically for aversive stimuli. We recorded pupillary responsivity in 40 college-age individuals while viewing affective images tightly controlled for content, luminosity, valence, and arousal. Participants viewed lists of 25 backward-masked images for four seconds each in one of four emotional conditions counterbalanced for order. In between the lists of images, participants completed a five-minute breathing exercise. As expected, we observed that mean pupil area was significantly higher for images high in arousal (regardless of valence) compared to neutral control images. Baseline-corrected follow-up analyses revealed that in 32% of our sample, mean pupil area was significantly lower than control images only for aversive (highly arousing negatively valenced) stimuli. This pattern suggests that certain individuals respond differently to highly emotionally-charged images. Furthermore, these data provide some support for the aversion-constriction hypothesis proposed by Hess (1965) and may be indicative of metabolic differences (i.e., sympathetic vs. parasympathetic dominance) in the general population. This could have important implications for theories of post-traumatic stress disorder and predicting individual psychophysiological responses in trauma-exposed populations.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Using Graph Theory to Uncover the Brain Network Organization Underlying Flow Experiences During a Semi-Naturalistic Behavioral Paradigm

Poster E15, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Richard Huskey[1], Shelby Wilcox[1], Rene Weber[2,3]; [1]School of Communication, The Ohio State University, [2]Department of Communication, University of California Santa Barbara, [3]Department of Psychological and Brain Sciences, University of California Santa Barbara

Flow experiences are characterized by a high level of intrinsic reward that emerges as a result of a balance between high-task difficulty and high-individual ability at the task (Csikszentmihalyi, 1990). The synchronization theory of flow offers an explanation for the neural basis of this psychological process (Weber et al., 2009). It predicts an energetically optimized brain network organization between cognitive control and reward regions under conditions of a balance between task difficulty and individual ability. While initial results provide support for the structural predictions (Klasen et al., 2012; Ulrich et al., 2016, 2013), the connectivity and energetic optimality hypothesis remain untested. Our study addresses this gap. Subjects (n=18) played an open-source, naturalistic, and high experimental control video game while undergoing functional magnetic resonance imaging. Following a procedure that has been empirically validated in four different studies (Huskey et al., under review), we experimentally manipulated the balance between task difficulty and individual ability. Using graph theoretic analyses, we show that the balanced-difficulty condition (compared to low- or high-difficulty conditions) was associated with highest average network degree in fronto-parietal control, ventral attention, and memory networks. We also show that this condition was characterized by the highest level of global efficiency. These results provide a first ever test of synchronization theory's core predictions and suggest important insights in the way in which task-related intrinsic reward shapes brain-network organization. Moreover, these results demonstrate the utility of using naturalistic behavioral paradigms for testing core questions in cognitive neuroscience (Krakauer, et al., 2017).

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Neurobiological Underpinnings of the Intersection between Emotion and Impulse Control in Adolescents

Poster E16, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Julia E. Cohen-Gilbert[1,2], Lisa D. Nickerson[1,2], Jennifer T. Sneider[1,2], Emily N. Oot[1,3], Anna M. Seraikas[1], Maya Rieselbach[1], Carolyn E. Caine[1], Elena R. Stein[1], Sion K. Harris[1,4], Marisa M. Silveri[1,2]; [1]McLean Hospital, [2]Harvard Medical School, [3]Boston University School of Medicine, [4]Boston Children's Hospital

Adolescence features heightened emotionality and limited impulse control. Development of prefrontal cortex (PFC) and related circuitry during this period enables gradual improvements in inhibitory control. However, emotional information frequently disrupts adolescents' efforts to control impulsive responses. Brain activity was recorded using functional magnetic resonance imaging (fMRI) during a task requiring participants to ignore positive, negative, neutral or scrambled background images, while performing an inhibitory control task (Go-NoGo). Subjects were 30 healthy 13-14 year-olds (15 female). Brain activation on inhibitory (NoGo) versus non-inhibitory (Go) trials was contrasted between negative and neutral, and positive and neutral conditions. Results showed increased recruitment of multiple PFC regions during emotional versus non-emotional conditions, including inferior frontal gyrus, orbital frontal cortex and ventral medial PFC (VMPFC). VMPFC activation from the negative>neutral contrast was correlated with increased NoGo errors on negative (r=.49, p=.007) and neutral (r=.40, p=.039) trials, and parent-reported attention problems on the Child Behavior Checklist (r=.50, p=.005). VMPFC activation from the positive>neutral contrast was correlated with increased NoGo errors on positive trials (r=.38, p=.041). Contrasts of NoGo>Go for neutral and scrambled backgrounds revealed extensive deactivation in the default mode network (DMN), including VMPFC, amygdala and hippocampus. DMN deactivation during response inhibition was not evident in emotional background conditions. This suggests that emotional images reduce inhibitory control, in part, by eliciting self-referential emotional processing and reducing DMN deactivation, with VMPFC deactivation supporting inhibitory control across emotional conditions. These findings elucidate neural mechanisms underlying increased impulsive, often risky behaviors that can occur under emotional conditions during adolescence.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Mental context reinstatement may underlie successful retrieval of extinction memories

Poster E17, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Augustin C. Hennings[1], Jarrod A. Lewis-Peacock[1], Joseph E. Dunsmoor[1]; [1]University of Texas at Austin

Extinguishing learned fear involves new learning of extinction memories and successful retrieval of these memories rather than the fear. However, the retrieval of extinction memories tends to be contextually specific (Bouton, M. E., 2004). Fear learning, on the other hand, generalizes to novel contexts, and the overexpression of generalized fear is a hallmark of neurobiological disorders such as PTSD (Maren et al., 2013). Recent models of episodic memory in humans highlight the importance of mental context for the successful encoding and retrieval of memories (Sederberg et al., 2008). Mental context is defined as the running average of recent perceptual and mnemonic experiences. Specific mental contexts can be tagged by injecting trial-irrelevant stimuli during learning and using multivariate pattern analysis (MVPA) of fMRI data to track the reactivation of those stimuli as a proxy for the reinstatement of that context (Gershman et al., 2013). Here, we test the hypothesis that successfully recalling extinction memories following fear conditioning depends on the reinstatement of the mental context in which extinction occurred. Twenty-four hours after Pavlovian fear conditioning and extinction, participants were tested for extinction recall. MVPA readouts of mental context during successful extinction recall showed significant reinstatement of the mental context corresponding to extinction learning from the previous day. These results suggest that, in humans, extinguishing learned fear is dependent on the reinstatement of the mental context in which extinction was learned. These results have implications for future PTSD treatment strategies targeting mental context reinstatement as the gateway to enhanced efficacy of extinction.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Integration of reward with effort anticipation during performance monitoring revealed by ERPs and EEG spectra perturbations

Poster E18, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Davide Gheza[1], Gilles Pourtois[1]; [1]Ghent University

Effort expenditure has an aversive connotation and it can lower hedonic feelings. In this study, we explored the electrophysiological correlates of the complex interplay of reward processing with effort anticipation. To this aim, healthy adult participants performed a gambling task where the outcome (monetary reward vs. no-reward) and its expectancy were manipulated on a trial by trial basis while 64-channel EEG was recorded. Crucially, on some trials, the no-reward outcome could be transformed to a rewarding one,

pending effort expenditure by means of an orthogonal dot clicking task, enabling us to compare at the electrophysiological level reward processing when effort anticipation was present vs. absent. We extracted and compared different markers of reward processing at the feedback level using both classical ERPs and EEG spectral perturbations in specific bands (theta, delta and beta-gamma). At the behavioral level, participants reported enhanced pleasure and relief when the outcome was rewarding but effort expenditure could be avoided, relative to a control condition where the outcome was rewarding but no extra effort was anticipated. In this condition, EEG results showed a larger Reward Positivity ERP component and increased power in the Delta and Beta-gamma bands. By comparison, effort anticipation did not influence the processing of the no-reward outcome at the FRN and frontal midline theta levels. Al together, these neurophysiological results suggest that effort avoidance is associated with increased reward processing.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

When the Emotional Stroop Task Does Not Produce a Stroop Effect in Adolescents

Poster E19, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Diana Rodriguez Moreno[1], Yael M. Cycowicz[1,2], Lawrence V. Amsel[1,2], Zhishun Wang[1,2], Xiaofu He[1,2], Christina Hoven[1,2]; [1]New York State Psychiatric Institute, [2]Columbia University

Emotional Stroop effect and its associated brain circuitry are often used to assess emotion regulation. The Stroop effect (SE), consisting of faster reaction time (RT) to the congruent (C) trials than to the incongruent (I) trials, is thought to originate from the emotional and cognitive competing features of the stimuli. Thus, task performance requires cognitive and emotion regulation mechanisms. Emotion regulation increases during childhood and reaches maturity at the end of adolescence, and therefore SE may show a developmental trajectory. In our fMRI study with adolescents (N=26, mean age 14.8 years), we used emotional facial Stroop task and found that 12 participants did not show the expected behavioral SE. For those who did not show the SE, RTs in the C and I trials did not differ but fell between the RTs of the C and I trials for the group that showed an SE. On fMRI, Adolescents who showed an SE demonstrated higher activity (I vs. C) in regions previously associated to conflict resolution (ACC), while the adolescents who did not show the SE had higher activation in face recognition and emotion processing areas (amygdala, hippocampus, fusiform gyrus, lingual gyrus). Therefore, a large percentage of the sample showed neither the behavioral SE nor brain activities typically associated with SE. Instead, during the I trials, these participants demonstrated brain activity that is more typical of processing emotional facial expressions. These results suggest that the adolescents who did not show behavioral SE used alternative strategy to perform the task.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Inter-subject representational similarity analysis reveals individual variations in affective experience when watching erotic movies

Poster E20, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Pin-Hao Andy Chen[1], Eshin Jolly[1], Todd F. Heatherton[1], Luke J. Chang[1]; [1]Dartmouth College

We spend much of our life pursuing or avoiding affective experiences. However, surprisingly little is known about how these experiences are represented in the brain and whether everyone has an identical experience. In this study, 26 male participants watched 3.5 minutes of erotic pornography and completed an 8-item dyadic sexual desire scale as well as a 13-item brief self-control scale. We were interested in whether individual variations in sexual desire and self-control might be associated with individual variability in participants' experiences watching the erotic movies. We used inter-subject representational similarity analysis (ISRSA) to identify regions of the brain in which similarity in participants self-reported preferences were associated with similarity in temporal brain dynamics. This technique calculates a pairwise similarity matrix of participant brain dynamics in each ROI and maps these variations to a pairwise similarity matrix in responses to a self-report scale using rank correlation and permutation tests. We calculated ISRSA separately for 200 parcels from a whole-brain parcellation of co-activation patterns from over 10,000 published studies (Bonferroni corrected). We found that similarity in preferences for sexual desire was significantly associated with similarity in brain dynamics in the MPFC, PCC, and NAcc, indicating possible similarity in endogenous reward

processing. In contrast, similarity in preferences for self-control was correlated with bilateral DLPFC, indicating variations in the executive control network. These results suggest that individuals have substantial variability in their affective experiences, and that ISRSA is a useful technique for identifying brain regions where this individual variability maps onto preferences.

Topic Area: EMOTION & SOCIAL: Emotional responding

Emotion recognition in pediatric brain tumor patients: viewing patterns and white matter structure

Poster E21, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Iska Moxon-Emre[1,2,3], Eric Bouffet[1], Suzanne Laughlin[1], Jovanka Skocic[1], Cynthia de Medeiros[1], Donald J. Mabbott[1,2]; [1]The Hospital for Sick Children, [2]The University of Toronto, [3]Pediatric Oncology Group of Ontario

Objective: Pediatric brain tumor patients display emotion recognition deficits, and eye-movement monitoring might help explain why. Identifying facial emotions is thought to rely on white matter (WM) that connects posterior, limbic and frontal brain regions. Thus, we examined if emotion recognition deficits are related to viewing patterns and to WM. Methods: 22 patients treated for posterior fossa (PF) brain tumors and 12 healthy children participated in this study at SickKids (Toronto, Ontario). Participants completed the Diagnostic Analysis of Nonverbal Accuracy (DANVA-2), a computerized task that measures facial emotion recognition using photographs, while their eye-movements were recorded. Diffusion tensor imaging (DTI) was used to assess fractional anisotropy (FA). Whole brain voxel-based analyses were conducted to compare WM between patients and controls. Regional WM was correlated with the number of incorrect responses across all participants. Results: Patients made more emotion recognition errors than controls ($p=0.02$). However, patients and controls did not differ in the number of fixations made on the photograph: ($p=0.21$), or in the total time spent looking at the photograph: ($p=0.23$). Relative to controls, patients had lower FA in many voxels across the brain (all $p<0.05$). Across all participants, FA was negatively correlated with the number of incorrect responses in the left temporal region ($r=-0.503$, $p=0.005$). Conclusions: Patients treated for brain tumors display emotion recognition deficits and WM damage. The emotion recognition deficits do not appear to result from inattention to the photographs. Our results suggest that left temporal WM may be important for successful emotion recognition.

Topic Area: EMOTION & SOCIAL: Emotional responding

Transcranial direct current stimulation modulate fear extinction-processes

Poster E22, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Martin Herrmann[1], Natalie Dittert[1], Thomas Polak[1]; [1]Department of Psychiatry, Psychosomatics and Psychotherapy, University Hospital Wuerzburg, Germany

Although anxiety disorders are a widely spread mental disorder the effectiveness of their therapy is still unsatisfying. Transcranial direct current stimulation (tDCS) has already been used to improve psychotherapy but the underlying mechanisms have not been properly investigated yet. We hypothesized that tDCS could improve extinction processes, which happen to be the main functional factor of exposure based therapy for anxiety disorders. To examine our hypothesis, we used a fear conditioning paradigm with female faces as conditioned stimuli and a 95-dB female scream as unconditioned stimuli. We aimed to stimulate the ventromedial prefrontal cortex with tDCS because this region is involved in extinction learning. For tDCS we applied two 4 x 4 cm electrodes approximately at the electrode positions F7 and F8 (anode right, cathode left) with a current of 1.5 mA. 84 healthy subjects were randomly and double blinded assigned into a sham-stimulation and two real-stimulation group. To measure the fear reactions, we used skin conductance responses (SCR). The results showed a significant interaction between stimulus (Cs+, Cs-)* Phase (acquisition, extinction)* tDCS (verum, sham), $p < 0.01$). Post-hoc tests revealed higher CS+/CS- discrimination loss in real-stimulation vs. sham-stimulation groups ($t(82) = -2.39$, $p = .019$). The study shows that tDCS of the vmPFC modulates the early extinction-processes.

Topic Area: EMOTION & SOCIAL: Other

The Emotional Homunculus: Visual emotion discrimination and personality traits effects in somatosensory cortex

Poster E23, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Beatriz Calvo-Merino[1], Irena Arslanova[1], Vasiliki Meletaki[1], Bettina Forster; [1]City, Univerity of London, UK

Somatosensory cortex (SCx) plays an active role in emotion perception, as important bridge between our own body representations and the observed emotions. Crucially, somatosensory engagement during an emotion recognition visual task has been reported over and above any potential carry over effects from visual regions (Sel et al., 2014). Here we evaluate if somatosensory engagement during emotion recognition is sensitive to the perception of different emotions, and if it is modulated by intrinsic properties of the observer such as their emotional wellbeing (measured via Beck's depression inventory) or ability to understand emotions (measured via an alexithymia questionnaire, TAS). We directly measured participants' somatosensory-evoked activity (SEPs) by tactually probing (105 ms post presentation of visual facial stimuli) the state of SCx during an emotion discrimination visual task of faces displaying angry, sad, happy and neutral expressions. A control condition with only visual evoked potentials was subtracted from our experimental condition to remove any visually-driven effects from our somatosensory evoked potentials. Results show an early modulation of somatosensory evoked potentials depending on the type of emotion perceived, and this modulation occurs at different latencies for the perception of angry, sad and happy images. An embodiment neural index was calculated for each emotion, separately for every participant, and correlated to each subjective measure. Overall, our data provide evidence for somatosensory cortex' role in emotion discrimination, beyond mere visually driven processing, and highlights the relation between subjective information and embodied emotion.

Topic Area: EMOTION & SOCIAL: Person perception

Individual differences in empathy, but not mentalizing, predict visual attention to naturalistic social stimuli

Poster E24, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Callie De La Cerda[1], Ashley Frost[1], Katherine Warnell[1]; [1]Texas State University

Understanding how visual attention to social stimuli relates to both mentalizing (i.e., thinking about others' thoughts) and to empathy may help explain individual differences in social ability. Recent research has sought to identify the relationship between visual attention and social traits, but much of this work uses photographs. More naturalistic stimuli may better capture real-world social processes. In the present experiment, we collected eye-tracking data from fifty-one adults while they completed the Spontaneous Theory of Mind Protocol (Rice & Redcay, 2014). In this protocol, participants watch two silent movie clips depicting complex social interactions and then describe what happened in each scene, with the percentage of internal state descriptors serving as a measure of spontaneous mentalizing. We also calculated the percentage of the time each participant focused on characters' eyes during the film clips. Participants completed an additional mentalizing task involving inferring mental states from photographs of eyes (Reading the Mind in the Eyes; Baron-Cohen et al., 2001) and completed the Interpersonal Reactivity Index (IRI) to measure empathy (Davis, 1983). Participants' fixation time on the eye region during naturalistic social scenes was positively correlated with empathy ($r= .341$ $p=.018$) but eye-looking was not related to mentalizing capabilities for either the spontaneous mentalizing task or Reading the Mind the Eyes ($rs<.1$). The Perspective Taking subscale of the IRI showed the strongest correlations with eye-looking. Although the exact mechanism linking empathy and gaze patterns is unknown, results suggest that more empathetic individuals may be more likely to visually search for social information.

Topic Area: EMOTION & SOCIAL: Person perception

The Importance of Vestibular and Proprioceptive Signals on Perspective-Taking

Poster E25, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Anastasia Pavlidou[1], Maria Gallagher[2], Elisa Raffaella Ferrè[2], Christophe Lopez[1]; [1]Aix Marseille Univ, CNRS, LNIA, FR3C, Marseille, France, [2]Royal Holloway University of London, Egham, United Kingdom

The ability to adopt the visuo-spatial perspective of others is fundamental for successful social interactions. Here, we measured how vestibular (Experiment 1) and proprioceptive (Experiment 2) signals influence perspective-taking abilities. For each experiment, participants completed the "dot-counting task": they evaluated if a number (0-3) presented at the start of each trial matched or mismatched the number of balls visible from their perspective in a visual scene of a 3D virtual room that followed. A task-irrelevant human avatar or arrow was also present in the center of the room that either shared the same or different viewpoint as the participant's. This allowed us to examine the likelihood that participants would implicitly adopt the perspective of the object even though they were not required to. In Experiment 1, participants performed the task while they received low-intensity (1mA) galvanic vestibular stimulation (GVS). Analysis of reaction times between same and different viewpoints revealed that GVS reduced the likelihood that participants implicitly adopted the avatar's perspective, promoting an egocentric viewpoint. In Experiment 2, we manipulated the congruency between the participant's body orientation (e.g. their entire body was facing the right side of the screen) and that of the avatar. When participants and avatars shared the same body orientation, participants were more likely to implicitly adopt the avatar's perspective, resulting in longer response times in the dot-counting task. For both experiments, the effects were not observed for the arrow. Altogether, the results indicate that implicit simulation of another person's viewpoint requires vestibular and proprioceptive signals.

Topic Area: EMOTION & SOCIAL: Self perception

Cognitive flexibility tracks with dynamic transitions in intrinsic connectivity profiles

Poster E26, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Shruti Vij[1], Lucina Uddin[1,2]; [1]Department of Psychology, University of Miami, [2]Neuroscience Program, University of Miami Miller School of Medicine

Cognitive flexibility is a dynamic property of executive functioning that enables individuals to efficiently switch between mental processes. Recent advances in resting state functional magnetic resonance imaging (rs-fMRI) indicate that dynamic properties of the brain at rest may be associated with flexible cognition. However, the association between cognitive flexibility and brain dynamics have not been explicitly evaluated across the lifespan. Using a large publicly available rs-fMRI dataset (n = 187; age range = 6-85 years), we find that dynamic properties of functional connections measured over 10 minutes were significantly associated with the time it takes to correctly identify the "Odd Man Out" amongst four objects outside the scanner. Specifically, the number of transitions between five identified brain states increases as the reaction time for the correct response in the Penn Conditional Exclusion test increases. Performance on the Penn Conditional Exclusion test was also found to have unique patterns of age related changes in the features of brain dynamics. The number of transitions between the states linearly increases with age, and the frequency of occurrence and the dwell time of particular states linearly and quadratically increase with age. These results suggest that dynamic properties of intrinsic network interactions underlie individual differences in the ability to switch between cognitive tasks, and that is in turn dependent on cognitive aging.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Differential Effects of Maternal Exposures in Early Life on Working Memory Versus Inhibitory Control in Preschool-Aged Children

Poster E27, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Cassandra Svelnys[1], Michaela Gusman[1], Michelle Huezo[1], Andreina Tuccella[1], Rosalind J. Wright[3,4,5], Michelle Bosquet Enlow[1,2]; [1]Boston Children's Hospital, [2]Harvard Medical School, [3]Kravis Children's Hospital, New York, NY, [4]Mindich Child Health & Development Institute, New York, NY, [5]Icahn School of Medicine at Mount Sinai, New York, NY

Mothers are a significant source of environmental exposures that shape child brain development. Maternal lifetime exposure to stress may program key biological systems that impact fetal brain development during pregnancy (e.g., hypothalamic-pituitary-adrenal axis). In infancy, maternal caregiving behaviors help shape the development of cognitive, emotional, and behavioral regulatory systems. These early influences have implications for the development of the child's prefrontal cortex (PFC) and, consequently, executive functioning abilities. The current study examined associations of maternal lifetime stress exposures and caregiving behaviors during infancy with child executive functioning (N=53). During pregnancy, mothers completed interviews assessing lifetime stress exposures. At 6 months, mothers and infants completed a free play task during which maternal caregiving behaviors were assessed. At 3.5 years, children completed working memory (Nebraska Barnyard) and inhibitory control (go/no-go) tasks. Child working memory performance was negatively correlated with maternal lifetime stress exposures ($rs=-.49$, $p<.001$) and history of physical abuse in childhood ($rs=-.36$, $p=.015$) but not with stress during pregnancy ($rs=-.25$, $p=.075$). Child working memory was also positively associated with maternal cognitive support in infancy ($rs=.31$, $p=.039$). Child inhibitory control was not associated with maternal stress measures but was associated with greater maternal history of emotional support in childhood ($rs=.36$, $p=.021$) and maternal emotional support in infancy ($rs=.38$, $p=.015$). The findings suggest that prenatal and infancy exposures influence child PFC functioning and that different domains of PFC functioning have distinct developmental pathways. These findings have implications for the development of targeted interventions to optimize PFC development in early life.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Longitudinal associations between conflict monitoring and emergent academic skills: an event-related potentials study

Poster E28, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Elif Isbell[1], Susan Calkins[1], Veronica Cole[2], Margaret Swingler[2], Esther Leerkes[1]; [1]University of North Carolina at Greensboro, [2]University of North Carolina at Chapel Hill

Academic readiness and early academic achievement are considered critical for later academic outcomes. Thus, identifying the links between specific cognitive functions and emergent academic skills can have far-reaching consequences for determining pathways to support not only early academic performance, but also later academic achievement. In the present study, we focused on a key aspect of cognitive control: conflict monitoring, i.e. the ability to continuously monitor whether any information deviates from a template relevant for task goals. We investigated the longitudinal associations between conflict monitoring and early academic performance from preschool through the first grade, in a sample of socioeconomically diverse children ($N = 278$). Event-related potentials (ERPs) were recorded during a Go/No-Go task. A neural index of conflict monitoring was measured as the difference in ERP mean amplitudes of the N2 component elicited by No-Go versus Go trials. An autoregressive cross-lagged panel model revealed that the neural indices of conflict monitoring were associated with academic performance as children transitioned to formal schooling, and these longitudinal relations were specific to math but not reading performance. In particular, larger (i.e. more negative in amplitude) neural indices of conflict monitoring in preschool were associated with gains in math from preschool to kindergarten, and larger neural indices of conflict monitoring in kindergarten were associated with gains in math from kindergarten to first grade. These findings provided electrophysiological evidence for the contribution of conflict monitoring abilities to emergent math skills.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Temporal information and trait impulsivity guide prefrontal preparatory activity

Poster E29, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Jacqueline R. Janowich[1], James F. Cavanagh[1]; [1]University of New Mexico

Cognitive control helps guide behavior by instantiating rules. It is well-known how rule instantiation is elicited from predictable temporal demands, but it remains unknown if rules are encoded and maintained differently when temporal demands vary dynamically. To assess how control mechanisms vary by temporal delay, we recorded EEG while healthy young adult participants ($n=38$) performed a Dot Pattern Expectancy (DPX) task with cues indicating the upcoming rule and the length of the upcoming

delay (short, long, or unknown). Trait impulsivity was measured to gauge how mechanisms for temporally-guided rule instantiation may vary by individual differences in impulsiveness/planning. Rule type and delay information significantly modulated prefrontal response to cues. Temporal Principal Component Analysis (PCA) revealed that a high degree of variance was explained by prefrontal midline (AFz) activity late in the cue-probe delay interval (750-1000 ms post-cue). The slope of anticipatory ERP activity in this window showed a significant delay x rule interaction, with rare rules of known short duration eliciting the steepest slopes, and common rules preceding a known (short/long) delay triggering the flattest slopes. Trait impulsivity scores predicted significant variance in these patterns, with more impulsive participants showing larger slopes for rare rules. These findings describe a novel mechanism by which rule timing information may instantiate divergent anticipation processes guiding behavior, and highlight how this processing is modulated by individual differences in impulsivity.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

High-frequency alpha activity and its unsuccessful reduction in schizophrenia

Poster E30, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Kuk-In Jang[1], Jihoon Oh[2], Wookyoung Jung[3], Sungkean Kim[4], Sang Min Lee[5], Seung Huh[6], Seung-Hwan Lee[7], Jeong-Ho Chae[8]; [1]The Catholic University of Korea, [2]The Catholic University of Korea, [3]The Catholic University of Korea, [4]The Catholic University of Korea, [5]The Catholic University of Korea, [6]The Catholic University of Korea, [7]The Catholic University of Korea, [8]The Catholic University of Korea

Previous studies have demonstrated an attenuation in resting-state electroencephalography (EEG) alpha bands in schizophrenia. The alpha activity decreases during cognitive task performance compared to resting state. The change in alpha activity underlying disturbed cognitive function in schizophrenia is not well understood. Because abnormal alpha activity levels could be related to cognitive deficits, how the alpha activity is altered during task performance and in the resting state can help understand the pathophysiology of schizophrenia. This study investigated the attenuation of alpha activity in schizophrenic patients, and compared between event-related alpha activity and resting-state alpha activity. Thirty-four patients with schizophrenia and 29 healthy controls were recruited. EEG was performed in the resting state and during the auditory P300 task. The delta, theta, low-frequency alpha, high-frequency alpha , low-frequency beta, high-frequency beta, and gamma EEG bands were analyzed. In schizophrenia, the high-frequency alpha activity was reduced in the resting state. Furthermore, the high-frequency alpha source density was decreased in both the resting state and the P300 task in patients with schizophrenia compared to that in healthy participants. Healthy controls, but not patients with schizophrenia, showed a reduction in the high-frequency alpha source density during the P300 task compared to that in the resting state. The negative correlation between the high-frequency alpha source density in the resting state and the positive symptoms of schizophrenia was significant. The high-frequency alpha activity in schizophrenic patients and its unsuccessful reduction may be biological markers of cognitive impairments in schizophrenia.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Norepinephrine transporter phenotype impacts oscillatory power during cognitive flexibility

Poster E31, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Sara White[1], Paolo Medrano[1], Robert S. Ross[1]; [1]University of New Hampshire

A critical aspect of cognitive control is the ability to flexibly change behavior when encountering changing goals. This cognitive flexibility can be measured using rule-switching tasks and is related to oscillatory power in the alpha (8-12 Hz) and beta (13-30 Hz) frequency bands. Genetic phenotypes of the norepinephrine transporter gene (NET) related to the rs36024 single nucleotide polymorphism change fMRI network activity supporting cognitive control. As brain oscillations allow neuronal communication within and across brain regions, the current study compared oscillatory power during rule-switching in participants with different NET genetic phenotypes. Participants (n = 71) differentiated trial-unique stimuli based on two rules, color (red or green) or shape (circle or square). A cue indicated which rule to use on any given trial. A given rule was used 3-5 times before the cue indicated a switch to the other rule. The trial where the rule changed were termed switch trials and the trial immediately following a switch trial were

termed maintain trials. Participants were split into two groups, those homozygous for the C allele of rs36024 (n = 25) and those who possessed a T-allele (C/T and T/T, n = 46). Comparison of oscillatory power in the theta, alpha, and beta frequency bands across NET phenotypes suggest that individuals with a T-allele show larger alpha desynchronization 300-400 ms post-cue in a region localized to right precuneus and 500-800 ms post-cue in a region localized to left temporal-parietal junction. These results suggest norepinephrine transporter phenotype influences alpha oscillatory power during cognitive flexibility.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Effect of reward prospect on corticospinal excitability during task preparation is dependent on task and action requirements.

Poster E32, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Carsten Bundt[1], Marcel Brass[1], Wim Notebaert[1]; [1]Ghent University

Action preparation is associated with corticospinal excitability (CSE) changes that vary depending on individuals' motivation, but it is unknown whether such motivational effect is contingent upon task and action requirements. In three different experiments, we investigated the effect of task and action requirements on reward-related CSE. In each experiment, a (non-) reward cue was presented, indicating whether accurate performance on the current trial would lead to reward (+1) or not (+0). After a delay period, a Simon (Exp. 1) or Stroop (Exp. 2) stimulus followed, requiring individuals to provide a left or right index finger response. During the delay period, we applied transcranial magnetic stimulation over the left primary motor cortex and concurrently recorded electromyography from the right first dorsal interosseous to measure CSE. Results showed that reward yielded an early increase and a subsequent transient decrease of CSE compared to non-reward in the Simon task (Exp. 1), but not in the Stroop task (Exp. 2), suggesting that the effect of reward on CSE depends on the task at hand. In Exp. 3, prior to the presentation of a (non-) reward cue, individuals were additionally informed whether (Go) or not (NoGo) an actual response had to be performed upon target presentation. We observed that reward modulated CSE for Go trials but not for NoGo trials, suggesting that the effect of reward on CSE is contingent upon the preparation of an actual response. These findings suggest that motivational effects on CSE depend on a complex interplay of task and action requirements.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Effective connectivity in the cognitive control network

Poster E33, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Fan Zhang[1,2], Sunao Iwaki[2,1]; [1]University of Tsukuba, [2]National Institute of Advanced Industrial Science and Technology

Inhibitory control plays the extremely important function in people's daily life. From the research on lesion and imaging studies, the pre-supplementary (pre-SMA)/supplementary motor area(SMA), inferior frontal gyrus(IFG) and basal ganglia (BG) are responsible for the rapid inhibition and switching between multiple options in motor reaction. These regions compose the cognitive control network for actions. However, two important questions remain to be addressed. First, it is not clear the roles of these regions in the cognitive control for inhibition. Secondly, the interactions between regions during the inhibition are still in the debate. We use stop-signal paradigm and functional magnetic resonance imaging (fMRI) to analyze the whole-brain contrasts, and use Bayesian Model Selection to compare the dynamical causal models (12 models) that represent the effective connectivity between IFG, SMA, Subthalamic nucleus (STN), Putamen,Thalamus and Primary Motor Cortex (M1) in cognitive control network. The results from whole brain contrasts and dynamic causal model with Bayesian model selection show that: IFG modulates the connection from SMA to STN. Both IFG and SMA are recruited to detect the important cues, and SMA acts as the key role in the suppression of unwanted motor response via hyperdirect pathway. Furthermore, we find the activation of Putamen, however, Bayesian parameter between Putamen and other regions are zeros, which means the 'stop' behavior is the result of race between hyper-direct pathway and direct pathway.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Cross-language positive and negative priming effects reverse when priming manipulations proceed from L2 to L1, compared with L1 to L2

Poster E34, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Ewald Neumann[1], Ivy Nkrumah[2]; [1]University of Canterbury, [2]University of Ivory Coast, Ghana

Twi is a native language in Ghana, Africa. Two experiments are reported in which Twi (L1) – English (L2) bilinguals encountered cross-language positive and negative priming manipulations. In each experiment participants were required to name a prime target word in one of their languages, followed by making a lexical decision (word/non-word) to a letter string in their other language. Positive priming is indicated if response times are faster when a prime target word becomes the translation equivalent of the probe target word, compared to a neutral control condition. Negative priming is indicated if response times are slower when a prime distractor word becomes the translation equivalent of the probe target word, compared to a neutral control condition. In the L1 to L2 (i.e., Twi prime-English probe) experiment, ignored repetition negative priming was observed, with no hint of attended repetition positive priming. This pattern of findings supports an inhibition-based view by suggesting that there are two operative sources of inhibition modulating these cross-language priming results. One source operates at the level of the local prime distractor word (accounting for the negative priming effect), and the other operates at the global level of the prime language (accounting for the absence of positive priming). In the L2 to L1 (i.e., English prime-Twi probe) experiment, however, attended repetition positive priming was observed, with no hint of ignored repetition negative priming. Consideration of how degrees of inhibitory modulation can vary, based on first versus second language dominance, provides an explanation for these opposing results.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Investigation of latent inhibitory control variables and aerobic fitness

Poster E35, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Daniel Westfall[1], Lauren B. Raine[1], Eric S. Drollette[2], Mark R. Scudder[3], Shih-Chun Kao[1], Matthew B. Pontifex[4], Arthur F. Kramer[1,5], Charles H. Hillman[1]; [1]Northeastern University, Boston, Massachusetts, [2]The University of North Carolina at Greensboro, Greensboro, North Carolina, [3]University of Pittsburgh, Pittsburgh, Pennsylvania, [4]Michigan State University, East Lansing, Michigan, [5]University of Illinois, Urbana, Illinois

PURPOSE: Converging evidence has demonstrated the importance of aerobic fitness for cognition in preadolescent children. However, to date, most studies have used traditional analyses, which investigate reaction time and accuracy separately. The current study utilized diffusion modelling to investigate latent variables that contribute to behavioral performance and associations with aerobic fitness. METHODS: Four hundred forty-eight children completed tests of aerobic fitness and inhibitory control. Behavioral data were entered into the EZ-Diffusion model to calculate drift rate (quality and speed of information uptake), boundary separation (response conservativeness), and nondecision time (encoding, memory access, and response execution). Hierarchical regressions were performed to investigate the associations between aerobic fitness and these latent variables while controlling for other potentially confounding factors. RESULTS: Higher aerobic fitness was associated with improved drift rate across conditions of the inhibition task (β's $\geq$ .145, p's $\leq$ .002). Additionally, longer nondecision time was associated with higher aerobic fitness across inhibition conditions (β's $\geq$ .112, p's $\leq$ .024). There were no associations with boundary separation (p's > .506). CONCLUSION: These findings demonstrate that diffusion modelling is a novel and successful approach that combines RT and accuracy information to investigate latent inhibitory control factors associated with aerobic fitness. As such, higher fitness was not only associated with better information uptake but also with spending relatively more time in nondecision processes. Further, fitness level was not associated with response conservativeness. These findings add to the research base by indicating cognitive processes that are selectively influenced by aerobic fitness.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Obesity is associated with lower executive function but inconspicuous prefrontal brain activity.

Poster E36, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Jennifer Beier[1], Bodo Warrings[1], Ann-Cathrin Koschker[2], Andreas J Fallgatter[3], Martin Fassnacht[2], Martin J Herrmann[1]; [1]Department of Psychiatry, Psychosomatics and Psychotherapy, University Hospital Wuerzburg, Germany, [2]Department of Internal Medicine I, Division of Endocrinology and Diabetes, University Hospital, University of Wuerzburg, Wuerzburg, Germany, [3]Department of Psychiatry, University Hospital of Tübingen, Germany

Obesity is a prevalent global-health problem associated with substantial morbidity, impairment and economic burden. It has been recently shown that it is associated with limitations of cognitive functions of the prefrontal cortex. Thus, the actual study aimed to examine the cognitive performance of executive function and related prefrontal brain activity of 62 adults with obesity (mean age 39.6; SD 9.8) compared to 48 healthy adults (mean age 39.0; SD 10.4). Brain activity was measured with functional near-infrared spectroscopy (fNIRS) during the execution of the trail-making-test (TMT). The TMT consists of a number condition (TMT-A), an alternating number and letter condition (TMT-B) and a control task. Additionally, we measured executive function with neuropsychological tests. The neuropsychological performance in the Stroop task, working memory task as well as the behavioral results of the TMT (TMT-B and control task) during the NIRS measurement showed significantly reduced executive functions in the obese patients compared to matched controls (controlled for age, sex and education). In contrast to this, both groups show similar activation patterns for the TMT, with a main effect condition ($F[2,216]=19.0$, $P<0.001$), a main effect ROI ($F[2,216]=7.6$, $P<0.001$), and an interaction effect condition * ROI ($F[4,432]=6.1$, $P<0.001$). In detail we found significantly higher bilateral activations in ventral and lateral PFC for experimental conditions TMT-A and TMT-B compared to control condition (all $t[109]>3.3$, $p<0.001$) with higher activation in TMT-B compared to TMT-A in VPFC. Normal brain activity with deficient behavioral performance in obesity is interpreted as ineffective compensatory mechanism or by capillary dysfunction hypothesis.

Topic Area: EXECUTIVE PROCESSES: Other

Reinforcement and Punishment Effects on Incentive Integration and Motivated Cognitive Control

Poster E37, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Debbie Yee[1], Carolyn Dean Wolf[2], Todd Braver[1]; [1]Washington University in St. Louis, [2]Brown University

Motivational incentives play a central role in influencing goal-directed behavior. However, few studies have examined how different motivational factors interact with cognitive control to influence behavior. We developed an innovative task paradigm that quantifies dissociable and integrative effects of liquid valence (e.g., appetitive, neutral, aversive) and monetary incentives on cognitive control. Study 1 (N=44, 33 females, 18-31) tested whether the affective valence of liquid interacts with punishment effects in the context of monetary gains. Post-response feedback – in the form of oral liquid delivery –indicated failure to earn monetary reward due to slow or inaccurate performance. Results demonstrated that motivation to avoid opportunity costs (loss of a potential gain) was significantly enhanced by aversive liquid feedback that was additive with the value of monetary gain. Study 2 (N=48, 37 females, 18-32) replicated and extended these findings using a within-participant manipulation of motivational context (gain or avoid loss). Liquid delivery provided feedback of either successful performance (reinforcement; gain context) or performance failure (punishment; loss context). Results revealed a significant motivational context effect, indicating that participants were more motivated to avoid losses than win money. These effects further interacted with monetary value, such that they were eliminated at the highest reward amount. The effects of liquid valence interacted with motivational context, with performance enhanced with aversive liquid in the loss context, but with appetitive liquid in the gain context. Together, these data provide compelling evidence of context-specific integration of motivational incentives, constraining hypotheses regarding candidate neural mechanisms that support motivated cognitive control.

Topic Area: EXECUTIVE PROCESSES: Other

Retroactive attentional shifts predict performance in a working memory task: Evidence by lateralized EEG patterns

Poster E38, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Daniel Schneider[1], Anna Barth[1], Laura Klatt[1], Edmund Wascher[1]; [1]Leibniz Research Centre for Working Environment and Human Factors

Shifts of attention within working memory based on retroactive cues (retro-cues) were shown to facilitate performance in working memory tasks. It was suggested that this retro-cue benefit is related to the concentration of working memory resources on a subset of representations, thereby improving storage and retrieval at the cost of non-cued items. While posterior asymmetries in the EEG, e.g. contralateral delay activity (CDA), can be used to study the active storage of visuo-spatial working memory representations, results on the relation of such asymmetric effects to retro-cue benefits were so far inconclusive. Here, we recorded EEG in a retro-cue working memory task with lateralized items and a continuous performance response. Following either a selective (one out of two items) or neutral retro-cue, participants had to adjust the orientation of a central memory probe to the cued memory item. Selective retro-cues elicited an early posterior contralateral negativity (PCN), anterior directing attention negativity (ADAN), and a later modulation of CDA indicating that active storage was concentrated on the cued information. By dividing all trials into three performance quantiles within experimental conditions, we could further show that high accuracy in the working memory task was associated with a sustained increase of the CDA effect following the retro-cue. This association with performance was not indicated in other correlates of retroactive attentional orienting (e.g. ADAN or posterior contralateral alpha power suppression). These results suggest that focusing resources on the active storage of relevant representations is an important factor regarding retro-cue benefits in working memory tasks.

Topic Area: EXECUTIVE PROCESSES: Working memory

Different dimensions of attended and unattended items are maintained in different states in visual working memory

Poster E39, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Qing Yu[1], Bradley Postle[1]; [1]University of Wisconsin-Madison

Previous studies of information held at different levels of priority in visual working memory for object identity have raised the question of how items outside the focus of attention (unattended memory item, UMI) are maintained. We propose that location information, previously shown to be spontaneously encoded regardless of task relevance, may serve as a stimulus dimension with which the brain “tags” UMIs. In the current study, subjects remembered the orientations of two grating stimuli, presented simultaneously, each at one of six possible locations. After stimulus offset, a retrocue indicated which would be tested for recall, followed by a probe presented at that item’s location, and then followed by a second retrocue that could cue either item with equal probability. We used a separate one-item working memory task to train inverted encoding models (IEMs) on orientation and spatial location separately, and used the IEMs to reconstruct the orientation and spatial location of the attended memory item (AMI) and UMI during the delay period. Our results revealed enhanced representation of the AMI’s orientation, compared with the UMI, most prominently in caudal intraparietal sulcus (IPS). Conversely, representation of the location of the UMI was stronger than that of the AMI in occipital cortex. These results suggest separate mechanisms of maintaining stimulus context versus stimulus identity as a function of attention in visual working memory, with the context of the UMI maintained in an active state, despite the absence of evidence for an active representation of its identity.

Topic Area: EXECUTIVE PROCESSES: Working memory

Predicting cognitive performance on the basis of electrophysiological properties of resting state neuronal dynamics

Poster E40, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Elena Cesnaite[1], Keyvan Mahjoory[2], Arno Villringer[1,3], Vadim V. Nikulin[1,4]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Functional Brain Mapping Laboratory, Université Libre de Bruxelles, Brussels,

Belgium, [3]Clinic for Cognitive Neurology, University of Leipzig, Leipzig, Germany, [4]Center for Cognition and Decision Making, National Research University Higher School of Economics, Russian Federation

Neuronal dynamics at rest as well as cognitive task performance differ substantially across subjects, however, the link between both remains elusive. In order to further address this link, we used long-range temporal correlations (LRTC) that have been previously shown to relate to critical dynamics, hypothesized to be beneficial for task performance. In a current study, we have hypothesized that stronger alpha band LRTC at rest would correspond to better cognitive performance. Multichannel resting state EEG has been recorded from 117 young, right-handed subjects (81 male, mean age 25.5, SD=3.14) and linked to cognitive performance: fluid intelligence, working memory and executive functions. Mean amplitude, peak frequency and LRTC of alpha oscillations were used as EEG predictors. Statistical analysis was performed using non-parametric Spearman correlations and cluster statistics to account for multiple comparisons. In addition, we performed inverse modeling in order to infer neuronal sources of best predicting regions. Among the three measures only LRTC in males predicted working memory performance: LRTC exponents positively correlated with an accuracy of a numeric 2-back task. Inverse modeling showed several regions primarily at the right temporal and parietal lobes to be most predictive. While areas in these regions have been previously linked to number processing in fMRI studies, our findings suggest that higher LRTC exponents at rest reflect their readiness to quickly process and update numeric information when task demands are present. *First two authors share co-first authorship of the work.

Topic Area: EXECUTIVE PROCESSES: Working memory

The acute effects of moderate-intensity aerobic exercise and high-intensity interval exercise on working memory

Poster E41, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Shih-Chun Kao[1], Joseph Ritondale[2], Keita Kamijo[3], Eric Drollette[4], Naiman Khan[2], Charles Hillman[1]; [1]Northeastern University, [2]University of Illinois at Urbana-Champaign, [3]Wasada University, [4]University of North Carolina at Greensboro

Existing literature has indicated facilitation of cognitive control during the recovery period following a single bout of moderate-intensity continuous exercise (MICE). Further, despite high-intensity interval exercise (HIIE) being known for its effectiveness toward improving health outcomes, little is known regarding the transient effects of HIIE on post-exercise cognition. Accordingly, this investigation compared the effects of acute HIIE and MICE on working memory; one aspect of cognitive control. Using a within-participants design, task performance (RT, response accuracy), slow wave positivity during memory encoding, and initial and terminal components of contingent variation negativity (iCNV, tCNV) during cognitive preparation were assessed while 36 young adults performed a modified Sternberg task following 20 minutes of rest, MICE, and HIIE on separate days in counterbalanced order. The results indicated shorter overall reaction time and increased iCNV amplitude, while no changes were observed for response accuracy, tCNV, or encoding-related slow wave amplitude following HIIE compared to rest. Interestingly, no behavioral or neuroelectrical changes were observed following MICE compared to rest and HIIE. Further, higher heart rate (i.e., beats per minute) prior to the Sternberg task was associated with larger iCNV amplitude. These findings suggest that a single bout of HIIE induced levels of arousal that may enhance attentional orienting and behavioral performance during a working memory task. Collectively, these findings demonstrate transient facilitating effects on working memory following acute bouts of HIIE, and provide evidence to support HIIE as a promising approach for enhancing cognitive control.

Topic Area: EXECUTIVE PROCESSES: Working memory

The relationship between theta oscillations and the function of working memory processes during reading comprehension

Poster E42, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Shelby Smith[1], Anna Allen[1], Kristin Ritchey[1], Scott Wittman[1], Caleb Robinson[1], Tania Morales[1], Charles Jackson[1], Tyler Halbert[1], Cori Conner[1], Alaina Myers[1], Kierstin Riels[1], Austin Tatum[1]; [1]Ball State University

The ability to draw inferences, the generated connections between the concepts within a text, is related to reading comprehension (Lorch & van den Broek, 1997; Kendeou, 2015; Lorch, 2015). Currently, there is a lack of neuroscientific research investigating the basis of online reading comprehension. For this study, we used electroencephalography (EEG) to deconstruct the processes involved in comprehending textual information. EEG was recorded while participants read, and we measured working memory capacity (WMC) using an operation span task in 17 participants. We hypothesized the roles of WMC and theta frequency waveforms would explain reading comprehension abilities. Our findings suggest that theta synchrony in the right frontal lobe ($r = .74$, $p < .01$) and right temporal lobe ($r = .64$, $p = .02$) as participants read, and generated inferences, correlates directly with WMC. Our results elucidate the role of working memory processes during reading, which yields a better understanding of online comprehension processes. Given how prior research suggests that WMC is a function of attentional control (AC; Engle, 2002), further research will investigate AC through the neural correlates of WM functioning during reading comprehension.

Topic Area: EXECUTIVE PROCESSES: Working memory

Interactive, non-speech acoustic experience modulates theta, beta and gamma oscillatory responses to speech at 9-months-of-age

Poster E43, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Silvia Ortiz-Mantilla[1], Teresa Realpe-Bonilla[1], April A Benasich[1]; [1]Center for Molecular and Behavioral Neuroscience, Rutgers University Newark, NJ, USA

To efficiently process language, infants must construct detailed phonemic representations within auditory cortex. This “phonemic mapping”, is accomplished by 12-months-of-age, via the interplay between maturation and experience. Whereas theta oscillations (4-8Hz) resolve syllabic information, high-gamma oscillations (>70Hz) support processing of specific phonemic features and represent a unique neural signature for phonemic mapping. Previously we demonstrated that interactive acoustic experience, using spectrotemporally- modulated non-speech, significantly enhanced processing of key pre-linguistic acoustic cues in 7-month-old infants, which generalized to novel non-speech stimuli. We now explore whether such experience-dependent effects also impact phonemic processing and mapping. 9-month-old, infants who had received active (AEx) or passive (PEx) non-speech acoustic experience between 4- and 6-months-of-age were presented with a consonant-vowel contrast using a passive oddball paradigm and compared to 9-month-old naïve controls (NC). Dense-array EEG/ERP was mapped onto an age-appropriate brain template. Source modeling placed dipoles in both auditory cortices. Temporal-spectral analyses were conducted on the standard stimulus in source space within the 2-90 Hz frequency range. Changes in spectral power were evaluated using TSE (temporal spectral evolution). Significant group differences were found in the theta, beta and gamma ranges. When processing the standard stimulus, AEx generated greater beta and high-gamma power than PEx and NC groups while within the theta range, less power was seen for AEx and PEx than NC. These results on phoneme mapping demonstrate that the experience-dependent effects of non-speech experience persist at 9-months-of-age and appear to confer a significant speech processing advantage, facilitating earlier establishment of phonemic cortical representations.

Topic Area: LANGUAGE: Development & aging

A double-dissociation of semantic and phonological processing in young children

Poster E44, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Yael Weiss-Zruya[1], Hannah G. Cweigenberg[1], James R. Booth[2]; [1]The University of Texas at Austin, [2]Vanderbilt University

Previous studies have investigated specialization for different language processing components in older children and adults. However, this specialization has not yet been investigated in young children. The current study aimed to examine early specialization of different brain regions for phonological and semantic processing of spoken language in young children. Children (5.5-6.5 year-olds, N=35) performed a phonological (same sound judgment) and a semantic (related meaning judgment) auditory word-level task. Using functional Magnetic Resonance Imaging (fMRI), we directly compared the phonological- and semantic-related activations. A greater phonological- as compared to semantic-related activation was found in the left superior temporal gyrus (STG) and supramarginal gyrus (SMG). In addition, activation in the left superior temporal cortex was related to phonological task difficulty, and phonological awareness performance was correlated with the task difference activation. In contrast, a greater semantic- as compared to phonological-related activation was found in the left middle temporal gyrus (MTG). The left middle temporal cortex activation was also related to semantic task difficulty, and semantic awareness performance was correlated with the task difference activation. In general, the results of this study indicate that by the age of 5-6 years, typically developing children already show some specialization of different brain regions for phonological and semantic processes. This project advances our understanding of the neural mechanisms underlying language acquisition in early childhood, while also laying the groundwork for future investigations of language impairment in this age range.

Topic Area: LANGUAGE: Development & aging

Spatio-temporal granularity of dorsal stream processing during word production

Poster E45, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

F.-Xavier Alario[1], Catherine Liégeois-Chauvel[2,3], Anne-Sophie Dubarry[4], Irene Wang[3], S Alomar[3], Imad M. Najm[3], Patrick Chauvel[2,3], Jorge Gonzalez-Martinez[3]; [1]Aix Marseille Univ, CNRS, LPC, Marseille, France, [2]Aix Marseille Univ, INSERM, INS, Inst Neurosci Syst, Marseille, France, [3]Cleveland Clinic Foundation, Cleveland (OH), USA, [4]Aix Marseille Univ, CNRS, LPL, Aix-en-Provence, France

A left lateralized dorsal pathway is thought to map auditory-phonological information with articulatory motor programs during word production. The dorsal stream interfaces temporo-parietal areas with frontal areas, particularly supra-marginal gyrus, angular gyrus, etc. with inferior frontal gyrus. To quantify dorsal stream activity at a finer spatial and temporal granularity than is currently available, we used functional data recorded from intra-cerebral electrodes (implanted for pre-surgical diagnosis purposes) in epileptic patients performing picture naming task. For each electrode contact, we computed intra-cerebral event related potentials (iERP) and high gamma activity (HGA) as indexes of focal processing within the area. Significant activity was detected per contact, then combined across patients using a consistency criterion. The results revealed the involvement/activation of widespread network. Significant iERPs were detected in Supramarginal Gyrus and Angular Gyrus, peaking on average 320 ms after stimulus. Responses in Angular Gyrus were much more consistent across patients than in Supramarginal Gyrus. Significant iERPs and HGA were also detected in left IFG, peaking around 350 ms. They were most clear and consistent in Pars opercularis, compared to Triangularis and Orbitalis. In conclusion, dorsal stream activity during word production simultaneously involves specific sub-regions within temporo-parietal and inferior frontal areas.

Topic Area: LANGUAGE: Lexicon

ERPs reveal early feedforward orthographic and phonological selectivity during single word reading.

Poster E46, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Laurie S. Glezer[1], Katherine J. Midgely[1], Karen Emmorey[1], Phillip J. Holcomb[1]; [1]San Diego State University

Previous fMRI research indicates that in the ventral visual processing stream there is a region in the fusiform gyrus that contains neurons that are tuned to the written form of real words and in the dorsal processing stream there is a region in the temporoparietal area that contains neurons tuned to the phonology of real written words. However, due to the poor temporal resolution of fMRI, it is unclear whether this selectivity is generated in a feedforward fashion or is a result of top-down feedback. The Bimodal Interactive Activation Model (Grainger and Holcomb, 2009) is based on findings from behavioral and ERP research using priming paradigms. This model supports the idea that single word reading is accomplished in a mostly hierarchical, feedforward fashion and that orthographic and phonological whole word recognition is achieved by 325 ms. However, much of the evidence to support this is based on nonword to real word priming paradigms. In the current ERP study, we presented real words in both the prime and target position and systematically altered the orthographic and phonological similarity examining precisely when selectivity to orthographic and phonological representations occurs for single word reading. Our results show orthographic and phonological selectivity can occur earlier than previously suggested and that this selectivity is achieved within the N250 window in posterior sites for

orthography and anterior sites for phonology. These results suggest that the whole word selectivity reported in fMRI studies is likely the result of the initial feedforward pass and not top-down feedback.

Topic Area: LANGUAGE: Other

Orthographic priming by fingerspelled and printed letters

Poster E47, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Zed Sevcikova Sehyr[1], Jamie Renna[1], Katherine Midgley[1], Karen Emmorey[1], Philip Holcomb[1]; [1]San Diego State University

ASL signers experience English orthography in two forms: printed letters and fingerspelled letters. We investigated the contribution of fingerspelled and English letter recognition to orthographic processing in deaf readers using a single letter priming paradigm. Event-related brain potentials (ERPs) were recorded over 29 scalp sites while participants performed a probe detection task (detect the printed or fingerspelled letter Y). Targets were single letters presented in a typical printed English font or in an ASL fingerspelling font, tested in separate blocks, and presented centrally for 200ms immediately preceded by a 100ms prime that was either a English printed letter or a fingerspelled letter. Preliminary data from 8 deaf ASL signers suggested that fingerspelled letters primed English printed letters, but English printed letters did not prime fingerspelled letters. That is, when printed English letter targets were preceded by fingerspelled letter primes, the N2 component was larger to unrelated compared to repeated letter targets. When fingerspelled letter targets were preceded by printed letter primes, there was no difference between repeated and unrelated pairs within the N2 window suggesting the absence of a priming effect. These findings indicate that early in processing, fingerspelled letters are mapped to English letter representations, but printed English letters do not activate fingerspelled letters. This pattern is consistent with previous research indicating that deaf ASL signers recode fingerspelled words into English in short-term memory, whereas printed words are not recoded as fingerspelling (Sevcikova Sehyr, Petrich, & Emmorey, 2016) and might have important implications for skilled reading in deaf population.

Topic Area: LANGUAGE: Other

Functional Connectivity of Language and Memory as a Cognitive Biomarker in Temporal Lobe Epilepsy

Poster E48, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Elise Roger[1], Cédric Pichat[1], Marcela Perrone-Bertolotti[1], Emilie Cousin[1], Lorella Minotti[2], Anne-Sophie Job[2], Chrystèle Mosca[2], Philippe Kahane[2], Monica Baciu[1]; [1]Univ. Grenoble Alpes, CNRS LPNC UMR 5105, F-38000 Grenoble, France, [2]Univ. Grenoble Alpes, Grenoble Institute of Neuroscience & Neurology Department CHUGA, France

Drug-resistant temporal lobe epilepsy (TLE) is a severe neurological condition that causes brain injury due to the recurrence of epileptic seizures, with mostly language (L) and memory (M) impairments. Our research aims to: (i) specify the properties of functional modifications on a language and memory network (LMN), according to the hemispheric lateralization of the epileptogenic zone (LH/RH); (ii) evaluate the efficiency of the LMN reorganizations in terms of functional connectivity (FC). Using MRI (3T Philips) we performed resting state fMRI to assess FC. 17 TLE (n=8 Left TLE; n=9 Right TLE) and a group of 28 healthy subjects were included. Two types of FC analyzes have been carried out on the LMN: ROI-to-ROI (pairwise correlations) and graph theory (integration: Eglob, Enod; segregation: Eloc) with Conn toolbox (Whitfield-Gabrieli & Nieto-Castanon, 2012). Spearman correlations were then made between FC biomarkers and LM standardized performance (verbal comprehension index, auditory memory index, naming, verbal fluency). Our main results revealed that: (a) LMN FC is extensively modified in LTLE patients (temporo-frontal and bilateral), compared to RTLE (posterior-right) and healthy; (b) the type of FC modifications depend on the cognitive function (mainly segregation for language and integration for memory); (c) FC parameters correlate remarkably with cognitive scores; (d) hyperconnectivity (increased functional integration capacity) of certain brain regions is not necessarily efficient and can negatively correlate to LM performance (negative plasticity). Thus, we wish to extend the concept of connectome to "cognitome" that taking into account the behavioral consequences of the changes observed in term of connectivity.

Topic Area: LANGUAGE: Other

The relationship between a chaotic home environment and language processing in children

Poster E49, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Elisa Gallegos[1], Julie Schneider[1], Michael Lopez[1], Yvonne Ralph[1], Mandy J Maguire[1]; [1]University of Texas at Dallas

Stressful home environments are linked to detrimental developmental outcomes in children (Nobel et al, 2012; Shonkoff, et al, 2012; Lupien et al, 2009). In the present study, we investigated how self-perceived stress in the home impacts neural indices of word learning. Children (ages 8-15) performed a language task, in which they tried to identify the meaning of unknown words embedded in written sentences as their EEG was recorded. Parents of child participants completed the Confusion, Hubbub and Order Scale (CHAOS; Matheny et al., 1995) which measures the amount of perceived stress in the home. We identified 10 children, 5 from high stress (M=64.8, SD=4.6) and 5 from low stress (M=33.6, SD=6.5) homes that were matched on maternal education, age, primary language (English or Spanish), and performance on the word learning task. Thus, the children only varied on measures of stress in the home, not economic background or language skills. Using the EEGlab toolbox of Matlab, we compared groups' neural activation throughout the course of the sentence during word learning task. Participants from higher chaos homes showed significantly greater alpha at frontal regions than participants from lower chaos homes. The results from the present study suggest an association between perceived stress in the home and a child's executive function (alpha increases) during language processing. This has implications for how children process language and learn new words.

Topic Area: LANGUAGE: Other

Language output monitoring in sign production: an electroencephalography study

Poster E50, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Soren Mickelsen[1], Linda Nadalet[1], Megan Mott[2], Katherine Midgley[2,3], Phillip Holcomb[2,3,4], Karen Emmorey[1,3,4], Stephanie Ries[1,3,4]; [1]School of Speech Language and Hearing Sciences, San Diego State University, [2]Department of Psychology, San Diego State University, [3]Center for Clinical and Cognitive Neuroscience, San Diego State University, [4]Joint-Doctoral Program in Language and Communicative Disorders, San Diego State University & University of California San Diego

A domain-general monitoring mechanism has been proposed to be involved in overt speech monitoring. This mechanism is reflected in a medial frontal component, the error negativity (Ne), present in both errors and correct trials (Ne-like wave) but larger in errors than correct trials. In overt speech production, this negativity starts to rise before speech onset and is therefore associated with inner speech monitoring. Here, we investigate whether the same monitoring mechanism is involved in sign language production. Seven deaf signers (ASL dominant) and seven hearing signers (English dominant) participated in a picture naming study in ASL. As in previous studies, ASL naming latencies were measured by keyboard release (any manual hesitations after keyboard release were removed from the data). EEG results revealed medial frontal negativities peaking within 100 ms after keyboard release in both groups but with no clear amplitude difference between errors and correct trials. However, a large second negativity peaking ~450 ms after keyboard release was present for errors and not for correct trials in the deaf signers, with only a minimal amplitude difference for the hearing signers. We suggest that the medial frontal monitoring mechanism may be better time-locked to sign onset which occurs ~400 ms after keyboard release, rather than to lexical access which is indexed by keyboard release (i.e., keyboard release occurs when signers know the sign they want to produce). Differences between groups may be linked to differences in language dominance, with more variable lexical access to motor programming latencies for hearing signers.

Topic Area: LANGUAGE: Other

Spatiotemporal Dissociations associated with Fulfilling and Violating Predictions at Multiple Levels of Representation: A multimodal approach

Poster E51, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Gina R. Kuperberg[1,2], Lotte Schoot[1,2], Lin Wang[1,2], Edward Alexander[2], Nate Delaney-Busch[2], Eddie Wlotko[2], Minjae Kim[1,2], Lena Warnke[2], Sheraz Kahn[1], Matti Hamalainen[1]; [1]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, [2]Tufts University

We used ERP, MEG, and fMRI to ask whether and when distinct neuroanatomical networks are engaged to inputs that fulfill or violate strong contextual predictions generated at the level of specific lexical items and/or semantic-thematic structure. Thirty-two participants read and judged the acceptability of three-sentence scenarios in fMRI and ERP/MEG sessions. Scenarios varied in their lexical constraint and in whether critical nouns fulfilled or violated lexical predictions and/or the selection restrictions of their preceding verbs. ERPs revealed reduced activity on the N400 to predictable nouns, relative to all other conditions. MEG localized this activity to the left inferior frontal cortex (IFG) and the left anterior superior/middle temporal cortex (ant-S/MTG). fMRI revealed most robust modulation within left IFG. These findings support a functional role of left IFG/ant-S/MTG in mediating semantic retrieval during sentence comprehension. Relative to unpredicted words in low-constraint contexts, words that violated strong lexical predictions evoked a larger late anteriorly-distributed positivity, which MEG localized to the left IFG and posterior inferior temporal cortex. fMRI confirmed this pattern. We suggest that these regions mediated prolonged attempts to retrieve unpredicted lexical items, and infer the event dictated by the bottom-up input. In contrast, words that violated selection restrictions evoked a larger late posteriorly-distributed positivity, which MEG localized to the left anterior superior DLPFC and the post-ITG/fusiform cortex. Again, fMRI confirmed this pattern. We suggest that these regions reflected reanalysis and prolonged efforts to infer novel event structures dictated by the bottom-up input.

Topic Area: LANGUAGE: Semantic

Distinguishing semantic and social neural networks in neurotypicals and autism

Poster E52, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Hillary Levinson[1], Miriam Rosenberg-Lee[1], William Graves[1]; [1]Rutgers University

Autism spectrum disorder (ASD) affects roughly 1 in 68 US children. While primary language impairment is not always present, even high-functioning individuals with ASD have difficulty with abstract semantics and pragmatic language. It remains unknown whether these difficulties arise from social deficits or from difficulty with semantic abstraction. In neurotypicals (NTs), cortical networks supporting semantics (word meanings) and social cognition largely overlap, notably in the left inferior parietal lobe. Recent evidence suggests these networks may be distinguished by connectivity from distinct but adjacent regions: angular gyrus (AG) for semantics, and temporoparietal junction (TPJ) for social cognition. We tested whether social cognitive abilities were related to connectivity in the social or semantic networks across a sample of 26 ASD and 26 NT individuals. We correlated resting state functional connectivity of the AG and TPJ with the social cognition subscale of the social responsiveness scale (SRS-Cog, higher scores = poorer social cognitive abilities). While SRS-Cog scores differed significantly between the groups (MASD=68.5; MNT=44.27), there were no group differences in AG or TPJ connectivity. Rather, SRS-Cog scores were negatively correlated with connectivity between left AG and posterior cingulate, and positively correlated with AG to middle frontal gyrus (MFG) connectivity. These results suggest that difficulties with social cognition in individuals with autism may be related to aberrant connectivity within the semantic – but not social – network. Increased AG-MFG connectivity suggests that individuals with social cognitive difficulties may recruit prefrontal resources to support semantic processing, a hypothesis we will examine in future task-based studies.

Topic Area: LANGUAGE: Semantic

The neural basis of verb and noun semantic representations in congenitally blind individuals

Poster E53, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Giulia V. Elli[1], Rashi Pant[1], Rebecca Achtman[2], Marina Bedny[1]; [1]Johns Hopkins University, [2]DePauw University

How are the meanings of words influenced by sensory experience? We used multi-voxel pattern analysis (MVPA) to compare the neural basis of lexical semantic representations in congenitally blind (N=15) and sighted individuals (N=13). Specifically, we asked how noun- and verb-responsive cortical regions encode semantic distinctions among words within a grammatical category. Participants judged the similarity of pairs of nouns (birds, mammals, man-made places, natural places) and verbs (light emission, sound emission, hand action, mouth action). In each group, we identified regions in the left hemisphere that respond preferentially to nouns – inferior parietal lobule (IP), precuneus (PC) and inferior temporal cortex (IT) – and to verbs – middle temporal gyrus (MTG). A linear support vector machine (SVM) classifier was trained to decode among verbs and among nouns on half of the data, and then tested on the other half (e.g. even/odd runs). In PC, IP and MTG, classification was successful among verbs and among nouns in both groups (p's<0.05). Furthermore, blind and sighted individuals showed similar grammatical class effects: better classification for verbs in MTG and for nouns in IP and PC (WordClass x ROI: $F(2,52)=15.38$, $p<0.000$, Group x WordClass x ROI: $F(2,52)=1.12$, $p=0.34$). However, decoding among nouns in IT was successful only in sighted participants (Group main effect: $F(1,26)=8.19$, $p=0.008$). These results suggest that the lexical-semantic network is largely unchanged in blindness. However, inferior temporal areas that preferentially process concrete object nouns in sighted individuals appear to be less relevant for such processing in those who are born blind.

Topic Area: LANGUAGE: Semantic

The neural encoding of thematic roles

Poster E54, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Jayden Ziegler[1], Miriam Hauptman[2], Jesse Snedeker[1], Evelina Fedorenko[3,4]; [1]Harvard University, [2]Tufts University, [3]Harvard Medical School, [4]Massachusetts General Hospital

The same event can be described in different ways. For example, dog is the subject in the “The dog chased the man,” but it is the (oblique) object in “The man was chased by the dog.” Yet, in both cases, the dog is the biter, or doer of the action. To capture this regularity in meaning, linguists posit thematic roles (agent=doer, patient=doee). Previous work (Frankland & Greene, 2015; F&G hereafter) has shown that a classifier trained on fMRI data acquired while participants read sentences like these can reliably (and dissociably) decode the identity of the agent or patient (whether dog or man in either case), regardless of syntactic position (subject vs. object). This decoding was localized to two non-overlapping regions within the left temporal lobe. We ask: What information do these agent- and patient-selective regions encode? We replicated F&G’s classification analysis with the addition of a third condition: intransitive sentences (“The cup broke”). On the thematic roles hypothesis, cup is a patient and should therefore get decoded by the patient-selective region. Data collection and analysis is ongoing. In N=16, we observe reliable and dissociable classification of agents and transitive patients (both $p<0.001$), as in F&G. We also see reliable classification of intransitive patients ($p<0.001$), but not in the same region that decodes transitive patients ($p=0.997$). Our findings (tentatively) do not support the hypothesis that the regions discovered by F&G encode thematic roles. We suggest other possibilities for what these regions may encode (e.g., the causal structure of events).

Topic Area: LANGUAGE: Semantic

Impaired metaphor comprehension in primary progressive aphasia

Poster E55, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Eileen Cardillo[1], Nathaniel B. Klooster[1], Marguerite McQuire[1], Michael Bonner[1], Charles Jester[1], Murray Grossman[1], Corey McMillan[1], Anjan Chatterjee[1]; [1]University of Pennsylvania

Patients with focal brain lesions can display impairments in comprehending metaphor despite not showing difficulty with literal language. This observation suggests that figurative language abilities are especially vulnerable to brain injury. Here we test metaphor comprehension in 12 patients with a neurodegenerative condition, the logopenic variant of Primary Progressive Aphasia (lvPPA), compared to 19 matched healthy comparison participants (HCs). Stimuli consisted of unfamiliar nominal metaphors and matched literal sentences sharing the same source term (The interview was a painful crawl/ The infant’s motion was a crawl). Sentences were presented visually, followed by four adjective-noun answer choices (one target and three foils). Participants were instructed to select the phrase that best matched the meaning of the sentence. Linear mixed-effects analyses revealed an interaction between group and figurativeness. Although they performed reliably better on literal sentences, HCs displayed good comprehension for both conditions. PPA patients, by contrast, performed especially poorly on metaphoric sentences. Compared to a sample of 35 age-matched healthy controls, patients exhibited significant cortical atrophy in left frontal and temporal-parietal areas, a distribution that includes areas previously identified as important for metaphor (e.g. posterior middle temporal gyrus) but spares others (e.g. inferior prefrontal cortex). The disproportionate difficulty patients showed comprehending metaphors compared to closely matched literal sentences supports the idea that metaphoric abstraction is a sensitive and relatively early index of cognitive dysfunction. That this pattern was observed in a group of patients with exclusively left hemisphere injury also challenges a privileged role for the right hemisphere in processing metaphors.

Topic Area: LANGUAGE: Semantic

Language and music do and do not share the merging operations in syntax

Poster E56, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Tomomi Hida[1], Hiroaki Mizuhara[1]; [1]Kyoto University

How have humans acquired language processing? Creating a complex syntactic hierarchy with more than two words requires two types of the merging operations of multiple unit (i.e., Merge) in syntax, the pot-type and the subassembly-type. Although the syntactic operation has been considered as sharing a common operation among any domains, it is impossible to determine only from analysis of languages whether Merge shared among domains, since we acquire languages from birth and Merge is common in all languages. Hence, by comparing both musicians' and non-musicians' syntax in musical triads, we verified if Merge in syntax were shared in language and in music in human behavioral experiments using Merge order judgement tasks (the main effect of Merge types in the chord task: $F(1, 29) = 11.914$, $P = 0.002$, $\eta 2G = 0.600$; Musicians' Sub-Merge and Pot-Merge: $q(29) = 2.785$, $P = 0.030$, Cohen's $d = 0.895$; Non-musicians' Sub-Merge and Pot-Merge: $q(29) = 1.145$, $P = 0.212$, Cohen's $d = 0.327$). We also got the similar results in the word task to the results in Musicians' chord task (the main effect of Merge types in the chord task: $F(1, 27) = 42.757$, $p < 0.0001$, $\eta 2G = 0.125$). Non-musicians without any musical training could recognize the subassembly-type but not the pot-type and only the pot-type has correlation to instrument playing period ($r = -0.497$, $P = 0.0044$). We demonstrate that the acquisition processing of the merging operations in human language is different: domain-generally in the subassembly-type and domain-specifically in the pot-type.

Topic Area: LANGUAGE: Syntax

Some Complex Concepts Require Language: An eye-tracking study with 12- to 24-mo-old infants and adults

Poster E57, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Ertugrul Uysal[1], Mihye Choi[1], Mohinish Shukla[1]; [1]University of Massachusetts Boston

What is the relation between language and thought? The possibilities range from these being completely separate cognitive systems, to them being two sides of the same cognitive coin. One specific proposal (De Villiers, 2014) suggests and provides empirical evidence for the idea that language might particularly be required for building complex conceptual representations. For example, the thought "dogs push cars" not only represents a specific asymmetric relation between a dog and a car, but does so across all instances of any dog pushing any car. In this study, we examine the building of such abstract, three-term transitive events (e.g., dog-pushes-car) in 12- to 24-mo-olds (n=26) and in adults (n=20). In separate groups of infants (n=20) and adults(n=25), we compare these to two-term, intransitive events (e.g., dog-jumps) using visually comparable stimuli. Adult participants were further divided into two groups: a group that underwent simultaneous verbal shadowing to restrict language use and a control group without verbal shadowing. We used an eye-tracker and an anticipatory looking paradigm to examine the development of an abstract representation, as measured by anticipatory looks towards target events (e.g., a dog pushing a car) versus role-reversed events (a car pushing a dog), with novel cars, dogs, and their combinations. For the intransitive events, we found significant anticipations towards targets vs. non-targets in both infants and verbal-shadowing adults. For transitive events, only control adults showed significant target anticipations. We suggest that representing three-term transitive events may be at a level of complexity that cannot be accomplished without language.

Topic Area: LANGUAGE: Syntax

Direct brain recordings reveal prefrontal cortex dynamics of memory development

Poster E58, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Elizabeth Johnson[1,2], Qin Yin[2], Lingfei Tang[2], Eishi Asano[2], Noa Ofen[2]; [1]University of California, Berkeley, [2]Wayne State University

Prevailing fMRI evidence points to the role of protracted prefrontal cortex maturation in the development of memory function. Until recently, however, it was not possible to detail the precise timing of frontal activity in the developing brain. We provide rare insight from 17 children and adolescents (6.2-19.4 years) undergoing direct cortical monitoring (ECoG), which yields data with unprecedented spatiotemporal precision in the study of neurocognitive development. Subjects encoded pictures of scenes in preparation for a recognition test. We examined the temporal propagation of frontal activity during encoding as a function of subsequent memory, and the large sample size allowed us to further examine individual differences. The multitaper time-frequency spectrum was calculated between 30-250 Hz in all lateral frontal channels (n = 447) and the 3-s encoding power segments were z-scored on a 300-ms pre-stimulus baseline via statistical bootstrapping. Outputs were analyzed per-trial on the individual level, and then modeled on the group level using linear mixed-effects models and ANCOVA. Results provide initial evidence that the developing frontal cortex is active within 1 s from scene onset, and that earlier precentral, middle frontal, and superior frontal gyrus activation predicts greater memory accuracy. Furthermore, sub-second deviations in the timing and directionality of dynamic activity flow between precentral and inferior and middle frontal gyri dictate whether scenes are subsequently remembered or forgotten. Finally, the lack of age-related variability challenges prevailing theories of memory development, and instead shows that even young children exhibit memory-relevant patterns of frontal activity, comparable to adolescents.

Topic Area: LONG-TERM MEMORY: Development & aging

Functional specialization of hippocampal subfields in young children

Poster E59, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Qijing Yu[1], Sruthi Ramesh[1], Bryn Thompson[1], David Chen[1], Mayu Nishimura[1,2], Noa Ofen[1]; [1]Wayne State University, [2]McMaster University

Episodic memory undergoes robust development during childhood and is dependent on the function of the hippocampus, a complex structure composed of cytoarchitectonically distinct subfields (Cornu Ammonis, CA; dentate gyrus, DG, Subiculum). Hippocampal subfields are thought to support complementary memory processes with the CA3 and DG supporting the ability to retrieve information based on partial cues and to distinguish between similar experiences. Recent advances in neuroimaging allows better visualization and reliable quantification of individual differences in hippocampal subfield volume in children, paving the way to testing hypotheses about the functional specialization of the hippocampal subfields and the role such functional specialization plays in accounting for memory functioning in children. We examined the relation between hippocampal subfield volumes, measured based on manual demarcation with high reliability (ICC(2)≥0.85), and episodic memory functioning, measured using stimuli of varied degree of similarity, in 5-6 year-old children (N=36, 42% females, M=6.19). Participants studied stimuli consisting of several exemplars from a category (‘within’ category) intermixed with single exemplars from other categories (‘across’ category), and were later given a yes/no recognition test. Memory sensitivity (d’) for ‘across’, but not ‘within’, category was related to the volumes of CA1-2 ($F(1,31)=8.02$, $p=0.008$) and Subiculum ($F(1,31)=5.75$, $p=0.02$). In contrast, memory sensitivity for both ‘within’ and ‘across’ category stimuli was related to the volume of CA3-DG ($F(1,31)=7.59$, $p=0.01$). These findings are consistent with the idea that CA3-DG uniquely supports memory that requires the representation of fine details and demonstrate such functional specialization of the hippocampal subfields in young children.

Topic Area: LONG-TERM MEMORY: Development & aging

Human aging reduces the neurobehavioral influence of motivation on episodic memory

Poster E60, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Maiya Geddes[1,2], Aaron T. Mattfeld[2,3], Carlo de los Angeles[2], Anisha Keshavan[2,4,5], John D. E. Gabrieli[2]; [1]Brigham and Women's Hospital, Division of Cognitive and Behavioral Neurology, Harvard Medical School, Boston, MA, USA, [2]Department of Brain and Cognitive Sciences and McGovern Institute for Brain Research, Massachusetts Institute of Technology, Cambridge, MA, USA, [3]Florida International University, Miami, FL, USA, [4]Department of Neurology, University of California, San Francisco, [5]Bioengineering Graduate Group, University of California, San Francisco and Berkeley

The neural circuitry mediating the influence of motivation on long-term declarative or episodic memory formation is delineated in young adults, but its status is unknown in healthy aging. We examined the effect of reward and punishment anticipation on intentional declarative memory formation for words using an event-related functional magnetic resonance imaging (fMRI) monetary incentive encoding task in twenty-one younger and nineteen older adults. At 24-hour memory retrieval testing, younger adults were significantly more likely to remember words associated with motivational cues than neutral cues. Motivational enhancement of memory in younger adults occurred only for recollection ("remember" responses) and not for familiarity ("familiar" responses). Older adults had overall diminished memory and did not show memory gains in association with motivational cues. Memory encoding associated with monetary rewards or punishments activated motivational (substantia nigra/ventral tegmental area) and memory-related (hippocampus) brain regions in younger, but not older, adults during the target word periods. In contrast, older and younger adults showed similar activation of these brain regions during the anticipatory motivational cue interval. In a separate monetary incentive delay task that did not require learning, we found evidence for relatively preserved midbrain and striatal reward anticipation in older adults. This supports a potential dissociation between incidental and intentional motivational processes in healthy aging. The finding that motivation to obtain rewards and avoid punishments had reduced behavioral and neural influence on intentional episodic memory formation in older compared to younger adults is relevant to life-span theories of cognitive aging including the dopaminergic vulnerability hypothesis.

Topic Area: LONG-TERM MEMORY: Development & aging

Effects of aging on functional networks in the cortical midline structures underlying the self-reference effect by taking self-perspectives

Poster E61, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Takashi Tsukiura[1], Karin Norimoto[1], Rie Yamawaki[1,2,3], Yayoi Shigemune[1,4]; [1]Graduate School of Human and Environmental Studies, Kyoto University, [2]Graduate School of Medicine, Kyoto University, [3]Kyoto University Hospital, [4]Graduate School of Letters, Chuo University

Memories for the self-related information are remembered more accurately than those for the other-related information (SRE: self-reference effect). Functional neuroimaging studies have demonstrated the importance of the cortical midline structures (CMS) including the medial prefrontal cortex (mPFC) in SRE, and this effect by knowledge-based self is relatively preserved in older adults. However, evidence is scarce in the age-dependent changes of neural mechanisms underlying SRE in event-based self manipulated by taking self-perspectives. To investigate this, we scanned 25 healthy young and 22 healthy older adults in our fMRI study. During encoding with fMRI, participants viewed event scenes by two strategies of the self- (Self) and other-perspective taking (Other). In Self, participants viewed scenes by projecting themselves onto the events, whereas a third person's view was employed as a viewing strategy in Other. During retrieval, participants made old or new judgments for scenes in high and low confidence. All encoding trials in each condition were categorized into subsequent hits (Hit) and misses (Miss). Young adults showed significantly larger SRE than older adults. In fMRI results, age-related decreasing activation in Self-Hit vs. Other-Hit was identified in the ventral and dorsal mPFC, precuneus, and hippocampus, whereas no region showed a significant aging effect in Self-Miss vs. Other-Miss. In the gPPI analysis for Self-Hit, functional connectivity of the dorsal mPFC and hippocampus with the precuneus, and of the dorsal PFC with the ventral PFC was significantly reduced by aging. Aging effects on SRE by event-based self could reflect the lower CMS network in older adults.

Topic Area: LONG-TERM MEMORY: Episodic

Hippocampal theta phase coherence signals binding during retrieval and novelty processing

Poster E62, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

John Walker[1], Nathan Whitmore[1], Stephen VanHaerents[1], Christina Zelano[1], Jessica Templer[1], Stephan Schuele[1], Joel Voss[1], Donna Bridge[1]; [1]Northwestern University

It has been hypothesized that hippocampal theta phase orchestrates binding during memory formation. We propose that binding happens rapidly and continuously during visual exploration, and is linked to theta phase coherence. To test this hypothesis, we used concurrent eye-movement tracking and intracranial EEG (iEEG) recordings from the hippocampi of 4 individuals with epilepsy while they completed a spatial memory task. Participants studied object-location associations on scene backgrounds and were then re-presented the objects in either their original (match) or novel (mismatch) locations. We examined hippocampal activity time-locked to visual fixations to identify signals corresponding to binding. We found that hippocampal theta phase was time-locked to retrieval fixations (viewing the original location during mismatch), reflecting binding between the retrieved content and the original memory. Similarly, theta phase was locked to viewing the novel object location later in the trial (following retrieval), reflecting binding between the novel location and the original object-location memory. Consistent with prior fMRI findings, we found that hippocampal activity can reflect binding in the service of opposing long-term memory outcomes depending on when the binding occurs and the specific information that is bound, producing either memory stability or updating. Importantly theta phase was not linked to all fixations. During the match condition, theta phase coherence was not linked to fixations of objects in their original locations, as these fixations did not provide any new information for binding. We show for the first time that binding-related activity can be isolated by the novel combination of eye tracking and iEEG.

Topic Area: LONG-TERM MEMORY: Episodic

Remembering emotional stimuli re-instantiates valence coding voxel-patterns from visual and temporal cortex

Poster E63, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Holly Bowen[1], John Ksander[2], Elizabeth Kensinger[1]; [1]Boston College, [2]Brandeis University

Retrieval involves the ability to reproduce information from the encoding episode. The visual cortex response during a prior experience may be re-instantiated at retrieval to support memory for visual details, particularly for negative memories which are more vivid (Bowen, Kark, & Kensinger, in press). In the current fMRI study, participants (N =16) intentionally encoded neutral words paired with a positive, neutral or negative stimuli. They then completed a memory test for those neutral words, in the absence of any emotional content. We identified regions that coded valence as a dimension (i.e. from positive to negative) while participants viewed emotional and neutral stimuli during study. Within those regions, we extracted the valenced stimuli's voxel-pattern similarity structure. We then searched for re-instantiations of that similarity structure at retrieval, when emotional valence information was no longer present. In our results, visual and temporal cortex demonstrated valence coding during study; the extracted similarity structures showed re-instantiations during retrieval that were distributed across cortex. A large cluster in left temporal-occipital gyrus coded valence at study, with significantly correlated similarity structures at retrieval in the insula, superior temporal gyrus, parietal lobule, parahippocampal gyrus and fusiform. A cluster on the right in occipital gyrus also showed valence coding during study, and correlated with retrieval similarity structures in the precuneus, superior temporal and parahippocampal gyrus. These results indicate that valence representations encoded in visual and temporal cortex are reinstated during retrieval, even when cued by neutral memoranda.

Topic Area: LONG-TERM MEMORY: Episodic

High-resolution dynamic neural correlates and functional connectivity of autobiographical memory retrieval

Poster E64, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Charles Ferris[1], Cory Inman[1], G. Andrew James[2], Stephan Hamann[1]; [1]Emory University, [2]University of Arkansas for Medical Sciences

Autobiographical memory (AM) retrieval is a complex process that recruits dynamically changing networks of brain regions as processing shifts between memory search, access, and content elaboration. In prior fMRI work we have characterized whole-brain changes in dynamic connectivity during AM retrieval, highlighting time-varying engagement of the hippocampus, PFC, and other regions. This study extended these investigations, using high temporal (TR = 1 second) and spatial (2 mm isotropic) resolution fMRI, an optimized experimental design, and both covert and overt (spoken) retrieval to test theoretical accounts of AM retrieval. After a low-level baseline task, participants retrieved unrehearsed AMs to cue words across a long retrieval period, followed by ratings of vividness and emotion. Similar to previous studies, we found a core network of brain regions including the hippocampus, medial and lateral prefrontal cortex, and the inferior parietal lobule which were active during both phases of AM retrieval. Dynamic changes between early and late processes included greater activation of the amygdala, hippocampus, and left TPJ during access, and greater activation of the superior temporal gyrus, anterior temporal lobe, and premotor cortex during elaboration processes. Graph theory analysis of dynamic functional connectivity between core AM regions was performed to characterize differences in interregional connectivity and whole-brain topological re-organization observed between early and late AM retrieval. These findings provide evidence that accessing and reconstructing autobiographical memories involves the activation of memory networks that reflect temporally varying retrieval processes and extends past studies by showing that these changes occur at faster timescales than previously described.

Topic Area: LONG-TERM MEMORY: Episodic

Associative Recognition for Word Pairs in Temporarily Ambiguous Sentences: Behavioral and Electrophysiological Evidence

Poster E65, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Kathryn Bousquet[1], Axel Mecklinger[2], Debra Long[1], Tamara Swaab[1]; [1]University of California, Davis, [2]Saarland University, Saarbrücken

Previous research suggests sentence processing is affected by syntactic complexity and verb bias – the frequency with which a verb appears in a particular syntactic structure. In general, complex sentential complement (SC) structures are more difficult to process than direct object (DO) structures; however, SC structures become easier to process when the verb is SC-biased (Wilson & Garnsey, 2009). Researchers have studied how syntactic complexity and verb bias affect sentence processing as it unfolds, but it is unclear whether both factors affect the formation of sentence representations in memory. In the current experiment, participants listened to temporarily ambiguous DO/SC sentences where the verb bias and structure were either consistent or inconsistent (e.g. the goalie confirmed/confessed the defeat…with heartbreak/was heartbreaking). Participants then completed an associative recognition task: intact pairs contained words spoken in the same sentence, rearranged pairs contained words from different sentences, and new pairs were not spoken at all. Behaviorally, item memory was significantly greater than associative memory, but neither were modulated by verb bias or syntactic complexity. Electrophysiological data revealed a significant old/new parietal effect with old pairs eliciting more positive waveforms than new pairs. Intact and rearranged pairs did not differ significantly. At early time windows, waveforms did not differ as a function of syntactic complexity, but a late parietal positivity was observed for word pairs from sentences with consistent bias and structure. The results indicate participants formed detailed sentence representations regardless of verb bias or syntactic complexity, but post-retrieval processing may be influenced by verb bias.

Topic Area: LONG-TERM MEMORY: Episodic

Neurocognitive bases for the functional role of gaze direction during episodic memory retrieval

Poster E66, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Roger Johansson[1], Inês Bramão[1], Richard Dewhurst[2], Mikael Johansson[1]; [1]Department of Psychology, Lund University, [2]School of Culture and Society, Aarhus University

Previous research has established that when engaged in episodic memory retrieval, people frequently look at locations associated with the sought-after memory trace, even if those locations no longer contain any information. While it has been further demonstrated that gaze positions showing compatibility between encoding and retrieval increase the likelihood of successful remembering (Johansson & Johansson, 2014), virtually nothing is known about the neurocognitive bases subserving this “looking at nothing” effect. The present study combined electroencephalography (EEG) and eye-tracking to investigate oscillatory brain activity for 30 participants who retrieved information from a previously encoded spatial arrangement of objects. Critically, participants were directed to fixate on a location of a blank screen, where the location was either congruent or incongruent with the original encoding location of the to-be-retrieved object. The results replicate previous findings, by showing superior episodic memory performance when looking at a congruent location, and further demonstrate that this facilitatory effect of gaze direction is associated with increased cortical desynchronization in the alpha/beta-band. Such desynchronization of oscillatory power in the alpha/beta band is considered to reflect successful encoding and retrieval of an episodes’ sensory information (e.g., Hanslmayr, Staresina, & Bowman, 2016). Gaze direction showing compatibility between encoding and retrieval would thus increase the specificity of neural reactivation and ultimately increase the likelihood of successful remembering. To our knowledge, this is the first causal evidence that gaze direction is functionally relevant for cortical reconstruction during episodic remembering.

Topic Area: LONG-TERM MEMORY: Episodic

Targeted stimulation influences age-related changes in connectivity and function of hippocampal-cortical networks

Poster E67, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Aneesha Nilakantan[1], John Walker[1], Sandra Weintraub[1], Stephen VanHaerents[1], Donna Bridge[1], M-Marsel Mesulam[1], Joel Voss[1]; [1]Northwestern University

Healthy aging is associated with episodic memory decline, consistently correlated with altered hippocampal-cortical connectivity at rest and abnormal hippocampal activity during memory formation. Here, we used noninvasive repetitive transcranial magnetic stimulation (rTMS) to test the causal role of hippocampal-cortical network connectivity in age-related memory decline. Subject-specific left parietal stimulation locations were determined based on their resting-state fMRI connectivity with the body of the hippocampus. In a counter-balanced order, participants (n=14, age range: 60-80 years) were given five consecutive days of full intensity (20Hz) stimulation and five consecutive days of low intensity stimulation (sham). fMRI was collected both at rest and during an associative memory task, involving the recall of 36 object-scene pairs, administered before and 24-hours after each five-day stimulation period. At baseline, older adults showed significantly decreased hippocampal connectivity with medial prefrontal and parahippocampal cortex, and increased hippocampal connectivity with posterior cingulate, precuneus, and parietal cortex, relative to young adults (n=16, age range: 18-34 years). Targeted stimulation significantly decreased the age-related hippocampal hyper-connectivity in the posterior cingulate, relative to sham. Similarly, targeted stimulation decreased posterior cingulate activity and increased hippocampal activity during memory formation. Importantly, these changes in connectivity and task-evoked processing were concurrent with an improvement in associative scene recollection, but not in object recognition. These findings suggest that changes in hippocampal memory network function are causally related to episodic memory impairment in aging, and demonstrate that noninvasive stimulation can be used to alter memory-related network function in older adults.

Topic Area: LONG-TERM MEMORY: Episodic

Persistence of hippocampal activation patterns in post-encoding rest predicts subsequent voluntary, but not involuntary recall of distressing film clips

Poster E68, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Renee M. Visser[1], Richard N. Henson[1], Emily A. Holmes[1,2]; [1]Medical Research Council Cognition and Brain Sciences Unit, University of Cambridge, UK, [2]Karolinska Institutet, Stockholm, Sweden

A key question in emotional memory research is how a traumatic event may result in intrusive, involuntary memories of that event – the core clinical feature of psychological disorders such as post-traumatic stress. Previous behavioural work shows that the strength of voluntary recall of traumatic events is not necessarily related to the frequency or vividness of the involuntary recall of those events, a dissociation that is not readily explained by mainstream episodic memory theories. Here, we investigated whether the two types of recall may be associated with distinct neural profiles at the time of encoding and shortly after. For this, 32 healthy participants underwent functional Magnetic Resonance Imaging while viewing clips of distressing events (the so-called 'trauma film paradigm'), with periods of resting state in between consecutive clips. Next, we applied 'multi-voxel correlation structure' to assess the degree to which voxel-by-voxel connectivity profiles related to the encoding of a specific clip persisted during the immediately-following post-encoding rest period. In the hippocampus, higher similarity between post-encoding rest and encoding profiles, compared to immediately-preceding pre-encoding rest periods, predicted the voluntary recall (both verbal and visual recognition) of the distressing events, a week later. This neural profile was not however related to the frequency or variety of intrusive memories that participants recorded in a daily diary, which they kept for a week following film viewing. These findings corroborate behavioural observations and tentatively suggest that voluntary and involuntary memories of the same event may to some extent rely on separate neural systems.

Topic Area: LONG-TERM MEMORY: Episodic

Episodic simulations reveal the structure of affective representations in medial prefrontal cortex

Poster E69, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Philipp C. Paulus[1], Ian Charest[2], Roland G. Benoit[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]University of Birmingham, UK

The medial prefrontal cortex (mPFC) has been associated with mnemonic processing as well as with valuation. Here, we test the hypothesis that this region supports these seemingly disparate functions by representing affective schemata of our environment. That is, we suggest that the mPFC codes for elements from our environment (e.g., for personally familiar people) such that the representational geometry of those elements is determined by (i) the position of the elements within their network (e.g., how central a person is to an individual's social sphere), (ii) the degree of knowledge about those elements, and (iii) their affective value. To test this hypothesis, participants provided names of personally familiar people and places. They then arranged the names on a two-dimensional surface to indicate how strongly they associate these elements with each other (indexing degrees of centrality). Participants also indicated how familiar they are with each person and each place (indexing degrees of knowledge), and how much they like them (indexing affective value). We combined centrality, familiarity, and liking to estimate the structure of participants' unique affective representations. In a functional MRI session, participants then vividly simulated episodes of interacting with each person and place, which allowed us to estimate their individual neural representations. Preliminary analyses support our hypothesis (particularly for people): the structure of the neural representations in the mPFC indeed seems to reflect the structure of the estimated affective representations.

Topic Area: LONG-TERM MEMORY: Episodic

Prioritization of weakly-encoded information for sleep-dependent consolidation

Poster E70, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Dan Denis[1,2], Verda Bursal[1,2], Shanice Oquin[1,2], Alexandra Morgan[1,2], Robert Stickgold[1,2]; [1]Beth Israel Deaconess Medical Center, [2]Harvard Medical School

A large body of evidence has shown that sleep plays an important role in the consolidation of declarative memory. More recently, it has been suggested that the brain prioritizes certain memories to be consolidated over others. The mechanisms underlying this remain unclear. This study investigated the role initial encoding strength may play in the selection of memories that undergo consolidation. Participants learnt unrelated word-pairs to 3 different levels of encoding. Encoding strength was manipulated by the number of times each word-pair was presented. Following learning, an immediate free-recall test showed that the encoding strength manipulation successfully led to 3 distinct levels of encoding. Then, half the participants (n = 20) returned for a delayed test 12 hours later (constituting a wake group), with the other half (n = 20) returning 24 hours later (constituting a sleep group). At delayed test, it was found that the 24-hour group showed less forgetting across all encoding strength conditions compared to the 12-hour group, suggesting a general beneficial role of sleep on delayed test performance. Furthermore, a significant group x encoding condition interaction showed that, in the 24 hour group, there was significantly less forgetting for the most weakly encoded items compared to the other levels of encoding. These results suggest that sleep is important for the consolidation of declarative memory, and the brain prioritizes those items that are weakly encoded over more strongly learnt information.

Topic Area: LONG-TERM MEMORY: Episodic

Dynamics of brain activity reveal a unitary recognition signal

Poster E71, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Christoph T. Weidemann[1,2], Michael J. Kahana[2]; [1]Swansea University, Wales, UK, [2]University of Pennsylvania

Dual-process models of recognition memory typically assume that independent familiarity and recollection signals with distinct temporal profiles can each lead to recognition (enabling two routes to recognition), whereas single-process models posit a unitary "memory strength" signal. Using multivariate classifiers trained on spectral EEG features, we quantified neural evidence for recognition decisions as a function of time. Classifiers trained on a small portion of the decision period performed similarly to those also incorporating information from previous time points indicating that neural activity reflects an integrated evidence signal. We propose a single-route account of recognition memory that is compatible with contributions from familiarity and recollection signals, but relies on a unitary evidence signal that integrates all available evidence.

Topic Area: LONG-TERM MEMORY: Episodic

Characterizing EEG signatures of inattention that predict forgetting

Poster E72, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

David DiStefano[1], Helen Schmidt[1], Paige Hickey[1], Elizabeth Race[1]; [1]Tufts University

Periods of inattention (e.g., being off task or mind wandering) have been associated with reduced cortical analysis of the external environment (perceptual decoupling), evident in attenuated ERPs to stimuli that appear during off-task vs. on-task periods (Smallwood et al., 2008). The current study investigated whether such EEG markers of inattention are present for task-relevant and task-irrelevant stimuli and can predict long-term memory. EEG was recorded while participants performed an incidental face encoding task in the presence of background, task-irrelevant tones. Periods of inattention were defined by (i) a subjective measure in which participants self-reported their attentional state and (ii) an objective measure of response time variability (Esterman et al., 2012). Perceptual decoupling (operationalized as attenuated ERPs during subjective/objective periods of inattention) was observed only for faces, albeit at later points in time (>500ms) than typically observed. The timing and topography of this attention-related response largely overlapped with those of ERPs predicting subsequent memory for faces. We also identified distinct neural signatures that predicted subsequent memory but did not overlap with those reflecting attentional state. These signatures included an early frontal response to task-irrelevant tones that was predictive of subsequent memory for the faces that followed. These results indicate that fluctuations in attention are associated with neural activity patterns that are similar to those that predict

subsequent memory, and suggest that the success of memory encoding can be predicted by neural responses to cross-modal, task-irrelevant stimuli.

Topic Area: LONG-TERM MEMORY: Episodic

Mental Chronometry of Episodic Memory Retrieval

Poster E73, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Logan J. Fickling[1], Michael J. Kahana[1]; [1]University of Pennsylvania

The process of learning, maintaining and later accessing information can be modeled as an ongoing process that blends new information (content) into a gradually drifting context. Several theories of memory search assert that context reinstatement precedes content reinstatement during episodic memory retrieval. In order to test hypothesized neural predictions made by the Context Maintenance and Retrieval Model, we employed a free-recall task in 221 patients with medically resistant epilepsy. Using intracranially recorded high frequency activity (HFA, 95 Hz), thought to be a reflection of general neural activation, we examined the neural dynamics underlying episodic memory retrieval in frontal, temporal, parietal and hippocampal electrodes. In the time course prior to a correct retrieval, we found the relative order of neural HFA activation to start bilaterally hippocampi, followed by left frontal lobe, left parietal lobe, right parietal lobe, right frontal lobe, right temporal lobe, left temporal lobe. Next we examined these interactions on a more spatially restricted scale, using the talairach atlas to further subdivide the brain. We additionally examined how this temporal ordering changed for recalls with inappropriate context or content, intrusions (words recalled from a previous learning list, or never shown before), and exploited neural similarity (correlations of HFA) between encoding and retrieval as a function of lag (positional distance relative to the recalled item) to isolate context and content signals. Our findings contribute to the understanding of episodic memory by characterizing the mental chronometry of correct and incorrect retrievals, and providing further support for context based models of memory.

Topic Area: LONG-TERM MEMORY: Episodic

Awake Targeted Memory Reactivation and Foreign Language Learning

Poster E74, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Linda J. Hoffman[1], Kylie H. Alm[2], Chi T. Ngo[1], Ingrid R. Olson[1]; [1]Temple University, [2]Johns Hopkins University

Several studies have shown that the contents of memory can be biased towards specific items using a technique called targeted memory reactivation (TMR). In typical TMR interventions, participants encode pictures and then take a nap, during which time sounds are played that were previously associated with the encoded images. When memory is later tested, pictures that were “reactivated” by the sound cues are better remembered. There is some evidence that suggests that sleep is essential for this process (Diekelmann, Büchel, Born, & Rasch, 2011). We, however, hypothesized that TMR can occur during wakeful rest, and that the nature of these effects are modulated by the level of environmental interference. To test this, two groups of English speakers were required to learn 72 Japanese vocabulary words, each of which was associated with a semantically related sound and image. After the learning phase, there was a rest phase during which one group of participants engaged in a high interference task (i.e. played Tetris), while the other engaged in a low interference task (i.e. watched a virtual fireplace video). Half of the sound cues were replayed during this rest phase. Results showed that when memories were reactivated while playing Tetris, memory was disrupted. However when memories were reactivated while engaging in more passive activities, memory was enhanced. These findings indicate that sleep is not essential for TMR. They also have implications for TMR’s potential utility in interventions targeting the attenuation of unwanted memories, and the amelioration of memory for academically oriented content.

Topic Area: LONG-TERM MEMORY: Other

Investigating the Neural Bases of Featured-Based Semantic Control: Evidence from High Resolution Functional Neuroimaging

Poster E75, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Andrew C. Connolly[1], Gavin K. Hanson[2], Evangelia G. Chrysikou[3]; [1]Dartmouth School of Medicine, [2]Case Western Reserve, [3]University of Kansas

Prior neuroimaging evidence using multivoxel pattern analyses has offered support for a domain-general system that is active in shifting attention toward concrete (e.g. color, shape) and abstract (e.g. function, thematic context) features during goal-directed object knowledge retrieval (Hanson & Chrysikou, 2017). However, precisely how these semantic features, as well as their conjunctions, are represented within this hypothesized attentional system remains unexplored. Here, we employed a high-resolution functional magnetic resonance imaging (fMRI) protocol with the goal of identifying feature-selective attentional signals that would support some domain specificity according to a particular topographical organization within frontal and parietal cortex. Healthy adult participants performed a semantic decision making task according to which they matched a cue word to one of three targets depending on a single feature (i.e., color, shape, function) or a conjunction of features (i.e., color and shape; color and function; shape and function). Univariate model-based and multivoxel pattern analyses revealed the contributions of frontotemporal and dorsoparietal networks in guiding attention to goal-oriented features and their conjunctions during semantic control. We discuss how these results support a frontoparietal network of regions guiding attention to different concrete and abstract semantic properties during flexible, goal-oriented object knowledge retrieval.

Topic Area: LONG-TERM MEMORY: Semantic

The conflicting outcomes of the organizational processing on test-potentiated learning.

Poster E76, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

SinYi Wang[1], ShihKuen Cheng[1]; [1]National Central University

Testing, or retrieval practice, benefits the long-term retention of studied materials. The testing effect has been widely observed with various kinds of materials including paragraphs, sentences, motor sequence. Recently, some studies have shown that testing might benefit retention by potentiating subsequent learning or encoding. Arnold and McDermott (2013) developed a procedure to show that the performance of subsequent restudy was enhanced after repeated testing. It was proposed that the “test-potentiated learning effect” comes from the organizational processing of the materials after test. The current study tested this hypothesis by employing categorized words as the study materials. If indeed test-potentiated testing effect receive contribution from enhanced organizational encoding of the materials, the benefit should be diminished if the study materials themselves, such as categorized items, demand little organizational processing. Consistent with our prediction, the test-potentiated learning effect was not observed when the categorized words were used as study materials. Interestingly, the test-potentiated learning effect was also not observed when non-categorized words were used as materials. Instead, we found that repeated testing hampered the effect of restudy, resembling the “negative testing effect”. In summary, our results do not support the hypothesis that testing enhances the organizational processing of the materials.

Topic Area: LONG-TERM MEMORY: Semantic

Age-related differences in the underlying mechanisms of temporal statistical learning

Poster E77, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Noémi Elteto[1], Karolina Janacsek[1,2], Dezso Nemeth[1,2]; [1]Eotvos Lorand University, Budapest, Hungary, [2]Brain, Memory and Language Lab, Hungarian Academy of Sciences, Budapest, Hungary

Statistical learning underlies many day-to-day activities during the entire lifespan since it is crucial in the acquisition of perceptual, motor, cognitive, and social skills. Janacsek et al. (2012) reported that the basic ability to pick up implicitly triplets that occur with high- vs. low-probability in a sequence – measured by raw reaction time (RT) - is superior in children and it is decreased around

age 12. Yet, the qualitative ontogenetic changes that give rise to the quantitative differences in performance are not understood yet. Here our aim was to characterize performance in more detail by estimating ex-Gaussian parameters of the RT distributions. We re-analyzed the dataset from the Janacsek et al. study where participants between 4–85 years of age were trained on a probabilistic sequence learning task. First, we confirmed the decreasing developmental pattern of temporal statistical learning; the difference in the mu parameter (mean value) between the high- and low-probability triplets was the highest before 12 years of age. Importantly, the sigma parameter (variance) was larger for the high- than the low-probability triplets in children, and this difference was gradually reversed through adolescence. However, triplet types were not differentiated by the tau parameter (exponential rate). This suggests that while children have acquired some high-probability triplets more than others, adults learned these approximately similarly. Therefore, we propose that the learning of high probability events per se undergoes a shift from weighting specific events to learning whole probabilistic structures around age 12.

Topic Area: LONG-TERM MEMORY: Skill learning

Calibrating Atypical Timing in Clinical Populations Through Music

Poster E79, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Lisa Hirt[1], Lara Pantlin[1]; [1]Colorado State University

Music in clinical practice has been shown to be a powerful tool in rehabilitation therapies and integrating behavioral and psychological activity. This relationship insinuates why individuals with psychopathology often associate themselves with music. Often, those suffering from psychopathology also have impaired internal timing functions and music offers a repetitive beat that can synchronize irregular neurophysiological and behavioral timing functions. Clinical populations seek music to calibrate themselves to our societal clock. Thus, the hypothesis was (1) healthy controls who have had musical training would have improved behavioral and social timing as compared to controls that have no musical training. (2) People with musical training who self-report symptoms of a clinical diagnoses will exhibit behavioral and social timing improvements, compared to those with a clinical diagnosis and no musical training. Participants (N = 58) were selected from a large university and were screened for psychopathology. All participants' brain activity was recorded using EEG during a passive auditory timing task (mismatch negativity). Participants then completed two behavioral timing tasks. Data was analyzed using a two-way ANOVA. As expected, those endorsing psychopathology had worse neurophysiological timing compared to controls; however, if these individuals had some music experience, they demonstrated the highest accuracy on behavioral measures. Individuals with impairments in neurophysiological timing, which also supports existence of psychopathology, and play a musical instrument may be using the repetitive beat in music to compensate for their timing deficits. Future studies will examine neuroplastic capacity for timing in individuals who may have psychopathology.

Topic Area: METHODS: Electrophysiology

Anterior-Posterior Insular Segmentation of FreeSurfer Generated Region-of-Interest Volume

Poster E80, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Brittany Strauss[1], Todd D'Amour[1], Jeremy D. Cohen[1]; [1]Xavier University of Louisiana, New Orleans, LA, USA

The Parieto-Frontal Integration Theory (P-FIT) of intelligence suggests that a distributed network underlies individual differences in intelligence and reasoning. The P-FIT model assumes that cognitively salient information is integrated from temporal and occipital regions to the prefrontal cortex. Insular cortex is a central region of the salience network that has been functionally implicated in intelligence and cognitive capacity in both developmental and aging populations previously. We investigated the relationship between Kaufman Brief Intelligence Test (KBIT) and insular volume. Freesurfer was used to collect insular region-of-interest data from 45 individuals aged 7 to 19 (26 Autism Spectrum Disorder, 19 Typically Developing). Freesurfer insular labels were converted to 3D volumes, imported into Mango, and bisected into functionally relevant anterior and posterior insular regions based using a freely accessible Plugin tool. There were no significant differences in either verbal or non-verbal IQ between to the two groups. Right anterior insular volume was significantly positively correlated with non-verbal IQ. There was also a significant

positive relationship between right posterior insular volume with both verbal and non-verbal IQ. Increased rightward asymmetry (i.e. right volume greater than left) of posterior insula was also significantly positively correlated with both verbal and non-verbal IQ. Current structural insular data supports previous findings of increased insular cerebral blood flow related to increased IQ. Data also supports the integral role of the salience network within the P-FIT model of intelligence and reasoning ability.

Topic Area: METHODS: Neuroimaging

The limits of behavioural outcome prediction following focal brain injury

Poster E81, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Tianbo Xu[1], Ashwani Jha[1,2], Hans Rolf Jager[1,2], Michel Thiebaut de Schotten[6,7], Geraint Rees[1,3,4,5], Parashkev Nachev[1,2]; [1]Institute of Neurology, UCL, London, WC1N 3BG, UK., [2]National Hospital for Neurology and Neurosurgery, Queen Square, UK., [3]Institute of Cognitive Neuroscience, UCL, London WC1N 3AR, UK., [4]Faculty of Life Sciences, UCL, London, WC1E 6BT, UK., [5]Wellcome Trust Centre for Neuroimaging, UCL, London WC1N 3BG, UK., [6]Brain Connectivity Behaviour group, Paris, France, [7]Sorbonne Universités, UPMC Univ Paris 06, Inserm, CNRS, Institut du cerveau et la moelle (ICM) - Hôpital Pitié-Salpêtrière, Boulevard de l'hôpital, F-75013, Paris, France

Our capacity to predict the behavioural outcome of focal brain injury is commonly conceived to be limited by the complexity and variability of the underlying functional anatomy. But a more proximal limit is set by the spatial characteristics of the focal lesions through which lesion-outcome relationships are established in the first place. Here we sought to quantify this hard upper limit on outcome prediction by evaluating a comprehensive set of hypothetical lesion-deficit classification models with the largest published collection of anatomically registered maps of ischaemic focal brain injury (N=1172). Theoretically maximal predictive performance was quantified for lesion-deficit models assuming either single-region or two-region functional dependence, across the space of all possible two-region combinations, defined by a Brodmann area parcellation of the brain. Predictions derived from mass-univariate analyses yielded an average theoretical maximum receiver operating characteristic (ROC) area under the curve (AUC) of 0.923 (95%CI=0.914-0.933) for two area models, and 0.981 (95%CI=0.978-0.983) for one area models, whereas predictions derived from high-dimensional multivariate analyses yielded an average theoretical maximum AUC of 0.963 (95%CI=0.958-0.968) and 0.988 (95%CI=0.986-0.990), respectively. These results show that the spatial structure of natural focal lesions limits not only the fidelity of functional-anatomical inferences drawn from them but also the fidelity of predictive models of behavioural outcome that are agnostic of the underlying anatomy. High-dimensional multivariate methods lift this limit higher than the mass-univariate methods in widespread current use, and ought to be preferred.

Topic Area: METHODS: Neuroimaging

Multimodal structural predictors of naming therapy outcomes in persons with aphasia

Poster E82, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Erin Meier[1], Jeffrey Johnson[1], Yue Pan[1], Maria Dekhtyar[1], Swathi Kiran[1]; [1]Boston University

Cross-sectional studies (e.g., Sims et al., 2016; Basilakos et al., 2014) implicate the integrity of specific gray matter (GM) and white matter (WM) regions of interest (ROIs) in language recovery after stroke. The goal of this study was to determine the extent to which regional left hemisphere (LH) and right hemisphere (RH) integrity predicts naming therapy gains in persons with aphasia (PWA). Before therapy, 27 PWA underwent whole-brain DTI and T1-weighted scans. Bilateral ROIs implicated in naming (i.e., anterior cingulate; superior, middle and inferior frontal gyri; middle and inferior temporal gyri; supramarginal and angular gyri) (Indefrey & Levelt, 2004) were extracted from the Harvard-Oxford atlas. LH GM metrics (i.e., percent spared cortical tissue) and bilateral WM scalars (i.e., fractional anisotropy [FA], mean diffusivity [MD]) were obtained from cortical and subcortical masks in each ROI. To identify a cohesive set of predictors, LH and RH structural metrics were entered into two separate principal component analyses (PCAs). The LH and RH PCAs yielded six and three components, respectively. These nine components (i.e., LH_Temporal, LH_Parietal, LH_IFG, LH_DLPFC, LH_DMPFC, LH_ACC.spared, RH_FA, RH_MD, RH_Temporal_FA) were entered as predictors into a backward stepwise regression. The final model containing LH_Temporal, LH_IFG, LH_DMPFC, LH_DLPFC, and RH_MD explained 61% of the variance in treatment response ($F(5,21)=6.49$, $p<.001$). This multimodal model

better predicted treatment gains than models containing GM metrics (p=0.003) or lesion volume (p=.024) alone. In sum, naming treatment success was most reliant on the combined GM and WM integrity of critical LH frontal and temporal regions.

Topic Area: METHODS: Neuroimaging

SHARP (Strengthening Human Adaptive Reasoning and Problem Solving): A case study for highlighting the role of independent test and evaluation in government funded research

Poster E83, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Dimitrios Donavos[1], Alexis Jeannotte[2], Amber Sprenger[3], Chrissy Thuy-Diem Vu[3]; [1]Booz Allen Hamilton, [2]IARPA/ODNI (US Government), [3]MITRE Corporation

SHARP is a multi-site and cross-team, collaborative research effort aimed at investigating whether fluid intelligence (Gf) can be enhanced through interventions focused on behavioral, cognitive, and neurophysiological outcome measures in high performing adults funded by Intelligence Advanced Research Projects Activity (IARPA). Programs at IARPA are structured as competitions, where only teams with the strongest results continue throughout the program period. In designing candidate interventions for enhancing Gf on the SHARP program, teams were required to test a sufficiently powered subject cohort and employ research designs that utilized active controls and placebo controlled, double-blinded intervention groups. These interventions were independently verified using a battery of tests developed by a third-party organization (MITRE). This battery is comprised of measures that are available for use by other researchers and were developed to have a number of features, including strong construct validity evidence, parallel versions to enable pretest-posttest comparisons, and appropriate difficulty for a high ability population. As the primary evaluation metric, the battery is used to evaluate whether teams meet predetermined targets for improving Gf in a high-performing cohort, relative to an active control group. Against a backdrop of a broader replication crisis in the scientific community, the value and outcomes of a testing approach that employs a rigorous and common set of test and evaluation methods and metrics will be further discussed.

Topic Area: METHODS: Other

Context-dependent selective role of the left medial prefrontal cortex in communication: a TMS study

Poster E85, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Beatriz Martin-Luengo[1], Matteo Feurra[1], Alicia Vorobiova[1], Andriy Myachykov[1,2], Yury Shtyrov[1,3,4]; [1]National Research University - Higher School of Economics, [2]Northumbria University, [3]Aarhus University, [4]Saint Petersburg State University

Behavioral research shows that, depending on the social context, participants tend to report more (in informal) or less (in formal social contexts) information whose correctness they are not confident in. The left medial prefrontal cortex (lmPFC) is suggested as one area linked with self-referential processing in metacognitive decisions, and it may be the key to understanding this differential reporting. We assessed the lmPFC involvement in the willingness to share information in different social contexts by using inhibitory repetitive transcranial magnetic stimulation (rTMS) during a behavioural metacognitive task. Three groups of participants were exposed to an offline 1-Hz rTMS stimulation of either: (1) lmPFC, (2) sham (placebo stimulation) or (3) control site (rmPFC). Afterwards, participants answered difficult general knowledge questions and rated their confidence in the correctness of their answers. Finally, they decided if they would prefer to report or withhold those answers in a formal (job interview) and in informal (chatting with friends) contexts. In all three groups, there were significantly more reported than withheld answers in the informal context. Crucially, in the formal context, there were significantly more withheld than reported answers in the group that received the lmPFC rTMS, and no differences in the other two groups. No differences were found in the confidence ratings between the three groups. These results highlight the importance of pragmatic context when deciding which information to share, and suggest that the left medial prefrontal cortex plays a role in self-referential processes involved in controlling communicational exchanges under different social circumstances.

Topic Area: OTHER

Statistical learning of nonadjacent dependencies among different modalities

Poster E86, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Yu-Huei Lian[1], Kunyu Xu[1], Denise H. Wu[1]; [1]National Central University

Previous literature indicates that statistical learning (SL), the ability to detect regularities among adjacent elements, is a general mechanism for learning and for processing any type of sensory input that unfolds across time and space. However, whether SL is also possible and common when the dependent elements in different modalities are nonadjacent remain to be determined. We employed the SL tasks with triplets presenting nonadjacent regularities in the visual and auditory modalities to answer these questions. Specifically, relatively complex visual shapes and nonverbal environmental sounds were randomly organized to create triplets whose first and third elements were paired while the second element was variable in the visual and auditory SL tasks, respectively. After a familiarization phase, participants' explicit and implicit knowledge of the nonadjacent regularities were measured by recognition and familiarity judgement, respectively. Although participants were capable of learning nonadjacent dependencies in both visual and auditory modalities with comparable accuracy, individual differences in the learning performance seemed to suggest that visual and auditory SL abilities rely on different mechanisms, as participants' explicit SL of nonadjacent visual dependencies significantly correlated with their working memory, while their implicit SL significantly correlated with their IQ scores. On the other hand, neither explicit nor implicit SL of nonadjacent auditory dependencies correlated with any of the general cognitive abilities. Further research is needed to provide direct evidence for distinct mechanisms underlying SL of nonadjacent dependencies in different modalities.

Topic Area: OTHER

Similar motor-related sensory attenuation for tones and voices

Poster E87, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Ana Pinheiro[1], Michael Schwartze[2], Sonja A. Kotz[2]; [1]Voice, Affect and Speech Laboratory, Faculty of Psychology, University of Lisbon, Lisbon, Portugal, [2]Basic and Applied NeuroDynamics Laboratory, Faculty of Psychology and Neuroscience, Department of Neuropsychology and Psychopharmacology, Maastricht University, Maastricht, The Netherlands

Perceiving one's own voice relies on the capacity to predict the sensory consequences of self-generated vocalizations. Suppression of sensory cortical responses to self-generated stimuli is reflected in the suppression of the N1 event-related potential (ERP) to self- compared to externally-generated stimuli. However, the study of sensory suppression to self-voice stimuli is methodologically challenged by motor artifacts concomitant to voice perception and differences in self-voice perception due to bone conduction. Button press paradigms overcome these issues but most have focused on computer-modulated stimuli. Hence, it remains to be shown whether motor-related sensory attenuation occurs similarly for natural stimuli such as voices. Following a within-subjects design, nineteen college students were tested in an auditory task consisting of self-triggered and externally triggered tones or self-voices. Participants displayed a significant N1 attenuation effect in response to both self-triggered tones and self-triggered voices ($F(4, 72)=7.286$, $p<.001$). Sensory attenuation was similar for both stimulus types ($p>.05$). Together, these findings suggest that self-initiated auditory sensations are attenuated irrespective of the specific physical features of the stimulus. This allows tagging of sensations as self-produced to avoid confusion with sensations of the external environment.

Topic Area: PERCEPTION & ACTION: Audition

Time-Frequency Effects of Syntactic Violation in Music, Language, and Rhythm

Poster E88, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Juho Daniel Lee[1], Harim Jung[1], Christine Mathew[1], Psyche Loui[1]; [1]Wesleyan University

Rhythm is an essential component in both music and language. This study contributes to the characterization of music and language processing by investigating to what extent rhythmic changes are processed similarly from musical and linguistic syntactic violation, thereby. With stimuli adopted from Slevc et al. (2009), participants read sentences that were paired with tonal chord progressions, and answered a comprehension question after each sentence, while their EEG was recorded. At predetermined critical time windows within each trial, we manipulated linguistic, musical, and rhythmic expectancy separately: Linguistic syntax was violated using syntactic garden-path sentences, musical syntax was violated using out-of-key chords, and rhythmic expectancy was violated by presenting segments early or late. Time-frequency analysis of EEG showed higher beta activity around 800ms after the critical time window in the linguistically unexpected compared to the musically unexpected condition. Higher beta activity around 100ms was observed in the rhythmically late compared to rhythmically early condition. Inter-trial phase coherence was increased in the beta band during the expected (rather than actual) onset of the critical time window. Results show differences between frequency and phase for the processing of musical, linguistic, and rhythmic information. These findings may have implications for rehabilitation strategies in clinical populations with communication disorders.

Topic Area: PERCEPTION & ACTION: Audition

Developmental perceptual impairments: when tone-deafness and prosopagnosia co-occur

Poster E89, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Sebastien Paquette[1], Hui Charles Li[1], Stephanie Buss[1], Gottfried Schlaug[1]; [1]Music and Neuroimaging Laboratory, Beth Israel Deaconess Medical Center, Harvard Medical School

Studies have shown subtle gray and white matter abnormalities in subjects with several developmental disorders including prosopagnosia, tone-deafness, and dyslexia. Tone-deafness and dyslexia are known to co-occur, suggesting a possible link between these developmental disorders. However, it is not known whether tone-deafness can also be associated with prosopagnosia. We addressed this question by assessing face perception abilities in a group of tone-deaf individuals and non-tone-deaf controls. The Cambridge and Warrington Face Memory Tests were used to assess face processing in a combined group of 12, out of which six were considered to be tone-deaf according to the Montreal battery of evaluation of amusia. Only tone-deaf participants (two) scored in the impaired range on the Cambridge test and one also on the Warrington Face Memory Test. Furthermore, the global melodic composite score of the Montreal battery of all participants significantly correlated with the face recognition score of the Cambridge Face Memory Test. Our results suggest that tone-deafness might co-occur with face perception impairments. It is implausible that both deficits can be linked to a single cognitive dysfunction that spans different perceptual systems in different modalities. Rather, they are likely associated with a common pathogenetic mechanism of early development that leads to anomalies, affecting the local function of different brain systems or the connection between regions.

Topic Area: PERCEPTION & ACTION: Audition

Statistical learning of categorical regularities in adults and children

Poster E90, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Yaelan Jung[1], Dirk B. Walther[1], Amy S. Finn[1]; [1]University of Toronto

Humans are able to learn statistical regularities that are present in the environment with very little exposure (Saffran, Aslin, & Newport, 1996). This learning can even occur rather abstractly; adults have been shown to learn statistical regularities that occur across categories and not specific exemplars (Brady & Oliva, 2008). Do younger children learn these abstract regularities like adults? Given evidence that children are more sensitive to features of individual items than adults (Sloutsky & Fisher, 2004) they may or may not show rapid learning of statistical structure at the category level. To address this, we performed statistical learning experiments on adults (18-22 y old) and children (6-9 y old). Observers were exposed to a 5-minute stream of animal images which

had a statistical structure – 4 triplets, in which 3 animals appeared in the same order, were randomly distributed in the stream. Critically, the images were always different exemplars in the stream (i.e., different monkey picture each time). Observers were tested using two alternative forced-choice and reaction time based target detection tasks. We observed that both adults and children were able to learn the statistical regularities when the patterns were at the category level. However, is the exposure to multiple exemplars necessary for category level learning or is an exposure to a single item (i.e., same monkey picture each time) sufficient to extract the category level knowledge? We found that both adults and children could still learn the statistical regularities at the category level even with single item exposure.

Topic Area: PERCEPTION & ACTION: Development & aging

Reward processing during dyadic social interaction: An EEG study of parents and young children

Poster E91, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Julia Anna Adrian[1], Kevin Jenson[1], Alvin Li[1], Scott Makeig[2], Gedeon Deak[1]; [1]UC San Diego, Cognitive Science, [2]Swartz Center for Computational Neuroscience

Actions are often motivated by the expectancy of a certain outcome. We investigated neural correlates of expected and unexpected outcome processing through EEG recordings during social interaction. Dyads of parents and their children (range: 3-6 years old) played a turn-taking game. In every trial one participant chose to touch one of two options on a touch screen, yielding a high or low reward outcome. The dyad learned a cooperative rule for obtaining high-reward outcomes through trial and error. Thereafter, the reward contingency was randomly reversed in 20% of trials, eliciting prediction errors. Independent component analysis (ICA) was used to exclude non-brain components. Event-related potentials (ERPs) were time-locked to own and partner's actions. Previous studies found an association between the amplitude of a late positive ERP component (P3) and reward processing. Children could be divided into two groups based on their ERPs: those whose P3 amplitude was larger for high versus low reward (independent of expectancy), and those whose P3 was larger for unexpected versus expected outcomes (independent of reward magnitude). Notably, children did not exhibit a P3 component in response to their parents' outcomes. Parents' P3 amplitudes were more strongly modulated by their children's action outcomes than their own. Their P3 amplitude was large for expected high and unexpected low reward, the two possible outcomes after a correct action. We conclude that this event-related potential dependency might be an indication of parents' increased attention to the consequences of their children's actions than to their own.

Topic Area: PERCEPTION & ACTION: Development & aging

Electrocorticographic dissociation of alpha- and beta-band activity in human sensorimotor cortex

Poster E92, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Arjen Stolk[1], Loek Brinkman[2], Mariska van Steensel[2], Erik Aarnoutse[2], Robert T. Knight[1], Frans Leijten[2], Floris de Lange[3], Ivan Toni[3]; [1]University of California, Berkeley, [2]Utrecht University, [3]Donders Institute

Alpha and beta rhythmic activities over the sensorimotor cortex are prominent and functionally relevant [Brinkman et al., 2014; 2016]. However, it is unclear whether alpha and beta rhythms build on spatially overlapping neuronal ensembles, and whether those ensembles actually contribute to computing a forthcoming movement. Complicating the issue is the fact that rhythmic activity rides on top of concurrent power-spectral 1/f modulations, making it difficult to make robust claims involving truly oscillatory activity. Here we recorded neural data directly from the cortical surface (ECoG) of eleven epilepsy patients while they prepared goal-directed movements with either the left or right hand. We used irregular-resampling auto-spectral analysis to distinguish subject-specific rhythmic from 1/f components of the ECoG signal [Wen & Liu, 2016]. Alpha and beta rhythms showed effector-specific trial-by-trial modulation, and were both spatiotemporally correlated with high-frequency activity (60-140 Hz). However, alpha and beta rhythms differed in their cortical and functional properties. Sensorimotor alpha is maximal on the postcentral gyrus, with the majority of electrodes yielding predominantly somatosensory sensations of the upper limb following electrical stimulation. In

contrast, sensorimotor beta is strongest on both pre- and postcentral gyri, at electrodes yielding both movements and somatosensory sensations following stimulation. Further, each rhythm exhibited unique, non-overlapping spatiotemporal patterns, with beta rhythmic activity closely tracking fluctuations in excitation:inhibition balance across sensorimotor cortex [Gao et al., 2017]. Together, these observations suggest that alpha and beta involve different neuronal ensembles and dissociable components of movement computation.

Topic Area: PERCEPTION & ACTION: Motor control

Association between Unintentional Interpersonal Postural Coordination Produced by Interpersonal Light Touch and the Intensity of Social Relationship

Poster E93, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Tomoya Ishigaki[1,2,3], Ryota Imai[1], Shu Morioka[1]; [1]Kio University, [2]Fit-care Home-visit Nursing Station, [3]Higashiikoma Hospital

Interpersonal postural coordination (IPC) produced by interpersonal light touch (ILT), whereby time series variations in the postural sway between two people unconsciously resemble each other, is a possible social interaction. From a social sociopsychologial standpoint, close mutual behavioral coordination is recognized as “social glue,” which represents the closeness of relationships and contributes to build good rapport. Therefore, if IPC functions as social glue, we hypothesized that IPC produced by ILT also represents a social relationship. To examine this hypothesis, we recruited dyad participants with a preexisting social relationship and assessed the closeness toward the partner as rapport. Postural sway in two quiet standing conditions, no touch (NT) and ILT (a mutual slight touch with <1 N) conditions, were measured concurrently, and the association of IPC with intradyadic closeness was analyzed using hierarchical linear modeling. As a result, higher IPC was observed in both axes of the ILT condition than that in the NT condition. Additionally, IPC in the mediolateral axis of the ILT condition was positively correlated with intradyadic closeness, while that in the anteroposterior axis showed a negative association. As expected, IPC represented intradyadic closeness; hence, intradyadic closeness may function as a gain controller for modulating the degree of sensory information processing of the partner’s and own postural control (i.e., good closeness increases gain to receive partner feedback). We conclude that unintentional IPC produced by ILT functions as social glue, and it provides an understanding of the sociopsychological aspect in the human-to-human postural coordination mechanism.

Topic Area: PERCEPTION & ACTION: Motor control

Neural correlates of executed and imagined joystick directional movements: A functional near-infrared spectroscopy study

Poster E94, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Matthew A. Mathison[1], Donald C. Rojas[1]; [1]Colorado State University

Motor-based brain computer interfaces (BCIs) attempt to restore and/or enhance motor functioning by measuring brain signals and converting them to computerized output. Given the high temporal resolution and low risk, the majority of extant BCI research has utilized electroencephalography (EEG) to measure these signals. Relative to EEG, functional near-infrared spectroscopy (fNIRS) offers greater resistance to noise and motion, higher spatial resolution, and simple setup but has lower temporal resolution. Few BCI studies have utilized fNIRS as the sole imaging method and none have combined a high-density optode array with a paradigm in which the imagery task closely mirrored the motor goal. The current task utilized a high-density array consisting of 46 sources and 32 detectors, forming 150 channels. Twenty-four participants were asked to complete a series of imagined and executed joystick deviations in one of four directions, indicated by an on-screen prompt. During each stimulus presentation, participants were asked to repeatedly move the joystick for sixteen seconds in the designated direction at a rate of one movement per second, in synchrony with an auditory tone. Results indicated significant differences in hemodynamic activity during executed conditions relative to imagined conditions. More specifically and of greater interest for BCI purposes, significant activation differences were observed in multiple brain regions (e.g. motor, premotor, and posterior parietal cortices) for each imagined movement direction

compared to other imagined movements. These results lend support for the use of fNIRS in BCI. Future research could implement a machine learning algorithm to classify movement directions in real-time.

Topic Area: PERCEPTION & ACTION: Motor control

Seen and heard emotions alter perception and cortisol

Poster E95, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Vivian M. Ciaramitaro[1], Sarah C. Izen[1], Hannah E. Lapp[1], Daniel A. Harris[2], Richard G. Hunter[1]; [1]University of Massachusetts Boston, Dept of Psychology, Developmental and Brain Sciences Program, [2]Brown University, School of Public Health

Emotional states can be expressed through several modalities (e.g., body posture, facial expression, or the intonation in a voice) and are often experienced concurrently across our senses, such as seeing an emotional face while hearing an emotional voice. While much research has examined emotional processing within one sensory modality, less is known regarding how emotional information across our different senses interacts. We examined if visual and auditory emotional information of matched valence (congruent) conferred stronger perceptual and physiological effects compared to visual and auditory information of unmatched valence (incongruent). We quantified how a 3-minute exposure (adaptation) to emotional faces and/or voices biased perception and altered cortisol, a physiological proxy for stress or arousal. For each of 163 participants we quantified their unique neutral point, pre- and post-adaptation, by fitting data with a cumulative normal to determine the point of subjective equality, the face equally likely to be judged happy or angry. For a subset of 122 participants we also quantified the physiological stress response, pre- and post-adaptation, by measuring salivary cortisol. While we found no significant advantage in perceptual or physiological effects from congruent over incongruent emotional information, the weakest effects on perception and cortisol tended to arise from heard emotions. Furthermore, changes in cortisol were significantly associated with changes in perception. Following exposure to negative emotional information, we observed larger decreases in cortisol (indicative of less stress), which correlated with more positive perceptual after-effects (indicative of stronger biases to see a neutral face as happy).

Topic Area: PERCEPTION & ACTION: Multisensory

Boosting auditory pitch learning with unconscious visual information

Poster E96, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Milton Avila[1], João Pereira Leite[1], Cristina Marta Del-Ben[1]; [1]Ribeirão Preto Medical School, University of São Paulo

Previous studies have demonstrated that audiovisual integration may improve perceptual unisensory performance and learning. This integration occurs even when one of the sensory information is unconsciously presented, e.g. auditory semantic information may impact unconscious visual perception. In unconscious visual perception, studies have shown that the flow of information remains restricted mostly to early cortical processing, without reaching higher-order areas, such as the parieto-frontal network. Considering that multisensory interactions in the cortex may occur since early stages of processing, we hypothesized that unconscious visual presentation with no prior semantic information might improve auditory pitch learning. In this study, we tested subjects in a pitch learning paradigm. Individuals had to identify six different pitches separated by 50 cents from one another. Groups were divided according to the training: Auditory-only (A), Auditory + congruent unconscious visual (AVu), Auditory + incongruent unconscious visual (AVui). They went through a pre- and post-training pitch identification test with auditory-only information. The performance was calculated according to the Mean Absolute Deviation from the correct pitches. The results show that not only AVu group performed better during training, when the unconscious visual information was present, but also that the effect of training (improvement from pre- to post-test) was higher in the AVu group. Both control groups did not differ. These results provide a demonstration that the multisensory interactions occurring without awareness are powerful enough to boost perceptual learning. Besides, it raises new possibilities for protocols of auditory perceptual learning, especially those applied to relative and absolute pitch training.

Topic Area: PERCEPTION & ACTION: Multisensory

Silent lip reading generates speech signals in auditory cortex

Poster E97, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Karthikeyan Ganesan[1], Jacob Zweig[2], Marcia Grabowecky[2], Satoru Suzuki[2], Vernon Towle[3], James Tao[3], Shasha Wu[3], David Brang[1]; [1]University of Michigan, [2]Northwestern University, [3]University of Chicago

Observing a speaker's mouth movements helps listeners perceive the sounds they are producing, particularly in noisy environments. It has been proposed that crossmodal activation in auditory cortex – engendered by visual access to mouth movements – might underlie this effect. However, the content of this crossmodal activation remains unknown. Here, we utilize deep learning algorithms to demonstrate that the observation of visual speech movements generates neural activity in auditory cortex similar to that generated while listening to phonemes. We recorded electrocorticographic (ECoG) activity from macroscopic depth electrodes implanted within auditory cortices of the brains of epilepsy patients. On each trial, patients were presented with single phonemes or videos showing the lip movements articulating each phoneme. We constructed an ensemble of deep convolutional neural networks to determine whether the identities of the four phonemes (from auditory-alone trials) and visemes (from visual-alone trials) could be decoded from auditory cortical activity. As expected, the ensemble accurately decoded phonemes from activity in auditory cortex, with decoding accuracy influenced by information from the theta band (4-7 hz) and beta band (~20 hz). Critically, the ensemble also accurately decoded visemes from activity in auditory cortex, revealing that lip reading generates viseme-specific activity in auditory cortex in the absence of any speech sound. Importantly, the algorithm trained with phonemes successfully decoded visemes, indicating the involvement of similar neural populations and coding in auditory cortex regardless of the input modality. These results demonstrate that observing visual speech movements crossmodally activates auditory speech processing in a content-specific manner.

Topic Area: PERCEPTION & ACTION: Multisensory

Responsivity of a human mirror neuron system to the transitivity of an action when the end result of a movement is visible but not when it is obscured

Poster E98, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Jonathan Silas[1], James Munro[2], Margot Crossman[3], Joseph Levy[3]; [1]Middlesex University, [2]Edinburgh Napier University, [3]University of Roehampton

The human mirror neuron system (MNS) has been hypothesised to have a functional role in action understanding. Previous research has shown that, in the macaque, mirror neurons only respond to observed actions that are directed towards an object (transitive actions). In humans, a broadly distributed MNS does respond to observed actions, even when they are not directed towards an object (intransitive actions). However, some evidence has shown that the degree to which the MNS is activated in humans is modulated by transitivity. Given that the presence of an object provides more explicit information about the purpose of the action, it is suggested that a modulation of the MNS in response to transitivity is indicative of the functional role the system plays in action understanding. In the current study, 17 participants observed transitive and intransitive movements under two conditions while we recorded BOLD response using fMRI. In the first condition, the action and object were completely visible. In the second, the end of the action and what the action was directed towards (an object or nothing) was hidden from view. We show that areas within the MNS, in the left hemisphere, are responsive to transitivity only when the action and object are fully visible. We suggest that this demonstrates a limited role of an MNS in action understanding. When the goal is obvious and visible the MNS contributes to action understanding. However, when an inference is required for the goal to be achieved, the MNS does not contribute to action understanding.

Topic Area: PERCEPTION & ACTION: Other

Electroretinographic Markers of NMDA-dependent Functions in Healthy Controls and Patients with Schizophrenia

Poster E99, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Angus MacDonald III[1], Pantea Maghimi[1], Theoden Netoff[1], Robert Miller[1]; [1]University of Minnesota

The capacity for the non-invasive measurement of individual differences in NMDA receptor functioning has the potential to allow for efficient screening for NMDA-linked disorders, such as schizophrenia, as well as for understanding how variance in NMDA functioning relates to cognitive performance. Measured from the eye, electroretinography (ERG) signals such as the pattern (p) ERG and photopic negative response (PhNR), reflect the activity of NMDA-dominated retinal ganglion cells. The current study examined ERG signals in a final sample of 23 patients with schizophrenia or schizoaffective disorder (5 unmedicated) and 23 demongraphically-similar controls. Participants also completed tasks associated with visual pattern recognition (Jittered Orientation Visual Integration) and cognitive control (Dot Pattern Expectancy task), two cognitive processes thought to depend on NMDA functioning in cortex. PERG results suggest the P50 wave (an initial waveform rise following a change in brightness) is nominally more impaired in psychosis (T(44)=1.39, p=.08, ES=.41) relative to the N95 (the subsequent fall of the waveform, T(44)=-.90, p=.19, ES=-.27). These group differences are markedly magnified when comparing only the medicated patients to control and the two signals are equally discriminating (P50 T(39)=1.89, p=.034, ES=.59; N95 T(39)=-1.72, p=.046, ES=-.54). Machine learning analyses suggest informative timepoints are spread across the entire waveform, including points before the initial rise. In addition, these waveforms relate to individual differences in cortically-mediated behavioral tasks. These findings suggest medicated patients experience perceptual signal degradation even at the earliest perceptual entry points, and that PhNR and pERG may provide insights into cortical abnormalities in NMDA receptor function.

Topic Area: PERCEPTION & ACTION: Vision

A search for the representational content in the putative number form area

Poster E100, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Darren Yeo[1,2], Courtney Pollack[1], Gavin Price[1]; [1]Peabody College, Vanderbilt University, USA, [2]Nanyang Technological University, Singapore

Recent studies suggest a putative number form area (NFA) in the inferior temporal gyrus (ITG) that responds preferentially to Arabic numerals versus other symbols. Meta-analytic convergence in the right ITG has been observed for numeral-selectivity (Yeo, Wilkey, & Price, 2017, Neurosci Biobehav Rev., 78, 145-160). However, it is unclear whether the NFA is specialized for processing visual shapes, semantic associations, or both, and whether previous findings depend on actively processing the symbols. Here we use multi-voxel representational similarity (RS) analysis to investigate the functional organization of the NFA during passive viewing of digits, letters, and scrambled digits/letters in 39 adolescents. We tested RS in our data against 5 hypothetical models: (1) pixel- and (2) deformation-based physical shape similarity, (3) symbols versus novel characters, (4) digits versus non-digits, and (5) digits versus letters versus non-symbols. RS across exemplars of the 4 categories in the NFA did not match any of the hypothesized models. As within-category variability may mask potential between-category distinctions, we repeated the analysis using the averaged multi-voxel response pattern to each stimulus category. Results replicated our initial findings. In contrast, RS in the right inferior frontal gyrus matched models 1, 2, & 3. These findings suggest that the NFA, at least during passive viewing, may lack categorical functional organization. This suggests a nuanced role of the putative NFA in category specific digit processing that requires further empirical investigation.

Topic Area: PERCEPTION & ACTION: Vision

Eccentricity-dependent gradient in neural suppression in the primary visual cortex.

Poster E101, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Akari Nagashima[1], Yasuo Nakai[1,2], Akane Hayakawa[1], Takuya Osuki[1], Jeong-won Jeong[1], Ayaka Sugiura[1], Erik C Brown[3], Eishi Asano[1]; [1]Wayne State University, [2]Wakayama Medical University, [3]Oregon Health and Science University

We generated a large-scale, four-dimensional map of neuronal modulations elicited by full-field flash stimulation. We analyzed electrocorticography (ECoG) recordings from 63 patients with focal epilepsy, and delineated the spatial-temporal dynamics of visually-elicited high-gamma70-110 Hz amplitudes on a standard brain template. We then clarified the neuronal events underlying visual evoked potential (VEP) components, by correlating with high-gamma amplitude measures. The medial-occipital cortex initially revealed rapid neural activation followed by prolonged suppression, reflected by augmentation of high-gamma activity lasting up to 100 ms followed by attenuation lasting up to 1,000 ms, respectively. With a number of covariate factors incorporated into a prediction model, the eccentricity representation independently predicted the magnitude of post-activation suppression, which was more intense in regions representing more parafoveal visual fields compared to those of more peripheral fields. The initial negative component on VEP was sharply contoured and co-occurred with early high-gamma augmentation, whose offset then co-occurred with a large positive VEP peak. A delayed negative VEP peak was blunt and co-occurred with prolonged high-gamma attenuation. Eccentricity-dependent gradient in neural suppression in the medial-occipital region may explain the functional difference between peripheral and parafoveal/central vision. Early negative and positive VEP components may reflect neural activation, whereas a delayed negative VEP peak reflecting neural suppression. Our observation provides the mechanistic rationale for transient scotoma or mild flash-blindness, characterized by physiological afterimage formation preferentially in central vision following intense but non-injurious light exposure.

Topic Area: PERCEPTION & ACTION: Vision

Structural connections differ for central vs. peripheral V1

Poster E102, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Sara Sims[1], Thomas DeRamus[1], Utkarsh Pandey[1], Jennifer Robinson[2], Kristina Visscher[1]; [1]University of Alabama at Birmingham, [2]Auburn University

Vision is an important part of our everyday life, and we use our central vision differently than our peripheral vision. For example, we use central vision to read and peripheral vision to scan a scene for danger. Different functions of central and peripheral vision suggest that information from central vision may be processed differently from that in peripheral vision. A functional connectivity study from our lab suggested that connections between centrally- and peripherally-representing visual cortex are distinct, and follow well-established networks. However, few studies have examined differential structural connections between central and peripheral representations in early visual areas. In this study, we used diffusion MRI of over 800 subjects from the Human Connectome Project. We performed probabilistic tractography on seed regions of interest in V1, corresponding to different visual eccentricities. We found that broad scale patterns of structural connectivity resembled those we had seen in functional connectivity. Regions showing stronger structural connectivity to central V1 than peripheral V1, significant after multiple comparison corrections included thalamus, superior and middle temporal gyrus, insula, and inferior and superior frontal gyrus. Regions showing the opposite effect included inferior temporal regions, lateral parietal lobe, fusiform gyrus, and middle frontal gyrus. These results suggest that eccentricity based regions are differentially structurally connected to the rest of the brain. Understanding the differential structural connections of V1 contributes to our understanding of the way the human brain processes visual information and forms a baseline for understanding any modifications in processing that might occur with training or experience.

Topic Area: PERCEPTION & ACTION: Vision

Unconscious number discrimination in the human visual system

Poster E103, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Ché Lucero[1,2], Geoffrey Brookshire[2], Colin Quirk[2], Susan Goldin-Meadow[2], Edward Vogel[2], Daniel Casasanto[1,2]; [1]Cornell Univerity, [2]The University of Chicago

Humans' ability to discriminate approximate numerosities is believed to rely on an evolutionarily ancient Approximate Number System (ANS). Measures of the ANS typically rely on explicit judgments of stimulus numerosity. Here we tested for unconscious sensitivity to approximate number by adapting the steady state visual evoked potential (SSVEP) technique. We recorded EEG from human participants (N=21) while they viewed dotclouds flashing at 30 Hz. Each 9.6-second trial consisted of 288 dotclouds.

On each trial, half of the dotclouds contained 10 dots (standards), and these standards alternated with other dotclouds whose numbers varied from 10 to 20 dots (oddballs). Within each trial, all oddballs had the same number of dots. Across trials, the standard:oddball ratio ranged from 1.0 (10:10) to 2.0 (10:20), in steps of 0.1. After each trial, subjects judged whether all of the dotclouds had the same number of dots, or if some of them differed. We analyzed EEG spectral power for SSVEPs at 15 Hz – the rate at which numerosity alternated in the stimuli. Results showed that power at 15 Hz was stronger than power at adjacent frequencies, and that this increase in power was positively correlated with the numerical ratio of the stimuli. This effect remained significant when controlling for non-numerical features of the stimuli. Although the neural signal (SSVEPs) showed that participants were discriminating dotcloud ratios implicitly, participants were at chance judging the dotcloud ratios explicitly. Results indicate that people can process visually presented numerosities rapidly and unconsciously.

Topic Area: PERCEPTION & ACTION: Vision

Naturalistic decision-making dynamics in spiking neuron circuits

Poster E104, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

John C. Ksander[1], Donald B. Katz[1], Paul Miller[1]; [1]Brandeis University

Animal foraging provides an ethological paradigm for studying fundamental human decision-making. Foraging behavior can be distilled as a series of basic decisions between two choices: consume the immediately available food (i.e. “stay”), or seek an alternate food source (i.e. “leave”). The current study provides a novel account of how the brain may implement such decision-making with bistable spiking-network models. Animal behavior in a taste preference task was simulated with pools of exponential leaky integrate-and-fire neurons. The within-pool and between-pool neuron connections produced network spiking activity that abruptly transitioned between two discrete states. The network’s active state indicated the animal’s behavior, with one state representing “stay” and the other “leave”. Simulations with this model reproduced two key aspects of foraging dynamics. Behaviorally, increasing the relative palatability of one stimulus caused a preference for the high-palatability stimulus. Neurally, the network dynamics demonstrated sudden changes in cortical spiking that have been shown to predict consumption behaviors. Further simulations evaluated whether animals only “stay” given a sufficiently hedonic stimulus, or if “leaving” requires aversive stimuli. Increasing within-pool inhibition caused rapid state transitions without palatable stimuli, reflecting a behavioral disposition for seeking other stimuli. Alternatively, increasing cross-pool inhibition produced a network which rarely transitioned without unpalatable stimuli, reflecting a behavioral aversion to leaving stimuli. These implementations yielded distinct network transition dynamics, providing empirically testable predictions for these accounts. Together, these results show realistic behavior in a taste preference task, produced by spiking-network models that provide plausible ways the brain may implement such naturalistic decision-making.

Topic Area: THINKING: Decision making

Attentional Differences and Estimation Frame Incongruence Predict Bias in Economic Judgments

Poster E105, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Kylie Fernandez[1], Joseph Schmidt[1], Camelia Kuhnen[2], Nichole Lighthall[1]; [1]University of Central Florida, [2]UNC Kenan-Flagler Business School

Previous research has found that when probabilistic outcome likelihoods are estimated from experience, estimations in the gain domain are relatively optimistic while predictions in the loss domain are relatively pessimistic (Kuhnen, 2015). The current study examines two potential mechanisms of this bias: a) high-magnitude gains and losses receive greater attention and are subsequently overweighted in outcome estimations, b) situations with greater incongruence between outcome-estimation framing and outcome valence enhance domain-specific errors through increased cognitive demand (e.g., difficulty of assigning positive evaluation to loss-minimizing vs. gain-maximizing options). Contributions of these effects were examined using an economic task that required estimating outcome likelihoods of probabilistic options relative to sure-thing options through experience. Outcome domain and stock-payout distributions varied by block. Study 1 measured probability evaluations under a positive estimation frame

("How good is the stock?") and examined attentional predictors of estimation bias via reaction time. Study 2 examined these variables under a negative estimation frame ("How bad is the stock?"). Study 3 replicated the design of Study 1, but examined the role of visual attention at choice and stock payout using eye tracking. Linear mixed models were used to examine the relationship between trial-level attention to gain and loss stimuli and subsequent estimation errors. Our results suggest that attention to high-magnitude outcomes and situational incongruence between estimation framing and outcome valence interact to drive judgment bias. Together our findings indicate that controlling attention to high-magnitude outcomes and minimizing conflict during cognitive estimations can help to reduce bias in judgments of future outcomes.

Topic Area: THINKING: Decision making

An Altered Cortico-Basal Ganglia Network Activation during Reward Anticipation in Multiple Sclerosis

Poster E106, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Pei-Pei Liu[1], Angela Spirou[1], Eliane Neuteboom[1], Ekaterina Dobryakova[1]; [1]Kessler Foundation, NJ

Individuals hold beliefs about the relationship between an action and its potential outcomes and such anticipation of outcomes drives one's behavior. Deficits in reward anticipation diminish motivations for behavior and could impair everyday functioning. The fronto-striatal network has been reported to be involved in reward processing and reward anticipation. Structural abnormalities have been observed in individuals with Multiple Sclerosis (MS), a central nervous system disease that leads to nerve damages. This study examined the neural mechanisms of reward anticipation in individuals with MS, testing whether individuals with MS show alterations in fronto-striatal network activity during reward anticipation. To assess reward anticipation, participants performed a number guessing game in which they could win and lose monetary rewards during functional magnetic resonance imaging (fMRI). Contrary to our expectations, the results showed no differences in the fronto-striatal network activities during reward anticipation between MS and healthy individuals. However, MS individuals exhibited greater activation in the right hippocampus than healthy individuals. Structural analyses revealed less volume in both caudate nucleus and hippocampus in MS than in healthy individuals. Overall, we observed structural alteration but not functional alteration in the fronto-striatal network in MS. Our results also suggest that hippocampus might play a more important role in reward anticipation in MS than it does in healthy individuals.

Topic Area: THINKING: Decision making

A behavioral and neural study of motivations for deception

Poster E107, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Anastasia Shuster[1], Dino Levy[1]; [1]Tel Aviv University

Deception plays a big part in social interactions, from mundane white lies up to multimillion dollar frauds. Previous studies showed that people incorporate into their decision the consequences of their lie on others, as well as their own gain. In this study, our objective was to identify the internal motivations that contribute to the decision to deceive, and outline their neural correlates. We used The Message Game task, in which a subject sends out either a profitable yet deceptive message or a truthful but not-as-profitable message to another participant. Payoffs varied across trials, in order to assess individual sensitivity to different motivations for deception. We defined three such potential motivations: Self Interest, Regard for Other, and Inequality. Thirty-three subjects completed the task, while inside an fMRI scanner. Behaviorally, we found that on average participants sent a deceitful message on half the trials. However, this behavior varied dramatically between subjects. Further subject-level analyses revealed high variability in motivations as well, both in which motivations drive the behavior and to what extent. On the neural level, we observed several regions implicated in the decision to deceive, including the amygdala and TPJ. Interestingly, we were able to identify motivation-specific regions of activation, modulated by how these motivations affected individual subjects' behavior. Utilitarian considerations correlated with activity in the lateral PFC and insula, while other-oriented motivations involved activity in regions such as the STS and ACC. Finally, we show that the connectivity between these regions is associated with subjects' behavior as well.

Topic Area: THINKING: Decision making

The cingulum as an important measure of individual difference in brain development

Poster E108, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Joe Bathelt[1], Mengya Zhang[1], the CALM team[1], Duncan Astle[1]; [1]MRC Cognition & Brain Sciences Unit, University of Cambridge

We investigated the relationship between individual differences in white matter microstructure and cognitive abilities in children. Individual differences in white matter were investigated in a representative database of typical development (NKI Rockland Sample, n=74, Age: 13.93 + 3.164SD) by extracting FA values for 10 major white matter tracts (JHU white matter atlas) and grouping individuals by similarity using a data-driven clustering approach. The algorithm indicated the presence of two groups that were distinguished primarily by FA of the left and right anterior cingulum (p<0.001). The range of FA values within the cingulum were used to group children in an independent sample with large variation in cognitive abilities (Centre for Attention, Learning, and Memory; n=165, Age: 9.81 -1.191SD). Comparison of cognitive scores between these groups indicated significant differences in fluid IQ, vocabulary, verbal and visuospatial short-term and working memory, and long-term memory (p<0.05). To investigate the association between cognitive scores and specific connections, the cingulum tract was reconstructed and connections were mapped using a connectomics approach. The results indicated significant differences between the clustering-defined groups in connections of the cuneus, parahippocampal, enthorhinal, and superior frontal cortex (p<0.05). A specific association between variation in fluid IQ and strength of the connection between the left precuneus and left superior frontal cortex was found (beta=0.286, p=0.005). These results indicate that cingulum-mediated connections are closely associated with inter-individual variation in cognitive ability in development.

Topic Area: THINKING: Development & aging

How Does the Brain Compose Mental Images?

Poster E109, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Dillon Plunkett[1], Joshua D. Greene[1]; [1]Harvard University

Imagine a penguin riding on a giraffe. This example highlights a critical feature of human cognition: It is compositional. We routinely combine familiar conceptual components (e.g., giraffes, penguins, riding) in order to construct novel thoughts, and do so in a structured way—distinguishing, for example, between the notions “penguin riding giraffe” and “giraffe riding penguin.” Not only can we understand the idea of a penguin riding a giraffe, we can picture this spectacle despite never having seen it before, composing a novel mental image from these familiar elements. In this study, we use functional magnetic resonance imaging to investigate how spatially structured, composite mental images are represented in the brain. Following a written cue on each trial, 24 participants imagined two shapes in a vertical configuration (e.g., “circle above square”), then held their mental image in mind for a brief delay before matching that image to one of two objects (e.g., “snow shovel” versus “snow globe”). Using multivoxel pattern analysis performed on imaging data collected during the delay, we identify a bilateral region in posterior parietal cortex which encodes information about the identity of the top shape in the configuration, as well as an adjacent bilateral region which encodes information about the identity of the bottom shape. These findings suggest that spatially structured mental imagery is supported by a spatiotopic map in parietal cortex and, to our knowledge, they are the first direct evidence for the spatiotopic representation of components of mental images in parietal cortex.

Topic Area: THINKING: Other

Quality of perceptual categories predict speeded, but not non-speeded, cognitive ability

Poster E110, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Emily Fritzson[1], F. Sayako Earle[1]; [1]University of Delaware

The representation of perceptual categories is fundamental to the capacity for human thought. In the language domain, the quality of speech category representations predicts higher-order skills, such as spoken language processing (Marslen-Wilson & Tyler, 1980) and efficient reading (Mody, Studdert-Kennedy & Brady, 1997). Moreover, poor speech representations are linked to disorders of spoken (Joanisse & Seidenberg, 2003) and written language (Serniclaes et al, 2004). However, relatively little is known about the relationship between individual differences in the quality of perceptual categories and general (nonverbal) cognitive ability. In order to address this question, we obtained measures of categorical perception on a synthetic vowel continuum /a/-/e/, and performances on timed (Block Design) and untimed (Matrix reasoning) measures of nonverbal cognition (WASI-II, Weschler, 2011). We conducted a series of linear regressions on a preliminary dataset of 27 participants aged 18-35 (average 21.59, SD 4.66; 4 male), in which Block Design and Matrix Reasoning were the dependent variables, with goodness-of-fit indexes for categorization and discrimination as the two predictors. We found this model to significantly account for differences in Block Design ($F_{2,24}=10.42$, $p<.001$, $r^2=.464$), in which categorization and discrimination were both independently predictive of Block Design scores ($t_{24}=-2.83$, $p=.011$ and $t_{24}=3.58$, $p<.001$, respectively). In Matrix reasoning, perceptual abilities did not significantly account for the variance in task performance ($F_{2,24}=1.35$, $p=.278$, $r^2=.10$). Based on these findings, we argue that individual differences in the representational quality of perceptual categories are intimately intertwined with speeded problem-solving abilities.

Topic Area: THINKING: Problem solving

ANS acuity, math achievement, and dyscalculia: Evidence for a domain-specific executive function relation

Poster E111, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Eric Wilkey[1], Courtney Pollack[1], Gavin R. Price[1]; [1]Department of Psychology & Human Development, Peabody College Vanderbilt University

Individual differences in math achievement and developmental dyscalculia (DD) are associated with acuity of the Approximate Number System (ANS), a neurocognitive system that represents numerical magnitudes without the use of language or number symbols. The most common task to index the ANS is nonsymbolic number comparison, whereby a participant judges which of two groups of objects is more numerous. Recent studies suggest that performance on the task, and its correlation with math achievement, is influenced by congruency between discrete quantity of object sets and non-numeric visual parameters (e.g., surface area, object size). This suggests that the relation between math performance and task performance may depend on executive functions used to resolve this conflict, such as visuospatial working memory or inhibitory control. We investigate this issue in a large sample of 6th grade children (n = 448), including a subset of children with DD. We find that DD children's accuracy on the nonsymbolic comparison task differs from low and typical achievement groups on incongruent trials but not congruent trials, even after controlling for multiple measures of domain-general executive functioning. Additionally, performance on incongruent trials, but not congruent trials, predicts math achievement across the full sample, controlling for domain-general executive functioning. These results suggest that number-specific executive function impairment represents a characteristic of DD beyond domain-general executive functions and also relates to a full range of math achievement.

Topic Area: THINKING: Reasoning

Visual Prediction of Novel Objects as a Function of Preparation Time, Temporal Expectancy, and Hemispheric Lateralization

Poster E112, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Cybelle M. Smith[1], Kara D. Federmeier[1]; [1]University of Illinois, Urbana-Champaign

When and how does the brain make use of contextual information to facilitate visual object perception? We recorded EEG while participants (N=72) learned paired associations between scenes and novel objects from novel object categories. At test, scenes

were presented and, after a delay, a matching or mismatching object appeared. We previously showed that varying the amount of scene preview time at test affects the time course of predictive facilitation for the object. Long (2500ms), vs. short (200ms), preparation times induced a latency advance in the LPC and the appearance of a fronto-central N300 match effect. We (N=36) replicated these findings using a parametric, within-subjects design, by randomly varying the scene preview duration (0-2500ms). LPC match effect amplitude increased and latency decreased with increased preparation time, consistent with earlier results. However, graded effects of match (assessed using mismatching objects that were similar to a match, both visually and in terms of their distribution across contexts) were attenuated or absent, suggesting a role for temporal expectation in graded contextual prediction. We next used lateralized presentation with a long scene preview (2500ms; N=36) to explore whether the cerebral hemispheres differentially contribute to visual object prediction. Right hemifield presentation, but not left, induced sensitivity to close vs. 'impossible' mismatches at fronto-central sites (onset ~350ms). Findings suggest knowing when and where a visual object will appear helps us to anticipate it, and the left hemisphere is better able to use category-level information to form graded visual predictions.

Topic Area: LONG-TERM MEMORY: Priming

The Enactment Effect: A Meta-Analysis

Poster E113, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Brady Roberts[1], Myra Fernandes[1], Colin MacLeod[1]; [1]University of Waterloo

The enactment effect refers to the finding that physically performing an action that represents a word results in better memory than simply reading the word. A three-pronged meta-analytic technique was used to investigate the mnemonic benefit of enactment using data from 70 behavioural, 8 neuroimaging, and 18 patient studies. Sample-size weighted statistical tests were performed to highlight patterns found across 225 effect sizes in the 70 behavioural studies. The memory boost from enactment as an encoding strategy was compared to that produced from watching the experimenter perform the action, engaging in self-generated imagery, and reading words. It was found that performing the task yourself led to comparable memory as watching the experimenter perform the task, and both led to enhanced memory relative to only reading words. The magnitude of benefit from enactment was maintained, regardless of the delay between study and test, regardless of whether the memory test followed intentional versus incidental encoding, and regardless of whether real objects were used for actions. Finally, the boost to memory was also significant whether investigated using between- or within-subject designs. Neuroimaging results revealed significant activation in both pre- and primary motor cortices, as well as the supramarginal gyrus, when retrieving information that was enacted during encoding. The enactment effect was also found across a variety of patient groups, though smaller in magnitude, and remained stable even in those with clinically significant motor impairments. Overall, the enactment effect has proven to be a robust, consistently replicated finding in both healthy and clinical populations.

Topic Area: LONG-TERM MEMORY: Semantic

Neural correlates of self-generation and verbal memory performance during paired-associate learning

Poster E114, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Sangeeta Nair[1], Jane B Allendorfer[1], Rodolphe Nenert[1], Amber N Martin[1], Daniel Mirman[1], Jennifer Vannest[2], Jerzy P Szaflarski[1]; [1]University of Alabama at Birmingham, [2]Cincinnati Childrens Hospital

Background: Self-generating verbally processed language-related information results in better retention over reading. We examined the neural correlates of memory performance improvement during self-generation of paired-associates. Design/Methods: FMRI data from 173 healthy English-speaking participants (97F; 57LH; ages 19-76) were analyzed using AFNI. In verbal paired-associate learning task, 60 related word pairs were presented with participants saying the second word aloud. In the "read" condition, both words were presented; in the "generate" condition the first word and first letter of the second word followed by asterisks were presented, and participants generated the second word. Post-fMRI forced-choice recognition test was performed. Relationships between handedness and post-scan memory with encoding-related brain activity were examined using regression

analyses. Results: Increased activity for generate>read was observed in bilateral posterior cingulate, right superior/middle temporal, left angular gyri and right insula; for read>generate in bilateral middle/inferior frontal, superior frontal, and left fusiform/middle temporal gyri, bilateral superior/inferior parietal lobule, right insula, cerebellum, and caudate. Decreased cortical activity was observed with increasing right-handedness (EHI) for generate>read in the left cerebellum (p=0.05; corrected), and increased activation was observed for typical (right-handed) > atypical handedness in the right cerebellum and bilateral calcarine/lingual gyrus (p=0.05, corrected). Recognition of read words was positively associated with involvement of right middle/superior frontal and right cingulate gyri (p=0.01, corrected). Conclusions: Learning via passive and active encoding results in increased right frontal activation. More widespread activation may be associated with higher memory performance with self-generation. Handedness may affect the lateralization of these processes.

Topic Area: LONG-TERM MEMORY: Semantic

Age-Related Deficits in Feedback-Based Cognitive Sequence Learning Among Healthy Older Adults

Poster E115, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Layla Dang[1], Mark A. Gluck[2], Jessica R. Petok[1]; [1]Saint Olaf College, Northfield, MN 55057, [2]Rutgers University, Newark, NJ 07102

Learning about sequences involves sensitivity to the typical serial ordering of events and is an important skill throughout adulthood. There is a lack of consensus on whether aging influences sequence learning, and if so, what factors might predict age-related impairments. For example, prior research suggests that working memory (WM) may underlie or mediate age-related sequence learning deficits. Additionally, the frontal lobe hypothesis of aging proposes that the prefrontal cortex is more vulnerable to the effects of aging than non-frontal areas and subsequently can hinder performance on tasks involving frontal functioning. The present study asked whether age predicts feedback-based cognitive sequence learning across the older adult lifespan (ages 55-89), and whether frontal functioning accounts for any age-related declines. Healthy older adults (n=147) completed a small battery of frontal functioning/WM-related neuropsychological measures, as well as a computerized feedback-based cognitive sequence learning task that required the step-by-step acquisition of associations through trial-and-error feedback. Of those who met a performance-based criterion, increasing age was positively correlated with higher number of sequencing errors. This relationship remained significant after controlling for frontal functioning. Furthermore, even though poorer frontal functioning was correlated with a higher number of sequencing errors, it was no longer a significant predictor of sequencing errors when accounting for age, suggesting that frontal functioning does not mediate the relationship between age and sequence learning. These findings indicate that older age is associated with cognitive sequence learning declines, irrespective of frontal functioning; however, structural neuroimaging studies are needed to substantiate this claim.

Topic Area: LONG-TERM MEMORY: Skill learning

Reliability of the Mismatch Negativity in a Kindergarten Population Oversampled for Dyslexia Risk

Poster E116, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Sean McWeeny[1], Brittany Manning[1], Emily M. Harriott[1], Sarah D. Beach[2,3], Ola Ozernov-Palchik[4], John D. E. Gabrieli[2], Nadine Gaab[3], Elizabeth S. Norton[1]; [1]Northwestern University, [2]Massachusetts Institute of Technology, [3]Harvard University, [4]Tufts University

Developmental dyslexia cannot currently be diagnosed until a child has failed to learn to read as expected. Researchers have sought to find neural measures that may help predict a child's later reading ability. One of these measures is the mismatch negativity (MMN), an event-related potential (ERP) component elicited by an oddball within a stream of standard stimuli. The MMN is thought to reflect automatic auditory change detection, and has been shown to predict later reading. For the MMN to be clinically useful, its psychometric properties must be further evaluated. In a sample of 130 kindergarten children oversampled for risk for dyslexia, we calculated reliability measures for early and late MMN time windows in terms of different electrodes of interest, stimuli, and response mean amplitude. Subjects were presented with 2 blocks of 1200 trials; one using /ba/ as the standard and one using /da/ as the standard. Cronbach's alpha across 9 different fronto-central electrode sites was excellent ($\alpha > .90$) for both early and late MMN mean amplitude. Group level comparisons between /da/ and /ba/ were non-significant, indicating that on average, there is no difference between the stimuli; $t(129) = .26$, $p = .79$. However, reliability of an individual's early and late MMN amplitude is not as reliable ($r=.16$) as previous research has shown. This may affect the strength of the conclusions we can draw from models incorporating these predictors. We discuss future directions for using this component as a predictor of future reading abilities.

Topic Area: METHODS: Electrophysiology

A Face-name Association Task fMRI for Mapping Memory Networks in Epilepsy Patients

Poster E117, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Yanmei Tie[1], Rui Hui[1,2], Laura Rigolo[1], Prashin Unadkat[1], Kim Willment[1], Alexandra Golby[1]; [1]Brigham and Women's Hospital, Harvard Medical School, Boston, US, [2]Navy General Hospital, Beijing, China

Mapping of memory function in epilepsy patients who are candidates for surgery is important for surgical planning. The alterations and hemispheric lateralization of memory networks in epilepsy patients has been studied in neuropsychological and neuroimaging literature, however, it remains to be fully verified and elucidated. Twelve epilepsy patients were included in this study and underwent functional magnetic resonance image (fMRI) using a face-name association paradigm. Patients were scanned during encoding of 230 face-name pairs. During a post-scan recall test where 2 names (one correct and one incorrect) were shown for each face, patients were asked to point out the name that was paired with the face and how confident they were in their decision. A group analysis showed bilateral activation in the superior and medial frontal gyrus, caudate head and body, and cingulate gyrus. Compared with healthy subjects, these patients demonstrated significantly less activation in the bilateral hippocampus and left inferior frontal gyrus. In addition, alterations in the dominant hemisphere were greater than the non-dominant hemisphere. In eight patients who also underwent intracarotid sodium amobarbital procedure (Wada test) for lateralization of memory function, the fMRI results were consistent with Wada test in 5 patients. For the remaining 3 patients, fMRI indicated left domination whereas Wada test indicated bilateral domination. Results suggest that the face-name association task fMRI can be used to map memory function in epilepsy patients, including memory hemispheric lateralization.

Topic Area: METHODS: Neuroimaging

Determining the functional anatomy of the human brain by using a combined VLSM and Bayesian network analysis approach

Poster E118, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Audrey Arnoux[1,2], Monica N. Toba[1], Joel Daouk[3], Jean-Marc Constans[3], Laurent Puy[1,2], Momar Diouf[4], Mélanie Barbay[1,2], Olivier Godefroy[1,2]; [1]Laboratory of Functional Neurosciences, EA 4559, University of Picardy Jules Verne, Amiens, France, [2]Department of Neurology, Amiens University Hospital, Amiens, France, [3]Department of Imaging, Amiens University Hospital, Amiens, France, [4]Department of Biostatistics, Amiens University Hospital, Amiens, France

Objectives: The ability of voxel-based lesion-symptom mapping (VLSM) to define the functional anatomy of the human brain has not been fully assessed. With a view to assessing VLSM's validity, the present study analyzed the technique's ability to confirm the known clinical-anatomic correlates of hemiparesis in stroke patients. Method: Lesions (in at least 5 patients) associated with transformed limb motor score (after adjustment on lesion volume) at 6 months were examined in 272 patients using VLSM. The value of additional multivariable linear, logistic and Bayesian analyses was examined. Results: We checked that motor hemiparesis was fully accounted for by corticospinal tract (CST) lesions. Conventional VLSM analysis flagged up 2 regions corresponding to the CST, but also 8 regions located outside the CST. All 10 brain regions achieving statistical significance in the VLSM analysis were submitted to additional analyses. The backward linear regression analysis selected 5 regions, one only corresponding to the

CST. The logistic regression analysis selected correctly the CST. The Bayesian network analysis selected regions including the CST and identified the source of multicollinearity. These lesions evaluated by structural equation modeling resulted in an excellent fit. Analyses of confounding factors showed that conventional VLSM analyses were strongly influenced by lesion frequency and multicollinearity. Conclusions: Conventional VLSM analyses are sensitive but weakened by a type I error due to the combined effects of multicollinearity and lesion frequency. We demonstrate that the addition of a Bayesian network analysis, and to a lesser extent of logistic regression, controlled for this type I error.

Topic Area: METHODS: Neuroimaging

Fiber Tract Asymmetry: A novel approach to assessing white matter integrity with Diffusion Tensor Imaging (DTI)

Poster E119, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Ansgar Furst[1,2], Andrei Vakhtin[1,2], Miguel T. Robinson[1], Dana Waltzman[3], Max Wintermark[2,1], Wesson J. Ashford[1,2]; [1]Veterans Affairs Palo Alto Health Care System, [2]Stanford University, [3]Centers for Disease Control and Prevention

Diffusion Tensor Imaging (DTI) is widely used in neuroimaging as a proxy for white matter integrity. Fractional Anisotropy (FA) is the most commonly reported DTI measure often averaged across different regions-of-interest (ROI) or across fiber tract volumes. We introduce here a novel approach that allows for the automated segmentation of 18 major fiber tracts, bilaterally. Based on pathology observed in trauma, stroke and neurodegenerative diseases we hypothesized that cerebral structural/functional decline typically does not occur in a symmetrical fashion (i.e. lesions, infarcts and hypometabolism are not mirrored contralaterally) and therefore propose a measure of white matter health based on Fiber Tract Asymmetry (FTA). We validated FTA on a convenience sample of 170 patients (Age: M: 46.0, SD: 11.0; Gender: 17 Females) seen by the War Related Illness and Injury Study Center (WRIISC), Palo Alto. Ninety-nine (57.2 %) of these patients had sustained mild and 17 (9.8 %) moderate Traumatic Brain Injury (TBI). We entered FTA values for all patients into a Generalized Linear Model with Age and TBI severity as independent variables. Generalized Linear Model Fit Estimates (Maximum Likelihood) indicated that both Age and TBI severity significantly accounted for median FTA variance in several tracts including the Cingulum, Superior & Inferior Longitudinal Fasciculus and the Thalamic Radiation. These findings suggest that FTA captures white matter health through individual comparisons of homologous brain structures.

Topic Area: METHODS: Neuroimaging

Fractional Anisotropy Asymmetries of White Matter Tracts in Traumatic Brain Injury

Poster E120, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Andrei A. Vakhtin[1,2], Wesson J. Ashford[1,2], Miguel T. Robinson[1], Dana Waltzman[3], Max Wintermaker[2,1], Ansgar J. Furst[1,2]; [1]Veterans Affairs Palo Alto Health Care, [2]Stanford University, [3]Centers for Disease Control and Prevention

Group comparisons of white matter (WM) integrity measures between traumatic brain injury (TBI) and healthy individuals have limited implications for assessing individual patients' scans. We examined the utility of fractional anisotropy (FA) asymmetry levels in contralateral WM tracts for detecting neurological disorders on an individual level, focusing on TBI. Diffusion tensor imaging data from 50 neurologically healthy participants (age = 46.8 +/- 10.6 yrs.), 4 mild TBI (age = 46.8 +/- 1.0 yrs.), and 4 moderate TBI (age = 47.5 +/- 1.7 yrs.) patients were subjected to automated fiber quantification, extracting 18 tracts and 100 FA values along them. A multiple sclerosis (MS; age = 63) patient was included for methodological verification due to known WM abnormalities. Patients' asymmetry indices along contralateral WM tract pairs were z-scored using the healthy group's variance, and assessed via peak magnitudes and tract fractions exceeding 95th percentiles of the healthy group's distribution. The MS patient displayed aberrant asymmetry levels ($z > 1.65$) in segments of the thalamic radiation (17%), corticospinal tract (38%), and cingulum (19%). All TBI patients displayed varying patterns of significant FA asymmetry levels among the 9 tract pairs relative to the control group, possibly reflecting different injury mechanisms. Average peak asymmetry across tracts was consistently elevated across TBI severity (mild $z = 2.14$; moderate $z = 2.14$), and highest in the MS patient ($z = 2.96$). Tract-specific FA asymmetry levels have the potential to localize WM abnormalities following trauma, allowing for patient-specific inferences and targeted treatments.

Topic Area: METHODS: Neuroimaging

Data-driven subgrouping of task-based and resting state fMRI timeseries

Poster E121, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Jonathan T. Parsons[1], Kathleen M. Gates[1], Joseph B. Hopfinger[1]; [1]University of North Carolina at Chapel Hill

Analysis of network activity has become an increasingly important method for interpreting fMRI data. Group Iterative Multiple Model Estimation (GIMME) is a method for detecting both the presence and direction of functional connections between brain regions (Gates et al., 2012). Previously, GIMME has been used to define subgroups of individuals, based on patterns of functional connectivity, that map onto groupings based on behavioral phenotype. Here, we investigate the robustness of this algorithm to recover differences in patterns of functional connectivity in a well-controlled experimental paradigm. Healthy young adults performed a series of separate tasks intended to stimulate processing in visual, motor, and auditory regions, in addition to a separate resting state scan. Time-series data from regions of interest in primary sensory and motor areas, as well as the default mode network and frontal-parietal control networks, were extracted. GIMME analyses revealed a robust ability to recover subgroups that mapped on to the tasks being performed. We discuss why these subgroupings corresponded more closely to task in some cases than others, including a comparison of task-based paradigms that followed the typical block design versus a "continuous task" paradigm that mimics typical resting state designs.

Topic Area: METHODS: Neuroimaging

Mechanisms of Timing: An integrative theoretical approach

Poster E122, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Lara Pantlin[1], Mark Prince[1], Deana Davalos[1]; [1]Colorado State University

Accurate timing allows individuals to perform functions central to societal demands, such as scheduling, responding to warning signals, and planning. Since timing impacts various functions, it is considered a cognitive primitive; however, research often examines each modality individually, providing a disjointed, myopic view of the mechanisms of timing. This study extends prior work by integrating and explaining the relationship between two commonly examined timing modalities, neurophysiological and behavioral, and relating these lower-level processes of timing to upper-level, social-cognitive timing abilities (SCTA). The hypothesis is that those with better neurophysiological timing (NPT) are associated with better SCTA and this relationship is mediated by accurate behavioral timing. Participants (N=36) were screened for psychopathologies associated with timing deficits and underwent EEG recordings of neurophysiology using mismatch negativity, two behavioral timing tasks, and three SCTA tasks. The direction of the relationship between NPT, behavioral accuracy and the latent variable SCTA was tested with two mediation models. Model 1 tested behavioral accuracy as a mediator of the c-path, NPT underlying SCTA. Model 2 tested the reverse c-path and had better model fit. Model 2 demonstrated a significant relationship of SCTA predicting NPT. Results suggested that those with high behavioral accuracy also demonstrate increases in SCTA and NPT. SCTA plays a key role in determining NPT abilities; therefore, tactics to increase time accuracy should target this realm. The hierarchical relationship between each level of timing should be explored to determine if timing is a singular, yet multifaceted domain, or if timing is composed of separate entities.

Topic Area: METHODS: Other

Estimating the Memory and Cognitive Capabilities of Time-Delayed Neural Structures

Poster E123, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Yosef Tirat-Gefen[1,2]; [1]George Mason University, [2]MaxWave Research LLC

This study discusses a mathematical model taking into account time delay effects in large neuronal nets. By using an approximate model of the highly nonlinear equation describing both artificial and biological neuronal nets in the presence of large propagation delays, we investigate the effect of delays in increasing the computational capacity and complexity of these nets, and its effect of on the net energy efficiency. We found that the presence of large time delays in biological neuronal nets may actually improve the number of available states to represent knowledge and improve their parallelism. Another effect is the impossibility to have a precise determination of both state values and their derivatives in time, what may be actually positive as it may enhance the computational capability of the nets at the price of decreasing state observability. We complete with an analysis of how time delays effects may have influenced the evolution of biological neuronal nets.

Topic Area: OTHER

Neurocognitive markers of suicidal ideation

Poster E124, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Alex Mitko[1,4], Regina McGlinchey[1,2,4], Melissa Amick[1,3,4], Michael Esterman[1,3,4]; [1]VA Boston Healthcare System, [2]Harvard Medical School, [3]Boston University School of Medicine, [4]Translational Research Center for TBI and Stress Disorders (TRACTS)

Suicides in the U.S. have increased steadily over the past 15 years and in 2015 there were more than twice the number of suicides than homicides. The high suicide rate has led to increased research to identify risk factors, such as suicidal ideation (SI), in order to introduce clinical interventions before an attempt. However, this research has mostly utilized self-report measures that are often subject to under-reporting. The purpose of the current study was to develop objective cognitive and neural markers of suicidal ideation. Identification of these neurocognitive markers could be used in complement with subjective measures to improve diagnostic accuracy of suicide risk, as well as reveal neurocognitive mechanisms of SI. Specifically, we examined functional connectivity and performance during concurrent fMRI and gradCPT, a well-validated measure of sustained attention and inhibitory control, in a sample of post-deployed, trauma-exposed Veterans, at high risk for suicidality. We compared Veterans with and without SI, and considered the effects of depression and PTSD upon these markers. Behaviorally, the SI group exhibited greater fluctuations in attention and a higher rate of inhibitory control errors. In addition, machine-learning models were able to classify SI from controls above chance, based on patterns of functional connectivity across several large-scale brain networks. These diagnostic connections were predominantly located in cognitive and emotional control networks, including executive, dorsal attention, and salience networks. This research has important implications for how cognitive neuroscience techniques can be used to identify neural fingerprints of suicide risk, which can serve as biomarkers for interventions.

Topic Area: OTHER

Funding opportunities at the National Science Foundation

Poster E125, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Uri Hasson[1]; [1]National Science Foundation

The Cognitive Neuroscience Program at the National Science Foundation, together with other NSF programs, has an important role in supporting cognitive neuroscience research in the United States, including international collaboration efforts. Different NSF programs support graduate students (GRFP), post-doctoral research in Social, Behavioral and Economic sciences (SPRF) and undergraduate studies (REU). Yet other programs support cognitive neuroscience research within interdisciplinary contexts (e.g., NCS, CRCNS, NEURONEX). These funding structures will be described and program directors will be available to answer questions and coordinate personal meetings.

Topic Area: OTHER

Predictability and Repetition in Sound: Characterising the Sustained EEG Response to Regularity

Poster E126, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Rosy Southwell[1], Candida Tufo[1], Maria Chait[1]; [1]University College London

We use sequences of tone-pips, which rapidly change in frequency in either a regular (REG) or random (RAND) pattern. We have previously shown that the brain closely tracks the level of regularity in these stimuli; manifest as a substantial, sustained increase in passive electroencephalography (EEG) responses to REG as compared to matched RAND. We also vary the number of unique frequencies (alphabet size) within each sequence, previously finding the smaller the alphabet, the larger the brain response. Notably, this pattern of results, where predictable sounds are associated with an increase in responses, is opposite to that predicted from neural adaptation or repetition suppression. A large body of work in audition shows suppression of neural responses to successive tone pips presented at the same frequency. Here, we use REG and RAND with a wider range of alphabet sizes from 1 to 20, to reconcile these opposing effects of predictability within a single paradigm. As alphabet size decreases, rendering the sequence more predictable, will the sustained response continue to increase, or will adaptation effects start to dominate? We find that for alphabet size = 1, the sustained response is indeed lower than for larger alphabets, with evidence for rapid adaptation as early as the fourth repetition. However, the EEG response does eventually build to a sustained level which is significantly higher than for alphabet size = 20. Our results point to a system for automatic monitoring of predictability in the auditory environment which is distinct from, but concurrent with, repetition suppression.

Topic Area: PERCEPTION & ACTION: Audition

Statistical Learning and Gestalt-like Principles Predict Human Melodic Expectations

Poster E127, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Aniruddh Patel[1], Emily Morgan[1], Allison Fogel[1]; [1]Tufts University

Across cognitive domains, humans form expectations about upcoming events. What knowledge do listeners draw upon to form these expectations? Music provides a test case for the trade-off between rule-based versus statistical-learning-based accounts. We ask whether expectations about upcoming notes in melodies are driven by rule-like Gestalt principles (e.g. a preference for small intervals) or by learned statistical knowledge from previous experience. We compare Temperley's (2008) Probabilistic Model of Melody Perception—which incorporates three Gestalt-like principles—with Pearce's (2005) IDyOM model—which learns n-grams from a training corpus. We use multinomial logit modeling to compare these models' ability to predict behavioral data in which participants hear melodic fragments and sing the note they expect to come next. Fragments were manipulated either to strongly suggest a particular continuation note or to not create strong expectations. We find that both the IDyOM and Temperley models contribute independently to predicting participant responses, but that IDyOM is a stronger predictor, indicating that melodic expectations are largely driven by learned statistical knowledge but also include a Gestalt-like component. We further note that both models perform better in cases where human data has high entropy (i.e. responses split among many notes) compared to cases where human data has low entropy (in particular, cases where the majority of participants sing the tonic—i.e. authentic cadences). We conclude that forming expectations purely on the musical surface is insufficient to capture listeners' expectations, suggesting an important role for hierarchical harmonic knowledge not captured by either of the models considered here.

Topic Area: PERCEPTION & ACTION: Audition

Behavioral and ERP Correlates of Declined Sensorimotor Control of Speech Production With Ageing

Poster E128, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Jingting Li[1], Hanjun Liu[1]; [1]The First Affiliated Hospital, Sun Yat-sen University

There is behavioral evidence showing that auditory feedback control of speech production can be modulated as a function of age, but the neural mechanisms underlying the ageing-related speech feedback control are poorly understood. In order to address this important question, we measured and compared vocal and event-related potential (ERP) responses to pitch perturbations of +200 and +500 tested produced by 22 young adults (10 male, aged 21-25 years) and 22 older adults (10 male, aged 60-72 years). Behavioral results showed that ageing adults produced significantly vocal compensations for pitch perturbations than young adults. At the cortical, the effect of age on N1 amplitudes did not reach significance. However, male young adults produced significantly larger N1 amplitudes than female young adults, while such gender effects were not observed in older adults. A significant interaction between age and gender was found in the amplitude of P2 response to pitch perturbations of +200 cents. P2 amplitudes became significantly larger with ageing in male adults only. P2 amplitudes also varied as a function of gender in young adults only, in which they were larger for males than for females. These findings provide neurobehavioral evidence for the effects of age on sensorimotor control of speech production, suggesting a decline in the ability of the audio-vocal system to inhibit compensatory vocal behavior to stabilize speech production. And gender-specific changes in speech motor control with aging highlight the importance of the interaction between age and gender in understanding the neural mechanisms underlying sensorimotor integration for speech production.

Topic Area: PERCEPTION & ACTION: Development & aging

The development of planning in tool use: EEG, eye tracking, motion tracking, and video

Poster E129, Monday, March 26, 2:30-4:30 pm, Exhibit Hall C

Ori Ossmy[1], Brianna Kaplan[1], Danyang Han[1], Melody Xu[1], Karen Adolph[1]; [1]New York University

Flexible, purposeful tool use requires action planning. Adults' action plans keep both the initial contact with the tool and the end goal in mind, even when the end goal stretches far into the future. Children, however, show dramatic deficits in planning when the end goal is not immediately accessible to perception. For example, participants of all ages normally reach for the handle of a hammer using an overhand radial grip. But when the environment changes and the handle points away from the dominant hand, an initially uncomfortable underhand grip is required to ensure the desired final position of the tool. Here, we examined the possible sources of differences in action planning between young children and adults. We innovated a novel method for obtaining electroencephalography (EEG), head-mounted eye tracking, motion tracking, and video simultaneously in an hammering task. At the neural level, we found differences in readiness potential over sensory-motor sites preceding grips in adults and flexible children compared with no differences in readiness potential preceding grips in non-flexible children. We used machine-learning algorithms to describe preparatory neural patterns underlying differences in planning between the groups. We also show that participants' fixation location and motion kinematics are correlated with flexibility. These results indicate that young children's deficits in planning for flexibility stem from differences in neural activity and visual attention prior to moving the hand.

Topic Area: PERCEPTION & ACTION: Development & aging

Individual Differences in Neural Representations of Semantic Content

Poster F1, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Katherine L. Alfred[1], Justin C. Hayes[1], Rachel G. Pizzie[1], David J. M. Kraemer[1]; [1]Dartmouth College

Neuroimaging studies of semantic knowledge often report group effects collapsing across individual differences. Though such differences are often treated as noise, previous studies (Miller et al., 2002; 2011; Kraemer et al., 2009; 2014; Hsu et al., 2011) have shown that individual variability can reflect stable and measurable differences in neural activity. Furthermore, some of these differences (e.g., encoding strategies and cognitive style) account for significant variance after accounting for task manipulation and demographic differences. In this study, we focused on individual differences in cognitive processing on a continuum from verbal to visuospatial, during encoding of word lists and picture lists. Using an intentional encoding task during fMRI scanning, we manipulated stimulus type in a 2[format: words, images] x 2[semantic relevance: meaningful, nonsense] design. Analyzing functional activity during encoding, we used multivariate pattern analysis (MVPA) classification to probe for between-subject differences in separate brain networks that support language processing and mental imagery, respectively. Networks of interest were identified through meta-analyses of previous studies (drawn from NeuroSynth) as well as through functional localization within our participant group. Results indicate that inter-individual differences in verbal versus visuospatial processing account for variation in neural patterns corresponding to the differential use of these separate networks when presented with semantically-meaningful stimuli. These findings indicate that the neural representation of semantic content varies as a function of individual differences in verbal and visuospatial cognitive processing independently of the format of stimulus presentation.

Topic Area: THINKING: Reasoning

Prior knowledge guides speech segregation in human auditory cortex

Poster F2, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Yuanye Wang[1,2,3], Jianfeng Zhang[4], Jiajie Zou[4], Huan Luo[1,2,3], Nai Ding[4,5,6,7]; [1]School of Psychological and Cognitive Sciences, Peking University, [2]McGovern Institute for Brain Research, Peking University, [3]Beijing Key Laboratory of Behavior and Mental Health, Peking University, [4]College of Biomedical Engineering and Instrument Sciences, Zhejiang University, [5]Key Labratory for Biomedical Engineering of Ministry of Education, Zhejiang University, Zhejiang Univ, Hangzhou, China, [6]State Key Laboratory of Industrial Control Technology, Zhejiang University, Hangzhou, China, [7]Interdisciplinary Center for Social Sciences, Zhejiang University, Hangzhou, China # These authors contribute equally

Segregating concurrent sound streams is a computationally challenging task that requires integrating bottom-up acoustic cues (e.g. pitch) and top-down prior knowledge about sound streams. In a multi-talker environment, the brain can segregate different speakers in about 100 ms in auditory cortex. Here, we used magnetoencephalographic (MEG) recordings to investigate the temporal and spatial signature of how the brain utilizes prior knowledge to segregate two speech streams from the same speaker, which can hardly be separated based on bottom-up acoustic cues. In a primed condition, the participants know the target speech stream in advance while in an unprimed condition no such prior knowledge is available. Neural encoding of each speech stream is characterized by the MEG responses tracking the speech envelope. We demonstrate that an effect in bilateral STG and STS is much stronger in the primed condition than in the unprimed condition. Priming effects are observed at about 100 ms latency and last more than 600 ms. Interestingly, prior knowledge about the target stream facilitates speech segregation by mainly suppressing the neural tracking of the non-target speech stream. In sum, prior knowledge leads to reliable speech segregation in auditory cortex, even in the absence of reliable bottom-up speech segregation cue.

Topic Area: ATTENTION: Auditory

Mobile EEG in a complex driving simulation – evaluating the effect of age on cognitive states

Poster F3, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Julian Elias Reiser[1], Marlene Pacharra[1], Stephan Getzmann[1], Edmund Wascher[1]; [1]Leibniz Research Centre for Working Environment and Human Factors

The everyday task of driving a car involves a sophisticated interplay of tasks and corresponding mental activity to ensure correct responses to ongoing events. While previous studies show a depletion of driving related attentional processes with age, the neurophysiological consequences of this depletion during actual driving are unclear. In this study, the effect of age was investigated in an hour-long driving simulation. Two age groups (young 19-26, old 63-76) with 12 participants each drove along the same track in a traffic network with interconnected driving segments (German “Autobahn”, highway, city) guided by a navigation system. These segments consisted of longer monotonous periods with occasional intermitting segment-specific tasks – e.g. overtaking on the highway or turning in the city. The EEG was recorded with a bilateral, miniaturized and mobile 18-channel around-the-ear setup (cEEGrids, TMSi, NL) to reduce preparation time and mobility constraints as well as to increase ecological validity while driving. Mental states were examined over time using normalized alpha- and theta-band-power (band-power / whole power spectrum) as cognitive correlates of attention in the frequency-domain. A mixed linear model revealed a significant interaction effect between

the factors age and time on task on normalized alpha- and theta-power. While remaining stable in elderly drivers, alpha- and theta-power increased over time in younger drivers. This indicates incremental attentional withdrawal in younger and a compensatory cognitive mechanism in older participants. Moreover, the data quality of the cEEGrids demonstrates the feasibility of recording EEG in real traffic environments.

Topic Area: ATTENTION: Development & aging

Integrating modality-specific expectancies for the deployment of spatial attention

Poster F4, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Paola Mengotti[1], Frank Boers[1], Pascasie L. Dombert[1], Gereon R. Fink[1,2], Simone Vossel[1,3]; [1]Research Centre Juelich, Germany, [2]University Hospital Cologne, Germany, [3]University of Cologne, Germany

The deployment of spatial attention is highly sensitive to predictability. Despite evidence for strong crossmodal links in spatial attentional systems, it remains to be elucidated how concurrent but divergent predictions for targets in different sensory modalities are integrated. We investigated the processing of modality-specific expectancies using a multimodal cueing paradigm in which auditory cues predicted the location of visual or tactile targets with modality-specific cue predictability. The cue predictability for visual and tactile targets was manipulated independently. A Bayesian ideal observer model with a weighting factor was applied to individual response speed to model the trial-wise inference about modality-specific cue predictability levels and their degree of integration. The weighting factor was analyzed in relation to cue predictability levels and divergence. We performed three behavioral studies, each including (n=21) healthy young participants. In Experiment 1 only the predictive spatial cue was presented, whereas in Experiment 2 an additional cue indicated the modality of the upcoming target. Results of the first two experiments showed that the degree of integration depended on the level of cue predictability and on the divergence of the modality-specific probabilistic contexts. When the two probabilistic contexts were matched in their level of predictability and were highly divergent (Experiment 3), higher separate processing was favored, especially when visual targets were processed. These findings suggest that modality-specific predictions are flexibly integrated according to their inferred reliability, supporting the hypothesis of separate modality-specific attentional systems that are however linked to guarantee an efficient deployment of spatial attention across the senses.

Topic Area: ATTENTION: Multisensory

Neural Mechanisms Underlying the Interactive Relationship between Working Memory and Cognitive Control During Conflict Processing

Poster F5, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Khoi Vo[1], Elise Demeter[2], Tobias Egner[1], Marty Woldorff[1]; [1]Duke University, [2]University of North Carolina Charlotte

Recent studies have suggested working memory (WM) and attentional control rely on shared resources. For example, holding a color word in WM during a color-discrimination task can elicit interference similar to the classic Stroop effect. Whether the neural dynamics underlying these behavioral effects differ, however, is unknown. Here, we addressed this question by recording EEG (N=26) during the WM-Stroop and classic-Stroop tasks, as well as a condition where participants held a number (rather than a color-word) in WM during a classic-Stroop task. We focused on the negative-incongruency (Ninc) ERP effect (incongruent-minus-congruent) as a neural marker of conflict processing during the Stroop task, and the P300 to the WM probe as a marker for WM cue representation. Behaviorally, responses in all three color-discrimination tasks were slower and less accurate on incongruent than congruent trials, but this effect did not differ between tasks. In contrast, the Ninc neural effect was elicited in all three color-discrimination tasks, but was substantially earlier and stronger in the WM-color task. We posit that having an active representation of a color word in WM is more difficult to suppress during color-discrimination of a nonmatching color, but this effect is mitigated by earlier and stronger conflict resolution. Behavioral responses to the subsequent WM probes were slower and less accurate following incongruent versus congruent color-discrimination processing, which was reflected in decreased P300s. These results thus suggest cognitive interference degraded WM strength, further supporting the interactive relationship between WM and cognitive control within shared neural resources.

Topic Area: ATTENTION: Nonspatial

Individual peak alpha frequency in touch – cognitive and methodological implications

Poster F6, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Alexander Jones[1], Jonathan Silas[1]; [1]Middlesex University London

Oscillations in the alpha frequency range (8-12Hz), measured using electroencephalography (EEG), have been shown to have a functional role in cognition and attention in particular. For example, voluntarily shifting covert attention to one side of space leads to a decrease of alpha activity over the contralateral hemisphere. More recently, interest has turned to the notion that across individuals there is notable variance in the peak of the frequency, and these peaks are dependent on task demands or the participant's "state". Here we directly contrast four separate tasks commonly known to modulate alpha power, in a within subjects design. Using a somatosensory cue, participants (N=21) either oriented (1) endogenous or (2) exogenous attention to the right or left hand and response times were measured. In a passive task (3) participants received tactile stimuli at regular intervals to one hand only, akin to studies determining peak alpha desynchronization for subsequent brain stimulation. Finally, EEG was measured from participants whilst at rest (4) when no stimuli were presented. Results show a difference in lateralized alpha power depending on the task. Interestingly, we also observe differences in peak frequencies across tasks within the same individual. These findings have key implications in terms of understanding the functional role of alpha oscillations and how they vary across different states and individuals. Furthermore, recent advances in transcranial alternating current stimulation (tACS) have relied on 'individualising' EEG frequencies for subsequent stimulation. We suggest, that such frequency 'individualisation' or 'localisation' for the purposes of tACS, requires task-specific functional localisation.

Topic Area: ATTENTION: Other

An Investigation of Brain-to-Brain Coherence in the Prefrontal Cortex During Joint Sentence Reading and Joint Fluid Reasoning Tasks

Poster F7, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Murat Perit Cakir[1], Erdinç İşbilir[1], Çağatay Taşcı[1]; [1]Middle East Technical University

Lack of an interactive context for joint action is an important limitation in social neuroscience studies. Portable brain imaging technologies such as functional near-infrared spectroscopy (fNIRS) have made it practical to simultaneously monitor the brain hemodynamics of two or more people engaged in social interaction. In this study, the modulation of inter-brain coherence is investigated in two different joint activity scenarios. In the first experiment, 22 dyads simultaneously read aloud matching and mismatching sentences in three conditions that differed in terms of the clarity in which partners hear each others' voices. Behavioral analysis indicated that participants significantly performed better when they could hear the other partner, $F(1.55,43.35)=78.53, p<.001$, and when the sentences match each other, $F(1,28)=14.31, p<.01$. A wavelet-transform coherence analysis (WTC) conducted on deoxy-hemoglobin (HbR) changes suggest that the level of inter-brain coherence in the right superior frontal cortex (SFC) tends to increase depending on the level of behavioral synchrony among the participants. In the second study (ongoing), 4 dyads attempted to solve Raven-like visual pattern completion tasks, where the pieces were revealed only when both partners' eyes dwell on the same box. WTC analysis of eye gaze data indicated that a significantly higher level of gaze coherence occurred during the actual task as compared to a free-viewing practice, $F(1.44,4.33)=8.28, p<.05$. The strongest coherence in HbR signals was around right SFC. Hyperscanning studies focusing on different joint tasks also found increased coherence in the right SFC, which altogether highlight this area's important role in the facilitation of joint attention and coordination.

Topic Area: ATTENTION: Other

Attentional bias toward fearful facial expressions: EEG correlates in theta oscillations

Poster F8, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Robert D. Torrence[1], Lucy J. Troup[1,2], Donald C. Rojas[1]; [1]Colorado State University, [2]University of the West of Scotland

Rapid attention to threatening stimuli in the environment has been a necessary trait throughout evolution. Fearful faces can signal the location of the threat to an observer. Previous research used behavioral (i.e. reaction time) and neuroimaging (e.g. fMRI, EEG, ERP) methods to examine attentional bias toward emotion facial expressions. Diao et al. (2017), found that theta oscillations in the contralateral electrodes to angry facial expressions were elevated. This study examined theta oscillations in response to fearful faces. The participants (N = 11) performed a standard dot-probe task that consisted of three trial types: fear congruent (i.e. dot appears behind the fearful face), fear incongruent (i.e. dot appears behind neutral face), and neutral (i.e. two neutral faces). The face pairs were displayed simultaneously for 50ms on the left and right side of the screen. The trial ended when the participant indicated the location of the dot. Inter-trial interval was 2 seconds. EEG data was analyzed using an average reference and filtered using a .1-30 Hz bandpass filter. ICA was used for artifact correction and rejection. Time-frequency analysis was conducted on electrodes PO7 and PO8. Elevated theta oscillations in the posterior contralateral electrode to the fearful facial expression were present around 200ms after face onset. These results were consistent with previous research that indicated greater theta oscillations in attention toward angry faces. This study then contributes to the existing body of research that there were elevated theta oscillations posterior contralateral to threat-related facial expressions.

Topic Area: ATTENTION: Spatial

Combining eye-tracking and EEG to measure attention to salient and emotional stimuli

Poster F9, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Louisa Kulke[1,2,3], Janette Atkinson[3,4], Oliver Braddick[4], Annekathrin Schacht[1,2]; [1]University of Göttingen, [2]Leibniz-ScienceCampus Primate Cognition, [3]University College London, [4]University of Oxford

In everyday life, salient or emotionally relevant stimuli often catch our attention and elicit saccades. However, most previous neuroscientific studies instructed subjects to covertly shift attention, thereby suppressing natural saccades. This set of studies used a novel method combining eye-tracking and EEG to measure overt shifts of attention. Study 1 compared neural mechanisms of covert and overt attention shifts. Twenty-four participants performed an attention shift task in which they either manually responded to peripheral targets while maintaining fixation (covert) or made a saccade towards them (overt). EEG and eye-tracking were combined to simultaneously measure neural responses and saccades. Event-related potentials were similar for overt and covert shifts of attention; however, an early fronto-central component differed between condition, potentially reflecting saccade suppression during covert attention shifts. This suggests that natural attention shifts may differ from covert shifts often recorded in labs. Study 2 manipulated disengagement of attention by comparing overt attention shifts to a salient peripheral target, both with and without a competing central target. Results from 41 participants show that saccade latencies towards targets are significantly shorter when no competing stimulus is present. The same latency pattern occurred for early occipital responses with shorter latencies for responses requiring no disengagement. Study 3 additionally introduced emotional faces as stimuli to investigate effects of valence on attention shift latencies. The results provide insights to the mechanisms of attention shifts to salient and emotional stimuli in a natural context, providing information on the neural mechanisms underlying the attentional draw towards these stimuli.

Topic Area: ATTENTION: Spatial

Alterations in Intrinsic Functional Brain Connectivity for Hypertensive Women Post-Menopause

Poster F10, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Judith Lobo[1], Nicole Rotkovitz[1], Julia Weinman[1], Roger McIntosh[1]; [1]University of Miami

Loss of ovarian estradiol enhances risk of neurological disease and of hypertension. Cardio vascular risk factors are linked with with cognitive deficits and altered resting-state connectivity. Menopause and aging may be interacting with this effect. The current

study aims to characterize and contrast intrinsic connectivity of hypertensive (HTN) and normotensive women as a function of age-menopause. Fifty-two post-menopausal women were selected from the NKI Rockland Study (HTN aged 63.42 years ± 13.00 NTN aged 65.37 years ± 14.72), 26 hypertensive and 26 normotensive. A group probabilistic independent component analysis (PICA) was performed in FSL using the MELODIC program in order to identify functional networks. Differences in intrinsic connectivity of several resting state networks were found as a function HTN status and the interaction of HTN with menopausal age. NTN women showed more robust activity in the Executive Control Network (ECN) and Salience network. When the interaction with age was included, activity of the the Default Mode network (DMN) and the Salience network (SN) was more robust in the normotensive group. Activity of the DMN, SN, Temporal network and Dorsal Attention network was more robust in the hypertensive group.The interaction between post-menopausal age and HTN status suggests that there is a synergistic relationship between the two factors that may be contributing the accelerated aging in the brain. Due to the importance of some of the identified networks in carrying out cognitive tasks, altered brain connectivity is a possible mechanism for cognitive changes associated with hypertension and aging in post-menopausal women.

Topic Area: EMOTION & SOCIAL: Development & aging

Brain activation during thoughts of one's own death and its association with the fear of death in older adults

Poster F11, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Kanan Hirano[1], Kentaro Oba[1], Toshiki Saito[1], Shohei Yamazaki[1], Ryuta Kawashima[1], Motoaki Sugiura[1]; [1]Tohoku University

To face at one's own death and to manage the fear of it are important existential, psychological, and clinical issues especially for the elderly. While recent neuroimaging studies investigated the brain responses to death-related stimuli, none has examined if the brain activation was indeed self-relevant and how it is related to the fear of death. In this study, we addressed these issues using an fMRI and questionnaire measurements. During the fMRI measurement, 35 elderly participants (aged 60-72) were presented with death-related (D) or unrelated (ND) words, and evaluated their relevance to oneself or other (prime minister). They also completed a questionnaire to measure their degree of the fear of death. While several cortical areas were activated during the death-related thought (i.e., D – ND), the left supplementary motor area (SMA) only showed activation during self-relevance judgment. We also conducted a regression analysis with the degree of the fear of death on activation during the death-related thought, and identified negative correlation in the right supramarginal gyrus (SMG) during self-relevance judgment only. The activation of the SMA during death-related thought was previously implicated in the inhibition of the threat and our finding confirmed this notion by demonstrating its specificity during thought on one's own death. Given the role of the right SMG in the bodily self-representation, the observed negative correlation of its activation and the fear of death may reflect fear-associated distancing of the physical self and death demonstrated in previous behavioral studies.

Topic Area: EMOTION & SOCIAL: Development & aging

Trait affective empathy mediates the relations between intrinsic default network functional connectivity and subjective happiness

Poster F12, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Yuta Katsumi[1], Natsumi Kondo[2], Sanda Dolcos[1], Florin Dolcos[1], Takashi Tsukiura[2]; [1]University of Illinois at Urbana-Champaign, [2]Kyoto University

Subjective happiness is a multidimensional construct that indexes one's evaluations of everyday emotional experiences, life satisfaction, and fulfillment, and is typically linked to high positive and low negative affect. Available evidence suggests that subjective happiness is closely related to empathy, broadly defined as the ability to understand others' feelings and intentions based on a clear psychological distinction between the self and others. However, little is known about the neural mechanisms underlying the relations between subjective happiness and different aspects of empathy, particularly with respect to the dynamics of resting-state functional connectivity (RSFC). In the present study, 67 college-aged Japanese females underwent resting-state fMRI recording, after which they completed self-report measures of subjective happiness and those of affective and cognitive empathy. Behaviorally, indices of affective empathy – empathic concern (other-focused feelings and concern) and personal distress (self-referential experience of others' negative feelings) – positively and negatively predicted subjective happiness, respectively. At the neural level, greater default network RSFC was associated with decreased subjective happiness. Finally, mediation analysis revealed that greater RSFC within the default network "core" regions (typically implicated in self-referential processing) leads to decreased subjective happiness through increased self- vs. other-focus in empathic responses. Overall, these findings suggest that reduced engagement of self-referential processing at rest may allow for an adaptive switching from self- to other-focused cognition in empathic responses, which may in turn contribute to increased subjective happiness. This new evidence sheds light on the important link between intrinsic functional connectivity, empathy, and subjective happiness.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Neurocognitive and emotion processing deficits in Bipolar Disorder and their first degree relatives

Poster F13, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Hugo Sandoval[1], Jose Gavito[1], Christopher Dodoo[2], Michael Escamilla[3]; [1]Texas Tech PLFSOM El Paso Radiology, [2]Texas Tech PLFSOM El Paso Biostatistics and Epidemiology, [3]Texas Tech PLFSOM El Paso Psychiatry

Specific Goals The objective of this study is to characterize nerucogntive and emotion processing deficits in Bipolar disorder type I (BPI) patients and children and adolescents at risk for BPI. This information can be used to give this patients tools to prevent worsening of the illness or to provide early treatment, . Methods Neurocognitive evaluation was performed on kids and adolescents with BPI, at risk for BPI, and healthy controls using the South Texas Assessment of Neurocognition (STAN). All diagnosis was conducted by a team of psychologists and psychiatrists to assign final consensus diagnoses using DSM-IV criteria. Multivariate linear regression was adjusted for age, gender, language spoken at home and race. P values less than 5% were considered statistically significant. All analysis were performed using SAS 9.4. Results summary Emotional judgment, sensory/motor processing speed, attention, executive function, and risk judgment were affected ($P<0.05$))in children and adolescents at risk for BPI. Global/intellectual functioning, language skills, sensory/motor processing speed, attention, memory, language skills, and risk judgment were impaired in BPI children and adolescents. Conclusion. Our results provide evidence of neurocognitive and emotional impairment in kids and adolescents with BPI and in kids and adolescents at risk of developing BPI because of having a first degree relative with BPI. These deficits, add burden and complexity to the life of those who suffer from BPI or have a first degree relative who suffers from it. This information can be useful in developing neurocognitive therapy as well as educational alternatives for those in need.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Believing, Desiring, or Just Thinking About: Toward a Neuroscientific Account of Propositional Attitudes

Poster F14, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Regan Bernhard[1], Steven Frankland[1], Joshua Greene[1]; [1]Harvard University

How does our brain appropriately connect an attitude, such as believing or desiring, to the state of the world to which the attitude relates? Here we use fMRI to identify brain regions that contain information about a set of object-location combinations, as well as regions associated with believing, desiring, or merely thinking about those combinations. We find increased activation in dissociable regions when participants have a clear belief that an object is in a specific location but no desire for it to be there (e.g. right posterior parietal cortex) versus when they have a desire for the object to be in the same location, but no specific belief about where the object actually is (e.g. portions of the default mode network). We find increased activation in a third set of regions (e.g. right inferior frontal gyrus) when participants are asked to think about the same object-location combination without wanting the object to be in that location, nor having any belief about where the object may actually be. Finally we find that believing, desiring, or merely

thinking about an object-location combination affects the pattern of neural activity associated with the representation of the object being entertained. We find better object decodability in the left putamen and medial frontal gyrus (among others) when the object is a constituent of a combination that is being desired but better object decodability in the right posterior superior temporal gyrus (among others) when the object is a constituent of a combination that is being believed.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Building an Effective Math Anxiety Intervention: Understanding the Role of Emotion Regulation

Poster F15, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Rachel Pizzie[1], David J. M. Kraemer[1]; [1]Dartmouth College

Math anxiety, or negative affect associated with anticipating or doing mathematical computations, has been identified as a significant obstacle to achievement in STEM fields, and is associated with avoidance of math problems, classes, and careers. Interventions have focused on increasing mathematical knowledge or providing short-term relief from anxious ruminations. In the present research, we present evidence that fostering cognitive reappraisal as an emotion regulation technique facilitates improvements in math performance for math anxious (MA) individuals. In Study 1, we investigate how reappraisal influences a psychophysiological measure of emotion, skin conductance, for high and low MA individuals. Results indicate that reappraisal attenuates the relationship between increased physiological arousal and math performance, such that math anxiety no longer impacts math task performance, even at high levels of arousal. In Study 2, we examine how reappraisal influences neural correlates of math anxiety and mathematical processing. In this fMRI study, we examine how reappraisal influences activity in regions associated with affective processing, as well as neural substrates of mathematical computations in adolescents (ages 13-18) and undergraduates (ages 18-22). In Study 3, we take what we learned about emotion regulation and math anxiety in a laboratory setting, and utilize these findings to implement a classroom intervention in high school math classrooms. Across our studies that examine physiological indices of negative emotion, neural substrates of affect and math computation, and academic performance in high school math classes, we find that cognitive reappraisal provides a promising method for remediation of the deficits caused by math anxiety.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Neural correlates of emotional inhibitory control in adolescents with and without family history of alcoholism

Poster F16, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Maya Rieselbach[1], Lisa D. Nickerson[1,3], Jennifer T. Sneider[1,3], Anna Seraikas[1], Emily Oot[1,4], Carolyn Caine[1], Elena Stein[1], Sion K. Harris[2], Marisa M. Silveri[1,3,4], Julia E. Cohen-Gilbert[1,3]; [1]McLean Hospital, [2]Boston Children's Hospital, [3]Harvard Medical School, [4]Boston University School of Medicine

Adolescence is a period characterized by elevated impulsivity, particularly in the context of intense emotions. Response inhibition deficits and difficulties regulating emotions are associated with alcohol use and other substance use disorders. Family history of alcoholism (FH) status is also associated with inhibitory control deficits, altered brain activation during inhibitory control tasks, and elevated risk for alcoholism. In this study, brain activation data were collected via functional magnetic resonance imaging (fMRI) while 30 healthy adolescents (ages 13-14, 15 female) performed an inhibitory control task (Go-NoGo) with distracting background images that were positive, negative, neutral, or scrambled. Adolescents had no personal history of substance use and were stratified into FH positive (FH+, parent and/or grandparent history of alcoholism, n=10) and FH negative (FH-, n=20) groups. A mixed model ANOVA examining NoGo trial accuracy revealed a significant interaction between trial background and FH status (p=.017). Post hoc analyses showed significantly lower NoGo accuracy on negative trials in FH+ versus FH- adolescents (p=.015), but no group differences on positive, neutral, or scrambled trials. Brain activation on inhibitory (NoGo) trials was contrasted between negative and neutral conditions. Results showed recruitment of bilateral inferior frontal gyrus (IFG) during the negative versus neutral contrast in the FH- but not the FH+ group. These findings suggest that adolescents with family history of alcoholism exhibit diminished impulse control in the context of negative emotional states, possibly due to a lack of recruitment of executive control regions, which may link to inherited risk for substance use and abuse.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Neuro-behavioral mechanisms of resilience against anxiety: An integrative brain-personality-behavior approach using structural equation modeling

Poster F17, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Sanda Dolcos[1], Matthew Moore[1], Steven Culpepper[1], K. Luan Phan[2], Florin Dolcos[1]; [1]University of Illinois at Urbana-Champaign, [2]University of Illinois at Chicago

Clarifying individual differences that predict resilience or vulnerability to emotional dysregulation is essential for identifying etiological factors contributing to affective disturbances, and for promoting emotional well-being. Despite recent progress targeting specific brain regions and personality traits, it remains unclear whether there are common factors underlying the structural aspects of the brain and the personality traits that, in turn, protect against symptoms of emotional dysregulation. In the present study, an integrative structural equation model was developed to examine the link among 1) a latent construct representing the volumes of a system of prefrontal cortical (PFC) regions including orbital, inferior, and middle frontal cortices, 2) a latent construct of resilience personality traits including cognitive reappraisal, optimism, and positive affect, and 3) measures of trait anxiety and depression, in a sample of 85 healthy young adults (18–34 years old, 48 females). Results showed that the latent construct of PFC volumes positively predicted the latent construct of resilience, which in turn negatively predicted trait anxiety. Mediation analysis confirmed that greater latent PFC volume leads to decreased anxiety through increased latent trait resilience. Additionally, the model showed evidence for specificity, as it fit well for anxiety and did not show a significant mediation for depression. These results support the idea that there are common volumetric and personality factors that help protect against symptoms of emotional dysregulation. These findings provide strong evidence that such brain-personality-behavior approaches can provide novel insights with valuable implications for understanding the interaction of these factors in healthy and clinical groups.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

Common Neural Correlates of Empathy and Worry when Processing Fearful Human Faces

Poster F18, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Lindsay Knight[1], Teodora Stoica[1], Farah Naaz[1], Nicholas Fogleman[1], Brendan Depue[1]; [1]University of Louisville

Empathy is the ability to understand and share an emotional experience with another person. This increased emotional awareness/sensitivity may also be related to increased worry, particularly when empathizing with individuals in distressing situations. However, the relationship between empathy and worry has not been characterized in terms of the underlying neural correlates that may support these convergent responses. We therefore conducted an fMRI study (n=49) in which participants viewed and rated fearful (F) and neutral (N) human faces. Additionally, questionnaires measuring empathy (TEQ), worry (PSWQ) and rumination (RRS) were administered. Behaviorally, higher empathy predicted higher worry. Neuroimaging regression of TEQ scores revealed that empathy was positively related to activity of the temporoparietal junction (TPJ), as well as functional connectivity from the TPJ to bilateral amygdala for F>N faces. Additionally, increased worry (PSWQ) was positively related to medial prefrontal cortex (mPFC) activity for N>F faces, suggesting carry-over and continued processing of the fearful faces. To further characterize the relationship between empathy and worry, a median split of the TEQ and PSWQ indicated that both higher empathy and worry were related to higher total rumination. Neuroimaging group analyses of the median split showed that when processing fearful faces, lower empathy and worry both related to increased activation of top-down attentional regions. Together, this suggests that in response to fearful faces, higher empathy and worry both correspond to decreased top-down attentional

control, coupled with increased activation of and communication with regions supporting emotion recognition, facial processing and mentalizing states of the self and others.

Topic Area: EMOTION & SOCIAL: Emotional responding

Weakened adaptation for negative compared to positive emotions in individuals high in social anxiety

Poster F19, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Erinda Morina[1], Sarah C. Izen[1], Vivian M. Ciaramitaro[1]; [1]University of Massachusetts Boston

Interpreting emotional expression is a crucial component of social interaction, and may be disrupted in clinical conditions, such as social anxiety (Yoon & Zinbarg, 2007). We used an adaptation paradigm to quantify how individuals high in social anxiety process emotional information in a face. Repeated exposure to a given emotion, positive or negative, can bias the perception of subsequent emotional faces. For example, after exposure to angry faces, an emotionally neutral face tends to be perceived as more positive. Such adaptation effects may be weakened in individuals high in social anxiety, and such weakened adaptation may maintain the negative bias exhibited in socially anxious individuals, who tend to perceive others as judging them negatively, perceive neutral faces as more negative, and remain vigilant to negative information. To quantify adaptation strength, for each participant we calculated their point of subjective equality (PSE), where a face is equally likely to be judged angry/sad or happy, the shift in PSE post-adaptation relative to baseline, and the slope of the psychometric function post-adaptation relative to baseline. We found a significant difference in the magnitude of adaptation with stronger adaptation to positive compared to negative emotions, and a tendency for weaker adaptation to angry compared to sad negative emotions. We also found a significant change in slope, with steeper slopes seen after adapting to positive compared to negative emotions. Thus, socially anxious individuals tend to perceive faces more categorically, an all-or-none rather than a gradual percept, after being adapted to happy compared to negative faces.

Topic Area: EMOTION & SOCIAL: Emotional responding

Differential Sensitivity to Reward and Punishment in East Asians vs. Western Europeans

Poster F20, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Ramiro Eduardo Rea Reyes[1], Youngbin Kwak[1], JaeHyung Kwon[2], Jaeseung Jeaong[2]; [1]University of Massachusetts, Amherst, [2]Korea Advanced Institute of Science and Technology

Collectivist cultures tend to promote uniform behaviors whereas individualistic cultures tend to reward originality. We aimed to determine if people from a collectivist culture show higher sensitivity to avoid punishments (i.e. avoiding being wrong), compared to members from individualistic cultures. 27 European-Americans and 31 Koreans went through monetary (MID) and social incentive delay (SID) tasks. In them, participants pressed a button as fast as they could when a target was presented. Immediately before this, a cue was shown to inform the participants about each trial. Reward cues indicated that faster reaction time (RT) (faster than a threshold) to the target would result in positive outcomes (e.g. winning money or being presented with positive facial expressions). Punishment cues indicated that slower RT (slower than the threshold) would result in negative outcomes (e.g. losing money or being presented with negative facial expressions). Supra-threshold RTs in rewarding scenarios or sub-threshold RTs on punishment scenarios were followed by neutral outcomes ($0 or blurred face), meaning failure to win or success in avoiding punishment, respectively. Two levels (high vs. low) of reward and punishment were presented in both tasks. Our results showed that Korean were significantly faster than European-Americans when avoiding punishment in MID [$F(1,56)=6.212$, $p=0.016$; $\eta p2=0.10$]. Also, Koreans showed significantly faster RTs in the high compared to low punishment scenarios in SID [$F(1,56)=5.154$, $p=0.027$; $\eta p2=0.084$] while no significant differences were found in European-Americans. These results suggest that culture can have significant influence in processing of basic motivational process related with reward and punishment.

Topic Area: EMOTION & SOCIAL: Other

Sex-related differences in behavioral and neural processing of facial threat cues via magnocellular and parvocellular pathways.

Poster F21, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Hee Yeon Im[1,2], Reginald Adams, Jr[3], Cody Cushing[1], Jasmine Boshyan[1,2], Noreen Ward[1], Kestutis Kveraga[1,2]; [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]The Pennsylvania State University

During face perception, we integrate facial expression and eye gaze to extract social messages from their shared signals. For example, fear with averted gaze provides a congruent avoidance cue, signaling both threat presence and its location, whereas fear with direct gaze sends an incongruent cue, leaving threat location ambiguous. It has been proposed that these cues are processed via two distinct pathways: reflexive processing of clear threat cues via the magnocellular pathway and reflective processing of ambiguous threat cues via the parvocellular pathway. Because growing evidence has identified a variety of sex differences in affective perception, we investigated whether threat cues presented to these pathways evoked different behavioral and neural responses in females vs. males. We adjusted luminance and color of face stimuli to selectively engage magnocellular or parvocellular processing and asked observers (N=108) to identify facial expression (neutral vs. fear). Females were more accurate to faces with averted gaze and showed greater left amygdala reactivity both to fearful and neutral faces. Conversely, males showed greater right amygdala activation only for averted-gaze fear (clear threat) faces presented as magnocellular-biased stimuli. Furthermore, females had greater bilateral amygdala volumes, which positively correlated with accuracy for magnocellular-biased fear, whereas males showed a similar positive correlation only for the right amygdala volume. Our findings suggest that magnocellular and parvocellular processing of facial threat cues is modulated by functional and structural differences in the amygdalae associated with observers' sex, with bilateral processing in women and more right-lateralized processing in men.

Topic Area: EMOTION & SOCIAL: Person perception

SCHIZOPHRENIA AND STIGMA: AN ERP STUDY

Poster F22, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Denice Vidals[1], Jayden Zeng[1], Lorraine Singh[1], Brianna Riviezzo[1], Jill Grose-Fifer[1,2]; [1]John Jay College of Criminal Justice, CUNY, [2]The Graduate Center, CUNY

Research has shown that people view schizophrenia as having more negative stigma than other mental illnesses. We used ERPs to investigate both early and late neural processes elicited when viewing pictures of people who were identified as having schizophrenia. We recorded EEG from undergraduates while they looked at photographs of angry or happy faces surrounded by a colored border signifying whether or not the individual in the picture had schizophrenia. The border color was counterbalanced across participants. We measured the P100, N170, and LPP and found that the P1 and LPP were not modulated by mental health labeling. In contrast, the N170 was larger for happy faces that were identified as being healthy than for those identified as having schizophrenia. The fact that an early ERP component (N170) associated with face processing was modulated by mental health labeling may indicate that our participants had negative implicit attitudes toward people with schizophrenia. This is supported by previous research that has shown larger N170s for in-group compared to out-group members. On the other hand, the LPP results suggest that our participants did not have any explicit biases toward people with mental illness. The majority of participants in our sample were psychology majors who are more likely to be aware about mental illness than other members of the general public. This paradigm may have future utility in assessing the efficacy of educational programs designed to reduce mental health stigma.

Topic Area: EMOTION & SOCIAL: Person perception

Freewill and the Self: A Transcranial Magentic Stimulation Study of Libet's Postulate

Poster F23, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Julian Paul Keenan[1], Olivia Tarrio[1], Briana Goncalves[1], Saeed Yasin[1], Heather Soder[2]; [1]Montclair State University, [2]University of Texas

Libet suggested that intention of movement-related tasks originate in the sub-cortical motor areas and that the frontal cortex only engages after intentionality has been established. The frontal regions establish a narrative for the intentionality which is not possible. In other words intentionality originates in sub-cortical motor regions and higher cortical regions remain agnostic until far into the 'decision' making process. Here we employed a non-motor, cognitive task demonstrating that free will can be manipulated. Inhibitory TMS was delivered to right and left Motor Cortex (MC) during a simple forced-choice picture preference task. Following right MC TMS, participants were more likely to prefer right sided images, and vice-versa following left MC TMS. Importantly, questioning during the task revealed that participants were willing to provide rational explanations for their choices with confidence. These data imply that notions of Libet's theory can be applied to higher-order decisions rather than simple motor intentional tasks. We hypothesize that the majority of the self is constructed in this manner and that the ease at which we mis-attribute intention supports the argument that free will is an illusion.

Topic Area: EMOTION & SOCIAL: Self perception

Characterizing the neural basis of adolescent cognitive control using connectome-based predictive modeling

Poster F24, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Raihyung Lee[1], Seyul Kwak[1], Dasom Lee[1], Jeanyung Chey[1]; [1]Seoul National University

The ability to exert cognitive control is linked to crucial life outcomes such as risk-taking behavior, substance abuse, and mental disorders in adolescence. Understanding the neural basis of adolescent cognitive control is thus critical for investigating the vulnerabilities of this period. Here, using connectome-based predictive modeling, we identified functional brain networks whose strength during a cognitive control task predicted individual differences in performance. We first built the network model relating connectivity strength to task performance as 58 adolescents performed the Multi-Source Interference Task (MSIT), an established cognitive control fMRI paradigm. To determine whether network strength predicts task performance in novel subjects, a leave-one-out cross-validation procedure was applied. We demonstrated that our network model predicted the interference reaction time (RT) of novel individuals from their task-based connectivity. The model also generalized to the resting state, predicting novel individuals' performance from connectivity observed during rest alone. As a stronger test of generalizability, we showed that our network model could also predict the performance of individuals on the Stroop task, another cognitive control test performed outside the MRI scanner, based on their resting connectivity. To characterize functional anatomy of the network, we summarized connectivity patterns that were primarily predictors of better cognitive control.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Functional and structural connectivity of cognitive control networks during narrative comprehension from birth to 9 years

Poster F25, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Rola Farah[1], Tzipi Horowitz-Kraus[1,2]; [1]Technion- Israel Institute of Technology, [2]Cincinnati Childrens Hospital Medical Center

Background: The cingulo-opercular (CO) and fronto-parietal (FP) networks are prominent components of the brain's cognitive control system. Evidence suggests that over the course of development, within network connectivity of brain regions supporting cognitive control functions increases, along with an increase in between networks connectivity, due to increased maturation along development. Characterizing the developmental changes in functional and structural connectivity of neural networks supporting cognitive control from birth may provide unique insights into the role of cognitive control in narrative comprehension during infancy. Methods: 88 children divided into three age groups: A)0-3 years-old, B)3-6 years-old and C)6-9 years-old participated in the study.

Participants participated in a DTI session and a functional MRI session while listening to stories inside the scanner. Measures of graph theory, within and between the CO and FP networks functional connectivity and Fractional anisotropy (FA) in the Arcuate Fasciculus (AF) were assessed. Results: Developmental increase in within-and between -network connectivity of the CO and FP networks from birth to 9 years-old was observed, mainly between groups A and C. Global efficiency of the CO and FP networks also increased, and greater FA in the AF was observed in group C, compared to A and B in hubs connecting language and cognitive control networks. Conclusions: Increase in functional and structural connections within and between networks related to cognitive control during narrative comprehension in children was observed. Future studies investigating failures in language acquisition should explore the role of those networks in the process as well.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Conflict Control on Emotional and Non-emotional Conflicts in Preadolescent Children

Poster F26, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Tongran Liu[1,2], Xiuying Liu[1,2], Danfeng Li[1,2], Jiannong Shi[1,2]; [1]CAS Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, China, [2]Department of Psychology, University of Chinese Academy of Sciences, China

Conflict control reflects an individual's goal-directed cognitive control and self-regulation behaviors, and the neurodevelopment related to conflict control is crucial for the development of cognitive and emotional abilities in children. The current study enrolled preadolescent children and adults, who completed the Simon and Stroop tasks in emotional and non-emotional contexts with simultaneous electrophysiological recordings. The behavioral findings showed that adults had faster response speed and better conflict control performance compared to children, and children's reaction time could be affected by emotional information. During the neural processes of conflict detection and conflict resolution, children generally had longer N2 latency for the monitoring process on conflicts and devoted more neural efforts with larger P3 amplitudes to detect and execute resolution control on the conflicts than adults did. Moreover, it was currently found that participant's performance speed and neural process speed of N2 and P3 latencies during conflict monitoring and resolution could be influenced by the interaction between the types of stimulus-stimulus and stimulus-response conflicts and the contexts of emotional context and non-emotional contexts. The current study elucidates the children's neurodevelopment effects of cognitive control on varied types of conflicts in both emotional and non-emotional contexts.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Relations between catechol-O-methyltransferase (COMT) genotype and inhibitory control development in childhood

Poster F27, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Maureen Bowers[1], George Buzzell[1], Virginia Salo[1], Troller-Renfree Sonya[1], Hodgkinson Colin[2], Goldman David[2], Gorodetsky Elena[3], McDermott Jennifer[4], Henderson Heather[5], Nathan Fox[1]; [1]University of Maryland, College Park, [2]National Institute on Alcohol Abuse and Alcoholism, [3]National Institute of Health, [4]University of Massachusetts, Amherst, [5]University of Waterloo

The Val108/158Met SNP of the catechol-O-methyltransferase (COMT) gene, primarily involved in dopamine breakdown within prefrontal cortex, has shown relations with executive functioning and inhibitory control (IC) in both adults and children. However, little is known about how COMT genotype relates to the development of inhibitory control throughout childhood. Here, we examined the effects of the MetMet genotype compared to ValVal and ValMet genotype on IC trajectories from ages 5 to 9. Children completed a Go/Nogo task at ages 5, 7, and 9; IC was characterized using signal detection theoretic measures to examine both IC performance (d') and response strategy (criterion). COMT genotype was related to developmental trajectories in IC performance from age 5 to age 9, with MetMet chidlren exhibiting similar levels of IC performance at age 5, but more rapid development of IC performance compared to ValVal and ValMet children during childhood. COMT genotype was not related to initial response strategy in IC at age 5 or developmental changes in IC response strategy. These results show that COMT genotype modulates the development of IC performance in mid-childhood.

Topic Area: EXECUTIVE PROCESSES: Development & aging

Managing two languages relates to managing two goals: fMRI evidence from task-switching

Poster F28, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Kelly A. Vaughn[1], Arturo E. Hernandez[1]; [1]University of Houston

Whether bilingualism is related to cognitive control in non-verbal tasks is a topic of debate among researchers (e.g., Paap, 2016). The current study used fMRI to compare brain activity in Spanish-English bilingual and English monolingual young adults during a shape-color switching task, in which each non-verbal switch or repeat cue was followed by 8-12 trials, and then another cue. The goal of the study was to understand whether task performance or fMRI activity was related to bilingual status. Bilinguals responded significantly more slowly and accurately than monolinguals across all trials. fMRI activity was analyzed at an FWE-corrected alpha of 0.05 for the switch > repeat and repeat > switch contrasts for the cues and for the trials. Monolinguals had the most significant fMRI activity in cognitive control regions (i.e., frontal cortex, anterior cingulate cortex, inferior parietal lobule, and basal ganglia) for the switch > repeat cues contrast, with additional significant activity in these regions during the trials. Bilinguals showed less significant fMRI activity than monolinguals for each task comparison. Overall, these findings lead to the conclusion that bilinguals handle a non-verbal switching task by monitoring conflict throughout the task and controlling speed to improve accuracy, whereas monolinguals handle the same task by responding to each cue as it comes and sacrificing accuracy for speed. This study suggests that bilingual experience, which may involve frequent monitoring of two languages, relates to successfully monitoring two task goals; monolingual language use, conversely, relates to a focus on one task goal at a time.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Fast synchronization and slow synaptic learning as a solution to the stability-plasticity dilemma

Poster F29, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Pieter Verbeke[1], Tom Verguts[1]; [1]Ghent University

The human ability to adapt to a constantly changing environment is remarkable. This relies on the ability to learn quickly about associations between perceptual, motor, and goal representations. Nevertheless, fast learning in neural networks typically leads to forgetting of older information; this is unfortunate because one would like to retain environmental regularities without disruption from novel information. Thus, there exists a tradeoff between being sufficiently adaptive to novel information (plasticity) while retaining valuable earlier regularities (stability). We propose that the brain deals with this issue by relying on two separate, yet interacting learning mechanisms in the same neural structures. The first, fast learning mechanism implements binding-by-synchronization (Fries, 2015) (sync learning). Here, perceptual, motor, and goal representations are bound together by synchronization of neural firing. The second, slow learning, mechanism corresponds to classical synaptic learning by (reward-modulated) Hebbian learning. To implement this hypothesis, we adapted the Verguts (2017) model and tested it on a reversal learning task. Simulations demonstrated that a model using only synaptic learning could not deal with sudden changes in task rules. A model using only sync learning could flexibly deal with task rule changes, but overwrote earlier learned rules. Combining sync learning with synaptic learning however, allowed the model to deal with task rule changes without overwriting earlier information. Thus, the resulting model combined (fast) plasticity using sync learning with (slow) stability using synaptic learning to address the stability-plasticity dilemma. In addition to solving this computational problem, we compare the model to neurophysiological and –anatomical data.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Decoding intentions of self and others from fMRI activity patterns

Poster F30, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Sam Gilbert[1], Hoki Fung[1]; [1]Institute of Cognitive Neuroscience, University College London

Previous studies using multi-voxel pattern analysis have decoded the content of participants' delayed intentions from patterns of fMRI data. Here we investigate whether this technique can be used to decode not only participants' own intentions, but also their representation of the intentions held by other people. In other words: if Sam is thinking about Hoki, can we decode the content of Hoki's intention by scanning Sam's brain? We additionally distinguished two components of intentions: action-plans versus goals, and included novel control analyses that allowed us to distinguish intending an outcome from simply expecting it to occur or simulating its consequences. Regions of frontal, parietal, and occipital cortex contained patterns from which it was possible to decode intentions of both self and other. Furthermore, crossclasification between self and other was possible, suggesting overlap between the two. Control analyses suggested that these results reflected visuo-spatial processes by which intentions were generated in our paradigm, rather than anything special about intentions per se. There was no evidence for any representation of intentions as mental states distinct from visuospatial processes involved in generating their content and/or simulating their outcomes. These findings underline the importance of considering exactly what it is that is being decoded when we decode intentions.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

Influence of motivational incentives on conflict resolution: new evidence from Alzheimer's disease patients

Poster F31, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Elisa Di Rosa[1], Nicky M.J. Edelstyn[2], Daniela Mapelli[1]; [1]Department of General Psychology, University of Padova, Italy, [2]School of Psychology, Keele University, Staffordshire, UK

Neuroimaging studies implicate dopaminergic (DA) modulation of prefrontal cortex (PFC) - basal ganglia (BG) connections during the interaction between motivation and cognitive control (Westbrook & Braver, 2016). Consistent with this, is the evidence of impairments in motivation (reward)-guided modulation of cognitive control in medicated Parkinson's disease (PD) - a condition marked by DA abnormalities (Di Rosa et al., 2015; Houvenaghel et al., 2016a-b). The hippocampus, a structure traditionally associated with cholinergic modulation, also receives dopaminergic projections from the BG, and preliminary evidence suggests it too is involved in reward-guided motivation (see Davidow et al., 2016). This raises the question as to whether reward-guided motivation is impaired in Alzheimer's Disease (AD), where the hippocampus is especially vulnerable to damage. Therefore, in the present study we employed the Motivational Simon task (Di Rosa et al., 2015) to evaluate the effect of reward and punishment on cognitive control in 20 AD patients (mean age 74.5) and 20 age-matched healthy volunteers (HVs). Results showed that while in HVs the presence of reward caused a significant increase in conflict cost (i.e. a bigger Simon effect), AD patients showed a bigger Simon effect in the punishment condition, with respect to the reward one. These findings suggest that AD patients retain the capacity to modulate cognitive control in response to different motivational incentives, and are broadly consistent with recent studies reporting a "negative bias" in AD patients (Perry et al., 2015; Gomez-Gallego & Gomez-Gallego, 2017).

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

The Negative Association of Underweight to Academic Performance and Cognitive Control in Undergraduate Women

Poster F32, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Keita Kamijo[1], Toru Ishihara[2], Suguru Torii[1], Charles H. Hillman[3]; [1]Waseda University, [2]Tamagawa University Brain Science Institute, [3]Northeastern University

Given the global epidemic of obesity, a growing number of studies have demonstrated the negative association between obesity and higher-order cognitive functions (i.e., cognitive control), which have broad implications for academic performance. These findings suggest that being obese is adversely related to not only physical health, but cognitive health and function as well. On the contrary, little is known about the association of underweight to cognitive health, even though being underweight has been associated with several health risks such as osteoporosis, infertility, and increased mortality. This study examined the relation of underweight to cognitive control, which was assessed using a neuroelectric measure of action monitoring, and academic performance in healthy undergraduate women. Underweight and normal weight participants performed an arrowhead version of a flanker task. Error-related negativity (ERN) was assessed during the flanker task, since this component has been thought to be a potential biomarker of academic performance in undergraduate students. Participants also reported their grade point average (GPA). Data were analyzed with multiple regression analysis, controlling for confounding variables. Analyses revealed that body mass index (BMI) was negatively associated with ERN amplitude, as underweight participants exhibited smaller ERN amplitude relative to their normal weight peers. Underweight participants also had lower GPA. These results suggest that underweight young women, relative to their normal weight counterparts, have less ability to monitor their performance and/or upregulate cognitive control, which in turn might underlie their lower GPA.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Effects of cognitive engagements after acute exercise on inhibitory control

Poster F33, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Keishi Soga[1], Tobias Vogt[2], Hiroaki Masaki[1]; [1]Waseda University, [2]German Sport University Cologne

Numerous studies have confirmed beneficial effects of acute aerobic exercise on executive function that is primarily processed in prefrontal cortex. However, empirical evidence is scarce on how cognitive engagements of prefrontal cortex after exercise affect executive function. This study examined the effect of cognitive engagements after exercise on executive function using a within-participant counterbalanced design. In an exercise condition, 18 young adult participants performed moderate intensity aerobic exercise for 20 min and then underwent a memory task, which requires activities of prefrontal cortex, before a flanker task to assess inhibitory control. In a rest condition, participants read newspaper for 20 min. During the flanker task, participants were instructed to respond to the direction of targets by pressing either left or right button as quickly and accurately as possible. We compared cognitive performance as well as event-related potentials (ERPs) during the flanker task between the exercise and rest conditions. Although there was no significant difference in performance between the two conditions, the P3 amplitude was significantly smaller in the exercise condition relative to the rest condition. Further, the standardized low-resolution electromagnetic tomography (sLORETA) analysis assumed that left middle frontal gyrus was responsible for the reduction of the P3 amplitude. Thus, our results suggest that cognitive engagements after exercise might induce efficiency of inhibitory control and that the left frontal brain function might be involved in the efficiency.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

The Effects of Vascular Risk Factors on Inhibitory Control in Cognitively Healthy Young Adults

Poster F34, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Juliette Seremak[1], Heather Nall[1], Alexandra Roach[1]; [1]University of South Carolina Aiken

Research has shown that the presence of various vascular risk factors, such as high blood pressure (BP), glucose levels (BGL), body mass index (BMI), and diabetes, can have an adverse effect on cognitive function in individuals regardless of age. Because many vascular risk factors can be stopped or reversed by taking preventative action, it is important to understand how early in the

lifespan these factors are affecting cognition. The focus of this study was to determine whether or not these risk factors are correlated with cognitive performance, specifically inhibitory control. We tested 47 undergraduate volunteers, between the ages of 18 and 45, on a computerized version of the flanker arrow task with congruent, incongruent, and neutral trials. We analyzed accuracy and reaction times (correct trials) using linear mixed models in R. With respect to accuracy, we found a main effect of systolic BP, $F(1, 42) = 4.371$, $p = .04$, and an interaction with trial type, $F(2, 15239) = 36.8$, $p<.0001$. For reaction time, we found a main effect of systolic BP, $F(1, 42) = 7.97$, $p = .007$, and an interaction between systolic BP and trial type, $F(2, 14394) = 4.76$, $p = .009$, and an interaction between BGL and trial type, $F(2, 14394) = 4.31$, $p = .013$. Overall, individuals with vascular risk factors (higher BP/BGL), had significantly slower reaction times, particularly on incongruent trials, suggesting that these factors may affect processing speeds in healthy young adults by altering neural processes very early in the disease progression.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

Functional Brain Alterations Associated with Cognitive Control in Blast-Related Mild Traumatic Brain Injury

Poster F35, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Danielle R. Sullivan[1,2], Jasmeet Hayes[1,2], Ginette Lafleche[1,2], David Salat[2,3,4], Mieke Verfaellie[1,2]; [1]Boston University School of Medicine, [2]VA Boston Healthcare System, [3]Massachusetts General Hospital, [4]Harvard University

Cognitive control refers to the flexible modulation of information processing in the service of goal-directed behavior and relies on the dynamic interaction of distinct functional brain networks. Recent studies in mild traumatic brain injury (mTBI) have reported neural alterations in the absence of observable behavioral impairment in cognitive control, but no studies have examined how these alterations can be understood with reference to larger functional network dynamics. In the current study, we assessed a sample of patients with blast-related mTBI to investigate these functional networks and their role in potential behavioral and neural alterations in cognitive control. We collected event-related functional magnetic resonance imaging (fMRI) data during a flanker task in 17 individuals with blast-related mTBI and 16 individuals with blast-exposure without TBI (control). Results revealed that groups did not significantly differ in behavioral measures of cognitive control. Relative to the control group, the mTBI group showed greater deactivation of regions associated with the default mode network during the processing of errors. Additionally, error processing in the mTBI group was associated with enhanced negative coupling between the default mode network and the dorsal anterior cingulate cortex as well as the dorsolateral prefrontal cortex, regions of the salience and central executive networks that are associated with cognitive control. These results suggest that deactivation of default mode network regions and associated enhancements of connectivity with cognitive control regions may act as a compensatory mechanism for successful cognitive control task performance in mTBI.

Topic Area: EXECUTIVE PROCESSES: Other

The Novel Application of an Integrative Measure; Self-Regulated Learning in Adult TBI

Poster F36, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Hana Miric[1], Asha Vas[2], Sandra Chapman[3]; [1]UTD, [2]TWU, [3]UTD

Goals: 1) To compare performance on integrative executive function of self-regulated learning, component executive functions of inhibition, switching and working memory, and immediate memory between adults with TBI and controls; 2) to examine sensitivity and specificity of self-regulated learning metric; 3) to compare the discriminative abilities of the experimental self-regulated learning metric with measures of inhibition, switching, working memory and immediate memory-all engaged in self-regulated learning. Methods: 95 persons have completed 3 hours of cognitive assessment. The group with TBI and controls were comparable on indices of age, gender, education and IQ. General linear model and discriminant factor analysis have been conducted. Summary of the results: 1) The group with TBI performed significantly lower than control group on self-regulated learning, as well as on component executive functions. Immediate memory was comparable between the two groups. 2) Self-regulated learning test alone has correctly identified 70% of TBI and 75% of control cases-the sensitivity and specificity higher than of any other executive function or immediate memory measure taken alone. 3) The only higher discriminative power has been found in combination with working memory and inhibition. This triad contributed with only modest (2%) improvement in discriminability of self-regulated learning alone. Conclusions: Deficits in component executive functions were not clinically significant, the only between group difference>2SD has been found on self-regulated learning performance. The experimental self-regulated learning metric is a valuable adjunct tool in following long-term recovery in TBI. The potential of training self-regulated learning in order to improve global outcomes should be investigated.

Topic Area: EXECUTIVE PROCESSES: Other

Neural Mechanisms of Perceptual Comparison Process for Detecting Feature-Binding Changes

Poster F37, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Bo-Cheng Kuo[1]; [1]National Taiwan University

Change detection is of considerable importance in daily life. Successful detection of changes depends on the ability to compare the preceding visual short-term memory (VSTM) representations with the incoming perceptual events. However, the neural substrates underlying the comparison process for detecting feature-binding changes remain unclear. Here I investigate the neural mechanisms for the comparison process in successful detection of feature-binding changes using functional magnetic resonance imaging (fMRI, N = 18) and electroencephalography (EEG, N = 18). Participants performed a change detection task. The type of change (color feature and color-location binding) was manipulated to test whether change type during the comparison process can affect neural responses for supporting successful change detection. In the fMRI experiment, I found a distributed and extensive activation in the prefrontal-parietal neural network for successful change detection versus correct rejection. The fMRI results also revealed stronger activation in the prefrontal and parietal cortices whilst contrasting the binding-change trials with the feature-change trials. In the EEG experiment, I observed significant differences between the binding-change and the feature-change trials, with increased theta activity (3-7 Hz) over right frontal, parietal and temporal electrodes, between 380 ms and 520 ms for the comparison process. In conclusion, these results support the notion that top-down control mechanism is necessary to compare VSTM representations with perceptual inputs when change detection requires comparison of relational information, such as feature binding.

Topic Area: EXECUTIVE PROCESSES: Working memory

Neural Mechanisms Underlying Cognitive Control over Attentional Capture by Working Memory Content

Poster F38, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Peter S. Whitehead[1], Mathilde M. Ooi[1], Tobias Egner[1], Marty G. Woldorff[1]; [1]Duke University

The contents of working memory (WM) have been found to guide visual attention towards items with matching features. Moreover, visual search is faster when a target spatially overlaps with a feature of an item currently held in WM (validly cued) and is slower when the target and WM feature occur at spatially divergent locations (invalidly cued). However, recent behavioral studies have indicated that attentional capture by WM content can be modulated by cognitive control: when WM cues are reliably helpful to visual search (predictably valid), capture is enhanced, but when reliably detrimental (predictably invalid), capture is attenuated. Here we investigated the neural underpinnings of cognitive control over WM biases on attentional selection, focusing on the N2pc ERP component as a neural signature of reactive target enhancement as a function of the predictability of WM-based distraction (N=27). We manipulated predictability of validity by grouping trials into unpredictive blocks (50% valid/invalid) and predictive blocks (100% valid, 100% invalid). Behavioral results confirmed that predictability enhanced the benefit of valid trials and reduced the cost of invalid trials. Comparison of the ERPs evoked by target elements in the search array as a function of validity and predictability showed that the N2pc amplitude was reduced in the predictable conditions. This reduction interacted with validity, with greater N2pc reduction for invalid than valid trials. N2pc reduction for predictably invalid trials suggests top-down attenuation of attentional capture by WM relies on proactive cognitive control reducing the need to reactively suppress WM-matching distractor features in our visual world.

Topic Area: EXECUTIVE PROCESSES: Working memory

Shifting auditory attention in perceptual and mnemonic space: an investigation of event-related EEG parameters in a sound localization and sound detection paradigm

Poster F39, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Laura-Isabelle Klatt[1], Stephan Getzmann[1], Daniel Schneider[1]; [1]Leibniz Research Centre for Working Environment and Human Factors, TU Dortmund

Recently, the capacity to selectively focus on internal representations held in working memory has received a surge of interest. However, since the majority of studies stems from the visual domain, the neural underpinnings of auditory retroactive attention remain largely unknown. The present study compared neurophysiological markers of selective spatial attention during a perceptual and a retroactive auditory search task. In both conditions, participants completed two separate blocks, including a sound localization and a sound detection task. The pattern of results largely differed depending on the investigated EEG parameter and its associated stage of processing. Consistent with previous results, N2 anterior contralateral (N2ac) effects were obtained when participants searched through a perceptual sound array, reflecting the initial shift of attention towards the target, irrespective of task demands. Critically, the N2ac was absent during retroactive search. However, regarding parieto-occipital alpha-band oscillations, similar mechanisms of selective spatial attention seem to operate in perceptual and retroactive search: While we found a pronounced lateralization of alpha power for localization trials, there was no such asymmetry for detection trials. Thus, we conclude that at an early, modality-specific stage of processing, auditory perceptual and retroactive search do not recruit the same spatially-specific neural mechanisms of target selection (e.g. N2ac). In contrast, at a later, potentially supra-modal level of processing, there is a substantial overlap in the neural mechanisms of attentional selection in perception and working memory. Importantly, only sound localization (and not detection) is based on a map of supramodal representations in perceptual and mnemonic space.

Topic Area: EXECUTIVE PROCESSES: Working memory

Visual memories bypass normalization

Poster F40, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Yurika Watanabe[1,2], Ilona M Bloem[1,2], Melissa Kibbe[1,2], Sam Ling[1,2,3]; [1]Boston University, [2]Center for Systems Neuroscience, Boston University, [3]Donders Institude for Brain, Cognition and Behavior, Radboud University

How distinct is visual working memory from visual perception? Although evidence suggests that briefly remembered stimuli are represented within early visual cortices, the degree to which these memory traces resemble true visual representations remains unknown. Here, we examined whether visual memory representations succumb to a hallmark neural computation: divisive normalization. The strength of normalization was assessed by utilizing a surround suppression paradigm wherein participants replicated stimulus intensity by means of a method-of-adjustment task. In the first experiment, observers were shown the center and surround stimuli either simultaneously or sequentially followed by a maintenance interval before they were tasked to report the contrast of the center that was held in memory. Results revealed that while there was substantial suppression across the five tested contrast levels (10-75%) in the simultaneous condition, the presence of the surround stimulus during the retention interval had no impact on the quality of the visual memory. We then tested the strength of normalization between two memory representations by asking observers to report either the contrast of the center or the surround, when they were presented simultaneously or sequentially. Again, while we found robust normalization in the simultaneous condition, we found no signature of normalization occurring between multiple memory representations. These results provide unique insight into the nature of visual memory representations, illustrating that while visual memory representations may reside within early visual areas, they are qualitatively distinct from true visual representations, bypassing divisive normalization, a canonical visual computation.

Topic Area: EXECUTIVE PROCESSES: Working memory

Can TMS to Visual Cortex Reactivate Activity-Silent Representations in Visual Working Memory?

Poster F41, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Morgan Widhalm[1], Nathan Rose[1]; [1]University of Notre Dame

Recent research on working memory (WM) has shown evidence for activity-silent retention mechanisms and the reactivation of latent representations in WM with TMS on simultaneously-recorded EEG (Rose et al., 2016, Science). What is unclear is if activity-silent representations are maintained in sensory cortex and, thus, if TMS could reactivate stimulus-specific features of latent representations. Here we applied single pulse TMS to left primary visual cortex to first localize phosphenes in the right visual field for each participant. Then two oriented gratings were presented -- one at the phosphene location and the other in the opposite (left) hemifield at the same angle and distance from fixation. These gratings were to be retained on a WM task with two retro-cues and two recognition probes. During the delay period, single pulse TMS was applied to left primary visual cortex to induce phosphenes in the contralateral visual field. TMS was applied at 100% or 80% of phosphene threshold to see if it would differentially reactivate or perturb memory of the orientation of the items presented ipsilateral and contralateral to stimulation. Memory precision was only impaired when TMS was applied at 100% of phosphene threshold prior to the second probe. There was no difference in precision for the orientation presented either contralateral to TMS (at the phosphene location) or ipsilateral to TMS. Ongoing analysis of the TMS-evoked response on simultaneously recorded EEG with inverted encoding models will reveal if TMS can reconstruct the specific orientation of the latent memory item.

Topic Area: EXECUTIVE PROCESSES: Working memory

The relationship between lexical development and neural measures of speech discrimination in monolingual and bilingual children: Longitudinal evidence

Poster F42, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

YAN H. YU[1], Valerie L. Shafer[2], Carol Tessel[3], Michelle MacRoy-Higgins[4], Nancy Vidal[5], Alahna Cogburn[2], Richard Schwartz[2]; [1]St. John's University, [2]The Graduate Center, City University of New York, [3]Florida Atlantic University, [4]Hunter College, City University of New York, [5]Iona College

The relationship between language development and neural measures in bilingual children are complex due to great variations in language input for each language and the phonological similarities/dissimilarities of the two languages. This study examines the relationship between language experience (input), lexical growth and neural indices of speech perception development in monolingual English and bilingual English-Spanish children. Behavioral measures of lexical development, neural measures of speech perception and language input were obtained from 21 monolingual English and 20 bilingual Spanish-English children at multiple time points between six months and five years of age. Neural measures were collected from 65 electrode sites to an English-only vowel contrast (/I/ in 'bit" versus /ɛ/ in "bet") in an oddball paradigm designed to elicit the mismatch negativity (MMN). Results revealed that children with monolingual and bilingual backgrounds have similar vocabulary at 12 months of age but monolingually-exposed children showed larger English productive vocabularies at the beginning of 2 years of age. A larger proportion of English monolingual compared to bilingual children had a clear MMN. Mixed-effects modeling reveals that both language group and age modulate MMN.

Topic Area: LANGUAGE: Development & aging

The development of print sensitivity in the visual word form system in pre-readers is influenced by orthographic experience and familial risk of dyslexia

Poster F43, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Jade Dunstan[1], Xi Yu[1], Jennifer Zuk[1,2], Clarisa Carruthers[1], Joseph Sanfilippo[1], Ellen Grant[1,2], Nadine Gaab[1,2,3]; [1]Boston Children's Hospital, [2]Harvard Medical School, [3]Harvard Graduate School of Education

Although the visual word form system (VWFS), including the visual word form area, shows activation sensitivity to print early in development, the specialization process for print, i.e., higher activation for print compared to other categories (i.e., faces), begins only with reading instruction (Centanni et al., 2017). Moreover, individuals with developmental dyslexia (DD), a highly heritable specific learning disability, have shown impaired functional characteristics in the VWFS. It is unknown, however, whether these atypical characteristics are already present prior to reading onset and which factors affect the emergence of this deficit. To address these questions, 5-year-old pre-readers with (FHD+) or without (FHD-) a family history of dyslexia were recruited. Participants performed a visual-auditory matching task for the categories of faces, color, and print (letters and words) during fMRI. Consistent with previous findings, print-specific activation (i.e., print>face+color) was not shown in these pre-reading participants, but print-sensitive activation (i.e., print>rest) was reliably observed in bilateral occipitotemporal regions consistent with the VWFS in both FHD+ and FHD- children. Subsequent region of interest analyses conducted in the print-sensitive regions in bilateral occipitotemporal cortex further demonstrated: 1) a positive correlation between print knowledge and neural activation during the print condition across both groups; 2) FHD- children showed greater print sensitivity than FHD+ children after controlling for letter knowledge skills. Current results demonstrated that the development of print sensitivity in the VWFS is influenced by both letter knowledge and familial risk of DD, and that the occipitotemporal deficits associated with dyslexia are already present before reading onset.

Topic Area: LANGUAGE: Development & aging

Linking Auditory Processing and Lexical Representation via Phonological Discrimination

Poster F44, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Vivi Tecoulesco[1], Erika Skoe[1], Letitia Naigles[1]; [1]University of Connecticut

Auditory Brainstem Responses (ABRs) are auditory evoked potentials recorded on the scalp that reveal the earliest stages of auditory processing. Unstable neural responses to speech sounds may be characteristic of reading-impaired populations; moreover, other language-impaired populations may likewise have unstable neural responses to sound. Thus, stability of auditory processing may support language development in both typical and atypical populations. This project studies the connections between auditory processing and language learning using a phonological discrimination task, which by hypothesis links early auditory processing and macro-level language competency. Eight typically-developing children (TD) and eight diagnosed with autism spectrum disorder (ASD) participated; MAs = 11 years in each group. All were screened for normal hearing thresholds before ABRs were recorded in response to a “da” stimulus (10.9/sec, 6000 trials). Phonological discrimination was assessed in a same/different task utilizing pairs of novel, bisyllabic, consonant-vowel-consonant words. Current language ability was measured using the CELF-5. The TD group performed significantly more accurately on phonological discrimination and on the CELF-5 than the ASD group. Neural response consistency was positively correlated with phonological discrimination ability in the ASD but not in the TD group. Bivariate correlations including both groups found that children with better phonological discrimination also had better language ability. Phonological discrimination appears to mediate the relationship between neural response consistency to speech sounds and current language ability ($z' = 2.8$, $p = 0.005$). As group differences were not observed between TD and ASD groups, similar processes may be at work in both typical and atypical populations.

Topic Area: LANGUAGE: Lexicon

Spoken Language Processing in Cochlear Implant Users Under Perceptually Challenging Conditions: Fluent-Automatic Versus Slow-Effortful Neurocognitive Processing

Poster F45, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Gretchen N.L. Smith[1], William G. Kronenberger[1], David B. Pisoni[2]; [1]Indiana University School of Medicine, [2]Indiana University

Reduced early exposure to auditory experience and language in deaf children with cochlear implants (CIs) may impact the self-organizing processes of central nervous system connectivity recruited for fluent-automatic spoken language processing (Kral et al., 2016), increasing reliance on slow-effortful language processing strategies compared to normal-hearing (NH) peers. This effect may be particularly strong under challenging language processing tasks such as when the speech of different talkers must be processed and recognized or when down-stream contextual cues are minimal or ambiguous. The present study tested two hypotheses:(1) that CI users with stronger fluent-automatic phonological coding skills would perform better on challenging-complex sentence recognition tasks; and (2) that CI users would show a greater decrement in performance than NH peers on challenging-complex sentence recognition tasks compared to simple/basic sentence recognition tasks. CI (n=49) and NH (n=56) samples were scored on measures of rapid phonological coding and challenging sentence recognition including the Perceptually Robust English Sentence Test Open-set (PRESTO) and Harvard Anomalous Sentence Recognition Test (Harvard-A). CI users scored lower than NH peers on PRESTO and Harvard-A (p<.001) tests even when basic sentence perception skills were controlled. Correlations between rapid phonological coding and PRESTO and Harvard-A scores were stronger for the CI sample (r=.84,r=.89,p<.001) than for the NH sample (r=.27,r=.36,p<.05). These findings are consistent with the Auditory Neurocognitive Model (Kronenberger & Pisoni, in press) which proposes that CI users are more dependent on slow, controlled-effortful language processing strategies, including recruitment of executive functions, during complex-challenging spoken language processing tasks compared to NH peers.

Topic Area: LANGUAGE: Other

The left-lateralized N170 and the phonological mapping hypothesis when learning to read in the adulthood

Poster F46, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Laura V. Sánchez-Vincitore[1], Jon Andoni Duñabeitia[2]; [1]Universidad Iberoamericana (UNIBE), Dominican Republic, [2]Basque Center on Cognition, Brain and Language (BCBL), Spain

Automatic and effortless reading is typically indexed by a left-lateralized N170 that responds to visual word forms (Maurer et al., 2006). Intensive training seems to be required to elicit such specialized component (Boltzmann & Rüsseler, 2013), since it tends to be difficult to obtain with neoliterate adult samples (Sánchez-Vincitore, Avery, & Froud, 2017). It has been claimed that the N170 for words stems from the recruitment of left-lateralized language areas while transforming visual stimuli into linguistic orthographic and phonological pieces of information during reading (Maurer & McCandliss 2007). According to the “phonological mapping hypothesis” (Sacchi & Laszlo, 2016), a correlation between phonological awareness in children and their left lateralization of word-related N170 has been suggested. However, this correlation is still to be tested in adults who are learning to read. In this study, we assessed 21 right-handed students enrolled in a national adult literacy program in the Dominican Republic. Participants were tested on phonemic and syllabic awareness tests and reading comprehension. In addition, a high-density EEG was recorded while participants performed a one-back task including words, symbols, objects, and faces, which was specifically designed to elicit the N170 ERP component. We found a significant correlation between phonemic awareness and the left lateralization of N170, supporting the phonological mapping hypothesis in adults who are learning to read in a transparent orthography (Spanish). This study addresses the importance of considering phonological awareness (specifically phonemic awareness) when designing and implementing adult literacy programs, as a skill that could be essential for reading automaticity.

Topic Area: LANGUAGE: Other

The Neurophysiology of Visual Rhyme in Deaf Undergraduate Readers

Poster F47, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Kali Cika[1], Daniel Koo[1], Lawrence Pick[1], Veronica Cristiano[1], Karen Garrido-Nag[1]; [1]Gallaudet University

We used a visual rhyming priming paradigm to determine the time-course and distribution of neural activation in pre-linguistic deaf undergraduate students (n=48). Participants were presented with two written words judged to be at a second-grade reading level and decided whether they rhymed (chair-pear; foot-calf). Due to a large number of participants performing below chance-level, event-related potential (ERP) data was included from those who performed at or above chance-level accuracy (n=10). First, a sustained negativity, termed the contingent negative variation (CNV), was observed following the first stimulus word (prime). This negativity was found over the central sites, which contrasts with what is reported in the literature of deaf and hearing subjects. The second effect we observed was an enhanced negativity (N450) to the non-rhyming second stimulus word (target) compared to the target-rhyme. This is thought to be a reflection of phonological matching or the rhyming effect (RE). Results showed a more negative deflection for non-rhyming vs. rhyming targets over the midline to right hemisphere between 300 and 600 msec. As reported in previous literature, the neural processing of a phonological task such as rhyming appears to be similar between deaf and hearing individuals. The majority of participants reported ASL as their primary mode of communication, suggesting these results are modality- (spoken vs. sign) independent. A comprehensive battery of neuropsychological measures was also administered to gain a better understanding of the linguistics and reading profiles of these deaf students. The relationship between the neurophysiological and neuropsychological findings will be presented.

Topic Area: LANGUAGE: Other

Sensory simulation, motor simulation and mentalizing during narrative reading: Insights from eye-tracking

Poster F48, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Marloes Mak[1], Roel M. Willems[1,2]; [1]Radboud University, Nijmegen, the Netherlands, [2]Max Planck Institute for Psycholinguistics, Nijmegen, the Netherlands

People engage in simulation when they become part of a narrative. In this study, we tried to pinpoint how different kinds of simulation (i.e. sensorimotor simulation, mentalizing) affect reading behavior. Eye-tracking data and self-report questionnaires were collected from 102 participants. All participants read the same three stories, in counterbalanced order. In a pre-test, 90 participants that did not participate in the eye-tracking experiment had determined which parts of the stories were high in motor simulation-eliciting content (n=30), sensory simulation-eliciting content (n=30) or mentalizing-eliciting content (n=30), resulting in scores of 0-30 per type of simulation-eliciting content, per word. The results show that words higher in motor simulation-eliciting content have shorter gaze duration (they are read faster). On the contrary, words that are higher in sensory simulation-eliciting content or mentalizing-eliciting content had longer gaze duration (slower reading). These influences of simulation-eliciting content on gaze duration are attenuated or even reversed when people report a high level of attention while reading the stories, but are increased when people report a strong emotional response to the stories (if they found the story more sad, tragic, ominous, touching, and thrilling). The fact that people, in general, slow down when reading sensory simulation-eliciting content or metalizing-eliciting content is in line with our hypothesis that simulation processes take time. Interestingly, this was not the case for motor simulation-eliciting content. Perhaps the neural networks involved in motor simulation are easier to activate than networks involved in sensory simulation and mentalizing, resulting in faster reading for motor simulation-eliciting content.

Topic Area: LANGUAGE: Other

ERP Evidence for Probabilistic Lexical Prediction

Poster F49, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Emily Morgan[1,2], Nate Delaney-Busch[1], Minjae Kim[3], Lena Warnke[1], Eddie Wlotko[4], Gina Kuperberg[1,5]; [1]Tufts University, [2]UC Davis, [3]Boston College, [4]Moss Rehab Center, [5]Massachusetts General Hospital

Successful linguistic communication relies on comprehenders making predictions about upcoming words. Here we ask: 1) Is such prediction an all-or-none phenomenon (in which a word is either pre-activated or not) or a probabilistic phenomenon (in which a word's pre-activation is proportional to its predicted probability)? and 2) Does the need to suppress competing alternatives increase the difficulty of prediction and/or lexical processing when a small number of candidates are likely? In an Event-Related Potential (ERP) experiment, we manipulate whether constraining sentence contexts have only one or more than one likely continuation, and whether participants see the most expected word, the second-most expected word (in cases with more than one likely continuation), or an unexpected word. Consistent with a probabilistic prediction account, we find a graded N400 effect in which N400 amplitudes increase with decreased word probability, replicating DeLong, Urbach, & Kutas (2005). We additionally find a late anterior positivity in response to unexpected words in constraining sentence contexts, replicating Federmeier et al. (2007). In future work, we plan to investigate whether this positivity varies gradiently with sentence constraint, as predicted by the probabilistic prediction account. Comparing responses to the most expected word in contexts with more than one likely continuation versus contexts with only one likely continuation, we saw no differences in N400 responses, providing no evidence for an effect of competition between alternatives on the difficulty of lexical processing.

Topic Area: LANGUAGE: Other

ERP exploration of semantic organization for abstract and concrete words in bilinguals and persons with aphasia

Poster F50, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Erika Exton[1], Chaleece Sandberg[1]; [1]Penn State University

No study to date has compared ERP data from unbalanced bilinguals and persons with aphasia (PWA) during abstract and concrete word processing, although there is reason to suspect similar processing of the weaker language in bilinguals and the disrupted language in PWA. Both unbalanced bilinguals and monolingual English PWA may have weaker connections between the lexical form in English and the conceptual representation. Thus, we tested 25 Dutch-English unbalanced bilinguals and 11 monolingual English PWA in both a lexical decision task and a semantic association task (modified from Crutch et al., 2009). The lexical decision task included 60 concrete words, 60 abstract words, and 120 non-words. The semantic relatedness task had four conditions, each with 40 word pairs: concrete similar, concrete associated, abstract similar, abstract associated. An unrelated condition for each word type (80 word pairs) was also included. Using repeated measures ANOVAs with paired t-tests, we found the expected concreteness effect in the lexical decision task – significantly greater N400 for concrete than abstract words – in the Dutch-English bilinguals, but not in the PWA. In the semantic association task, both PWA and Dutch-English bilinguals showed the expected pattern: a larger difference in the N400 in the similarity context between abstract and concrete words and a reversed (though smaller) difference in the association context between abstract and concrete words. However, for PWA the results did not reach significance. These results support the theory that abstract words are organized associatively while concrete words are organized taxonomically (Crutch et al., 2009).

Topic Area: LANGUAGE: Semantic

Relational versus Plural Concepts: The Role of the Left Angular Gyrus

Poster F51, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Adina Williams[1], Liina Pylkkänen[1,2]; [1]New York University, New York, [2]New York University, Abu Dhabi

The left Angular Gyrus (lAG) has been found to play a role in relational processing, showing more activation for words that label relational concepts (such as 'mother,' which names a relation between a female parent and her child) than nonrelational concepts (e.g., lady) (Williams et al. 2017, Thompson 2007). Another strand of research (Domahs et al. 2014, Boiteau et al. 2014) finds that plural concepts (e.g., ladies) drive lAG activity more than singularities (e.g., lady). Is there a single function for the lAG that can unify both sets of findings? If relational concepts activate possible objects that stand in the relation, then they should activate pluralities of objects, suggesting that relationality effects could be explained as plurality effects. We tested this by presenting singular and plural relational (e.g., sister/sisters) and non-relational (lady/ladies) nouns in isolation. Distributed MEG source activity localized in the left inferior parietal cortex was analyzed using cluster-based permutation tests. A 2 (relational/non-relational) x 2 (bare/plural-marked) ANOVA isolated a main effect of relationality (sister/sisters > lady/ladies) in a spatiotemporal cluster (in BA 39, 40) from 190-320ms after target noun onset. No effects of plural marking nor an interaction were discovered. These results rule out the hypothesis that the relationality effects isolated in previous studies can be explained as effects of plurality. Boiteau et al. (2014). Brain & Language. Domahs et al. (2014). J Cognitive Neuroscience. Thompson et al. (2007). J Cognitive Neuroscience. Williams et al. (2017). Neuropsychologia.

Topic Area: LANGUAGE: Semantic

An MEG study of lexico-semantic processing in sentence comprehension: A Representational Similarity Analysis

Poster F52, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Lin Wang[1,2], Ole Jensen[3], Gina Kuperberg[1,2]; [1]Department of Psychiatry and the Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, USA, [2]Department of Psychology, Tufts University, Medford, MA, USA, [3]Centre for Human Brain Health, University of Birmingham, Birmingham, UK

In EEG/MEG, semantic processing is classically indexed by a smaller N400(m) to expected than unexpected words between 300-600ms. MEG source localization suggests that one source of this effect is the left anterior superior temporal cortex. Intracranial recordings, however, report sources in the medial temporal region. The current MEG study used a representational similarity analysis to identify brain regions distinguishing between semantically expected and unexpected critical words. Twenty-six Chinese participants read 240 high-constraining sentences, ending with either expected or unexpected sentence-final words (SFWs). We extracted the spatial pattern of neural activity to SFWs within two regions of interest (ROIs): left superior temporal cortex and left medial temporal region (left parahippocampus + hippocampus + fusiform). Within each ROI, we correlated the spatial pattern between all possible pairs of (a) expected SFWs (b) unexpected SFWs (c) expected – unexpected SFWs. We then averaged these spatial patterns to construct two time series of R values, reflecting shared spatial patterns for expected SFWs (within-expected pairs), unexpected SFWs (within-unexpected pairs), as well as between the unexpected and expected SFWs (between-condition pairs). Within the superior temporal ROI, between 300–600ms after SFWs onset, spatial similarity was greater for within-unexpected than both within-expected and between-condition pairs. However, within the medial temporal ROI, spatial similarity was greater for both within-unexpected and within-expected pairs than for the between-condition pairs. We suggest that both the superior temporal and medial temporal regions were engaged in processing semantically unexpected words, whereas the medial temporal region was selectively engaged in processing semantically expected words.

Topic Area: LANGUAGE: Semantic

Semantic Priming of Reading by Visual Processing Stream: Exploring Encoding Through Stimulus Quality.

Poster F53, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Josh Neudorf[1], Chelsea Ekstrand[1], Shaylyn Kress[1], Alexandra Neufeldt[1], Ron Borowsky[1]; [1]University of Saskatchewan

Converging evidence from neuroimaging, computational modeling, and neuropathology cases supports the Distributed-Plus-Hub view of semantic processing, in which there are distributed connected, modality specific, sub-systems for processing shape, colour, and action, connected to an amodal semantic hub supporting integration of semantic representations (Patterson et al., 2007). Furthermore, neuroimaging and neuropathology evidence suggests that the visual sub-systems for colour and shape are processed mainly along the ventral visual processing stream while the action sub-system is processed mainly along the dorsal visual processing stream (e.g., Whitwell et al., 2014). Priming was used to examine the sharing of the visual semantic sub-system with the ventral-lexical reading stream, and the action semantic sub-system with the dorsal-sublexical reading stream. Participants named a word or pseudohomophone (PH) after reading a prime that required imagining either visualizing an object word, priming

the ventral stream, or performing an action word, priming the dorsal stream. Target items were degraded in a second experiment to explore processing at the encoding level. In a Linear Mixed Model analysis of reaction time (RT), shared-stream overall facilitation was observed for words but not PHs, whereby visual primes produced faster naming of the targets. Exploring encoding effects, when the target stimuli were degraded priming effects were not larger than those seen with intact targets, suggesting there was no semantic feedback to the encoding level. Reading words benefited more from the visual primes, reflecting the degree of shared-stream activation. Semantic priming was similar regardless of prime type, reflecting the degree of amodal semantic hub integration.

Topic Area: LANGUAGE: Semantic

Baseline semantic processing skills are important for typicality-based naming therapy outcomes

Poster F54, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Natalie Gilmore[1], Erin Meier[1], Jeffrey P. Johnson[1], Swathi Kiran[1]; [1]Boston University

Goal: To examine the degree to which semantic and/or phonologic deficit profiles predict treatment response from typicality-based semantic feature analysis (SFA) treatment in persons with aphasia (PWA). Methods: Twenty-seven PWA underwent SFA to improve word retrieval post-stroke. Baseline assessments were given to assess specific aspects of the lexical retrieval process: Pyramids and Palm Trees Test (nonverbal semantics), semantic feature and category verification tasks (lexical-semantics), phonological processing tasks requiring lexical retrieval (phonological output lexicon), and phonological tasks involving rhyme judgment, phoneme verification, and nonword discrimination (phonological buffer). After therapy, proportion of potential maximal gain (PMG) from treatment was calculated. Baseline scores on the language assessment measures were entered into independent linear regressions predicting PMG. Results: The model including nonverbal semantic processing, treatment response, and their interaction explained 85% of the variance in PMG ($F(4, 22) = 31.14$, $p < .001$). Controlling for aphasia severity, the interaction term was significant ($\beta = 2.70$, $p = .002$), indicating that PWA who responded positively to treatment had higher pre-treatment amodal semantic processing ability, and that this finding was not driven by overall language impairment. Furthermore, the integrity of lexical-semantic processing, the phonological output lexicon, and the phonological buffer system at baseline did not significantly predict outcomes of typicality-based SFA treatment. Conclusion: Heterogeneity in semantic treatment response may be in part explained by pre-treatment nonverbal semantic processing ability. These results suggest that PWA, who responded favorably to this treatment approach, relied on their intact semantic system to strengthen their lexical retrieval skills.

Topic Area: LANGUAGE: Semantic

Cortical tracking of linguistic phrases: bottom-up and top-down effects of prosodic processing

Poster F55, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Anastasia Glushko[1,2], Max Wolpert[1,2], Alessandro Tavano[3], David Poeppel[3], Karsten Steinhauer[1,2]; [1]McGill University, [2]The Centre for Research on Brain, Language and Music, [3]Max Planck Institute for Empirical Aesthetics

Cortical tracking of linguistic phrases has recently been demonstrated using magneto- and electroencephalography (e.g., Ding et al., 2016; Ding et al., 2017). However, the relative contributions of prosodic (bottom-up, overt or top-down, covert) and syntactic processing to the reported increases in cortical activity at phrasal rate remain unclear. We hypothesized that these neurophysiological effects can be largely attributed to covert (top-down) prosodic chunking (see e.g., Steinhauer & Friederici, 2001; Nozaradan et al., 2011). In our EEG study, participants listened to German four-word sentences presented in blocks of 12 with no pauses between words. Each word was 250 ms long, with syntactic phrase boundaries appearing at the rate of 2 Hz (ex.: “Your song | sounds good”). Within each block, sentences followed a specific prosodic contour: with prosodic cues (sound intensity and pitch) (a) flattened (“No Prosody”); (b) fluctuating at the rate of syntactic phrase boundaries (“Matching”; 2Hz); or (c) fluctuating at the rate different from the rate of syntactic phrase boundaries (“Mismatching”; 1Hz). To test top-down effects of covert prosody

processing, we additionally presented participants with “No Prosody” sentences asking them to mentally map either the “Matching” or the “Mismatching” intonation onto them. We found that processing of both overt and covert prosodic cues attenuated the effects of syntactic phrase processing, making them (1) more pronounced compared to the “No Prosody” condition if the prosodic contour of the sentence aligned with syntactic phrasing (“Matching”), and (2) less pronounced if the two did not align (“Mismatching”).

Topic Area: LANGUAGE: Syntax

Neurodevelopmental impact of early bilingual acquisition on children’s syntactic processing.

Poster F56, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Neelima Wagley[1], Xiaosu Hu[1], Alisa Baron[2], Akemi Tsutsumi Rioboo[1], Isabel Hernandez[1], James Booth[3], Teresa Satterfield[1], Lisa M. Bedore[2], Ioulia Kovelman[1]; [1]University of Michigan, [2]University of Texas - Austin, [3]Vanderbilt University

How does bilingual acquisition influence children’s neural architecture for sentence processing? Language acquisition is characterized by progressive use of inflectional morphology marking verb tense and agreement (“Today he is baking a cake” or “Every day he bakes a cake”). Children’s acquisition of linguistic milestones is also linked to increased neural specialization of the left inferior frontal (IFG) and posterior temporal (STG) regions classically associated with language processing. We used functional Near-Infrared Spectroscopy (fNIRS) to investigate how bilingual exposure influences children’s cortical organization for processing morpho-syntax. Forty Spanish-English bilingual children growing up in the U.S. (ages 6-10, M = 8) completed grammaticality judgment task that included English sentences with violations in earlier- (verb agreement, -ing omissions) and later-acquired (verb tense/agreement, -ed/s omissions) structures. Children had high dual-language proficiency and were faster and more accurate when processing violations of the earlier- than the later-acquired structures. Neuroimaging analyses revealed robust activations in left frontal channels for correct sentences and earlier-acquired structure violations (-ing), but not the later-acquired structure violations (-ed/s). In contrast, left temporal channels showed robust activation for all sentence types ($p < 0.05$). The findings parallel those previously found for young monolingual children with earlier neural specialization of the left temporal regions, followed by increased specificity of the frontal regions, especially the dorsal IFG regions considered critical for syntactic processing (Skeide & Friederici, 2016). The findings suggest that early-exposed and highly proficient bilinguals follow a monolingual-like trajectory of neural specialization for language processing in the dominant language of their daily use.

Topic Area: LANGUAGE: Syntax

Traumatic stress does not exert lesion-like effects on hippocampal function in children

Poster F57, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Jennifer Stevens[1], Sanne van Rooij[1], Ye Ji Kim[1], Timothy Ely[1], L. Alexander Vance[1], Bekh Bradley[1,2], Tanja Jovanovic[1]; [1]Emory University School of Medicine, [2]Atlanta Veterans' Affairs Medical Center

Non-human animal findings indicate the hippocampus is highly sensitive to the damaging effects of stress, but little previous research has addressed effects of early life stress on human hippocampal function. Here we investigated the effects of trauma exposure on fMRI activation in a hippocampus-dependent episodic memory encoding task, in school-age children at risk for experiencing high levels of inner-city violence. N=50 children ages 8-14 participated; this age window targets a time of peak exposure to childhood trauma, as well as substantial maturational change in medial temporal lobe connections with the prefrontal cortex. During fMRI, children viewed static scene stimuli with emotional content of negative, positive, or neutral valence. After a 30-minute delay, children completed a cued recall task assessing their memory for each scene from the scanning session. Children showed greater memory for negative and positive scenes, relative to neutral (ps<.05). Age was positively associated with overall recall performance ($R2=.07$, $p<.05$) and the enhancing effect of emotion on recall (negative–neutral scene recall; $R2=.08$, $p<.05$). Trauma load (number of different types of traumas experienced; TESI-C) was positively associated with recall performance, particularly for negative scenes (all scenes: $R2=.14$, negative scenes: $R2=.25$, $p<.05$). Furthermore, trauma exposure was positively associated with encoding-related activation in the hippocampus ($R2=.25$, $p<.05$) and amygdala ($R2=.11$, $p<.05$) for

negative stimuli. Findings point to a surprising increase in hippocampal activity with greater childhood trauma load, particularly for negative stimuli. We posit that this may represent a neurodevelopmental adaptation to a high-trauma environment, facilitating memory for negative environmental cues.

Topic Area: LONG-TERM MEMORY: Development & aging

Sensory dominance and multisensory integration as screening tools in aging

Poster F58, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Pawel J. Matusz[1], Alison F. Eardley[2], Trudi Edginton[3], Rebecca Oyekan[2], Emily Smyth[2], Micah M. Murray[1,4,5,6]; [1]University Hospital Center - University of Lausanne, Switzerland, [2]University of Westminster, London, UK, [3]City, University of London, [4]Fondation Asile des Aveugles - University of Lausanne, Switzerland, [5]Center for Biomedical Imaging, Switzerland, [6]Vanderbilt University

Multisensory information typically confers neural and behavioural advantages over unisensory information. We used a simple audio-visual detection task to compare healthy young (HY), healthy older (HO) and mild-cognitive impairment (MCI) individuals. Neuropsychological tests assessed individuals' learning and memory impairments. First, we provide much-needed clarification regarding the presence of enhanced multisensory benefits in both healthily and abnormally aging individuals. The pattern of sensory dominance shifted with healthy and abnormal aging to favour a propensity of auditory-dominant behaviour (i.e., detecting sounds faster than flashes). Notably, multisensory benefits were larger only in healthy older than younger individuals who were also visually-dominant. Second, we demonstrate that the multisensory detection task offers added benefits as a time- and resource-economic MCI screening tool. Receiver operating characteristic (ROC) analysis demonstrated that MCI diagnosis could be reliably achieved based on the combination of indices of multisensory integration together with indices of sensory dominance. Our findings showcase the importance of sensory profiles in determining multisensory benefits in healthy and abnormal aging. Crucially, our findings open an exciting possibility for multisensory detection tasks to be used as a cost-effective screening tool. These findings clarify relationships between multisensory and memory functions in aging, while offering new avenues for improved dementia diagnostics.

Topic Area: LONG-TERM MEMORY: Development & aging

The Tell-Tale Heart: Infant memory for a stressful social event at 4-months.

Poster F59, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Isabelle Mueller[1], Nancy Snidman[1], Jennifer DiCorcia[1], Akhila Sravish[1], Erin Duffy[1], Ed Tronick[1]; [1]University of Massachusetts Boston

Research on infant memory is typically based on non-stressful stimuli such as novelty- or imitation-paradigms, but our understanding of infant memory for a social stressor is limited. To fill this gap, the present study uses the Face-to-Face Still-Face (FFSF) procedure, a paradigm that elicits a well documented behavioral stress response in infants. Infants in the experimental condition (n=40) were exposed to the FFSF on two consecutive days, while the control group (n=40) completed a time-matched play-session on day 1 and the FFSF on day 2. Changes in behavior, heart rate (HR) and salivary cortisol were evaluated. Infants in the experimental condition showed a significant decrease in positive affect and an increase in HR on day 2, compared to controls. The change in infant HR was independent from maternal HR which did not differ between day 1 and day 2 or between groups. The groups did not differ in salivary cortisol on day 2. Findings suggest that a previous stressful experience may elicit a behavioral and physiological response in infants 24 hours later. The results could have implications for further research on stressful and traumatic events in early childhood.

Topic Area: LONG-TERM MEMORY: Development & aging

Mesial temporal lobe epilepsy is characterized by hippocampal stiffness alterations and relational memory deficits

Poster F60, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Hillary Schwarb[1], Curtis L. Johnson[2], Bradley P Sutton[1], Tracey M Wszalek[1], Graham Huesmann[3]; [1]University of Illinois, [2]University of Delaware, [3]Carle Foundation Hospital

Mesial temporal lobe epilepsy (MTLE) is the most common cause of persistent, medically-intractable seizures, but has promising surgical outcomes. The use of surgical intervention requires positive structural MRI findings (e.g. hippocampal volumetry), however, with traditional methods, significant tissue damage must occur before detection is possible. Because surgery is highly effective in stopping seizures, the development of novel, sensitive imaging biomarkers for earlier detection is essential. MTLE is characterized by degradation and scarring of lateral hippocampal tissue over time accompanied by considerable memory deficits. Magnetic resonance elastography (MRE) is an emerging non-invasive tool for quantitatively measuring tissue stiffness that reflect the microstructural health of tissue. Because MTLE ultimately results in sclerotic hippocampal tissue, which should be stiffer than healthy tissue, MRE may prove an important tool for early MTLE detection. Further, MRE measures of hippocampal integrity may provide insight to memory impairment in MTLE. In this study, 9 MTLE patients were compared to 7 matched controls, and all participants completed an MRE scan and a relational memory behavioral battery. Patients were significantly impaired on all relational memory measures. Furthermore, MRE revealed higher hippocampal stiffness in the epileptogenic hemisphere compared to the unaffected side. The ratio of epileptogenic to unaffected hippocampal stiffness dissociated patients from controls with high accuracy. Finally, the significant relationship between relational memory performance and tissue stiffness was similar in both hemispheres for controls, but present only in the contralateral (non-epileptogenic) hemisphere for patients. These data suggest that MRE, combined with memory measures, may be beneficial in characterizing MTLE.

Topic Area: LONG-TERM MEMORY: Episodic

The sleep spindle refractory period segments memory reactivation events across time

Poster F61, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

James Antony[1], Luis Piloto[1], Margaret Wang[1], Paula Pacheco[1], Kenneth Norman[1], Ken Paller[2]; [1]Princeton University, [2]Northwestern University

The stability of long-term memories is enhanced during sleep. Although the specific role of thalamocortical sleep spindles in memory function is poorly understood, correlative evidence has linked spindles with memory replay. Here, we show that spindles increased shortly after sound cues presented during sleep to promote replay. Furthermore, spindles after cues were associated with better memory, but spindles shortly before cues predicted worse memory. We hypothesized that memory replay was less likely when cues occurred within the spindle refractory period. We thus tracked spindles in real-time and presented cues inside or outside the presumptive refractory period; memory was superior in the latter case. Our findings provide new evidence for how spindles segment time into memory reactivation events and reactivation blinks – when spindles are refractory.

Topic Area: LONG-TERM MEMORY: Episodic

False memory for spatial location is mediated by V1

Poster F62, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Jessica M. Karanian[1,2], Scott D. Slotnick[3]; [1]Wesleyan University, [2]Tufts University, [3]Boston College

Prior fMRI results have given rise to the view that true memories, but not false memories, activate early sensory cortex. It is thought that false memories, which reflect conscious processing, do not activate early sensory cortex because these regions are associated with nonconscious processing. We posited that false memories may activate early sensory cortex when task conditions are

manipulated to evoke conscious processing. In an fMRI experiment, during encoding, abstract shapes were presented to the left or right of fixation. During retrieval, old shapes were presented at fixation and participants characterized each as previously on the "left" or "right" followed by a "unsure"–"sure"–"very sure" confidence rating. False memories for spatial location (i.e., "right"/left or "left"/right + "very sure" or "sure") were associated with activity in bilateral early visual regions, including V1. In a follow-up fMRI-guided TMS experiment, we assessed whether V1 activity was necessary for false memory construction by temporarily disrupting processing in this region. The identical memory paradigm was employed and, between the encoding and retrieval phases of each run, TMS (1 Hz, 8 min) was employed to target the location of false memory activity (identified in the fMRI experiment) in left V1, right V1, or the vertex (a control site). False memories for spatial location were significantly reduced following TMS to V1, as compared to vertex ($\chi 2$ (1) = 8.06, $p < .01$). The results of the present experiments provide strong evidence that early sensory cortex can contribute to false memory construction under particular task conditions.

Topic Area: LONG-TERM MEMORY: Episodic

Effects of emotional valence on retrieval-related recapitulation effects and subjective memory vividness

Poster F63, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Sarah Kark[1], Ryan Daley[1], Elizabeth Kensinger[1]; [1]Boston College

While many studies have examined memory reactivation (or 'recapitulation') of encoding processes during retrieval, few have examined the effects of valence (negative vs. positive) on recapitulation or memory vividness. We recently (Bowen, Kark & Kensinger, in press) proposed a model for the divergence between negative and positive memories: greater recapitulation in visual regions for negative memories, compared to positive memories. Here we test a prediction of this model in a new dataset, asking: Does activation in recapitulated visual regions track with memory vividness in a valence-specific way? Here, participants studied line-drawings of negative, positive, and neutral photos followed by the complete photo. After a 24-hour delay, participants completed a surprise recognition memory test. During test, participants were shown all of the previously studied line-drawings and an equal number of unstudied line-drawings. Participants indicated if they thought each line-drawing was new or—if they thought it was old—they rated memory vividness. Critically, low-level visual features were controlled at the item level, allowing us to examine emotional memory effects beyond any stimulus-related effects of visual complexity. We replicated our prior work demonstrating recapitulation in visual processing regions and the parahippocampal cortex for negative memories. While memory vividness was correlated with activation in the hippocampus across valence categories, we demonstrate valence-specific effects of memory vividness in a region of fusiform gyrus that also showed negative memory recapitulation effects. The current study provides support for our model that recapitulation of the visual processing regions supports long-term memory and subjective vividness for negative memories.

Topic Area: LONG-TERM MEMORY: Episodic

Thalamocortical spindles relate to changes in memory representations

Poster F64, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Emily Cowan[1], Anli Liu[2], Simon Henin[2], Sanjeev Kothare[2], Orrin Devinsky[2], Lila Davachi[1]; [1]New York University, [2]NYU Langone School of Medicine

It has long been hypothesized that sleep supports overnight memory consolidation. Features in the architecture of sleep have been related to sleep-dependent memory enhancements, including a relationship between specific stages of sleep and changes in univariate fMRI activation in the hippocampus and cortex during retrieval of memories learned before sleep. Evidence also suggests that functional connectivity measures may be time-sensitive, linking consolidation and the distribution of memory traces. However, it remains unknown how aspects of sleep architecture might relate to the representation of individual memory traces after sleep. To investigate this relationship, we designed a three-day experiment utilizing overnight polysomnography recordings and fMRI. Subjects encoded two lists of word-image pairs twice, either with an intervening period of overnight sleep (Sleep List), or a brief wakeful period (New List), such that the lists differed in the opportunity for consolidation. During the re-study scanning

session, subjects were presented with previously seen word-image pairs, and new pairs (Single Study List). Cued recall was probed immediately following the scan and after a 24-hour delay. We found evidence that the density of thalamocortical fast spindles during overnight sleep was related to both the representation and distribution of the memories encoded prior to sleep. Specifically, in the ventromedial prefrontal cortex, fast spindle density was related to greater multivariate pattern similarity amongst Sleep List pairs. Spindle density also was related to functional connectivity between the anterior hippocampus and vmPFC, only for pairs learned before sleep, providing evidence that spindles promote a hippocampal-cortical dialogue during sleep-dependent consolidation.

Topic Area: LONG-TERM MEMORY: Episodic

Sex differences in the brain during long-term item memory

Poster F65, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Dylan S. Spets[1], Scott D. Slotnick[1]; [1]Boston College

There is little evidence on sex differences in the human brain during long-term memory. In the current study, we reanalyzed data from two fMRI experiments to investigate the similarities and differences in brain activity between males and females during long-term item memory. In both experiments, during encoding, abstract shapes were presented to the left or right of fixation. During retrieval, old and new shapes were presented at fixation and participants classified each shape as “old-left”, “old-right”, or “new”. A random-effect general linear modal analysis was conducted (N = 11 males, 11 females). To isolate item memory, we contrasted item memory hits (with incorrect spatial location responses) and item memory misses. Contrasts were thresholded at $p < .001$, corrected to $p < .05$. As expected, for both males and females, this contrast produced activity in the dorsolateral prefrontal cortex, the parietal cortex, the hippocampus, and visual processing regions. The conjunction of item memory hits versus misses for males and females produced a limited number of small activations. The contrast of item memory hits for males versus females revealed very different patterns of activity. Males showed greater activity in the middle frontal gyrus, the medial anterior prefrontal cortex, and the hippocampus. Females showed greater activity in Broca’s and Wernicke’s areas, and early and late visual regions. Males and females also showed different patterns of activity in the anterior prefrontal cortex and the parietal cortex. Our results suggest that males and females recruit largely different brain regions during long-term item memory.

Topic Area: LONG-TERM MEMORY: Episodic

Increased fMRI connectivity of the anterior-medial hippocampal-cortical network via noninvasive brain stimulation

Poster F66, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Molly S. Hermiller[1], Melissa Gunlogson[1], Robert Palumbo[1], Brennan Durr[1], Valerie McDonald[1], Stephen VanHaerants[1], Joel L. Voss[1]; [1]Northwestern University Feinberg School of Medicine

The hippocampus interacts with distributed brain regions forming a hippocampal-cortical network in support of episodic memory. Anterior-temporal and posterior-medial subdivisions of this network have been linked to distinct memory processes primarily on the basis of fMRI findings. Noninvasive brain stimulation can be used to test the causal role of brain networks in cognitive function, but it is unclear whether distinct subdivisions can be separately influenced by stimulation. We have previously shown that the posterior-medial subdivision can be selectively modulated using transcranial magnetic stimulation. Here, we aimed to determine whether fMRI connectivity of the anterior-temporal subdivision could be selectively influenced. In this sham-controlled, multi-day study (N=16), 20-Hz transcranial magnetic stimulation was delivered for five consecutive days. Subject-specific hippocampal targets and stimulation locations in the dorsal lateral prefrontal cortex were identified using baseline fMRI connectivity. Prior to and 24-hours following the five days of stimulation, resting-state fMRI scans were acquired. Several core regions of the anterior-temporal network critical for memory showed increased fMRI connectivity due to stimulation, including the medial prefrontal/orbitofrontal and anterior cingulate cortex, as well as the left anterior hippocampus and surrounding rhinal cortex, which are also the intended deep-brain targets of stimulation. These findings demonstrate that the anterior-temporal subdivision of the hippocampal-cortical network can be indirectly, yet selectively, modulated by noninvasive stimulation. These findings provide the framework for future studies using stimulation to distinguish the role of distinct hippocampal-cortical network subdivisions in episodic memory.

Topic Area: LONG-TERM MEMORY: Episodic

Improving Episodic Autobiographical Memory in Older Adults with a Novel Digital Memory Augmentation Device

Poster F67, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Bryan Hong[1], Chris B Martin[1], Andrew Xia[1], Chris J Honey[1,2], Morgan D Barense[1,3]; [1]University of Toronto, [2]Johns Hopkins University, [3]Rotman Research Institute

The episodic and semantic subcomponents of autobiographical memory (AM) are differentially affected during aging, with episodic AM details being more vulnerable to degradation than non-episodic AM details. Additionally, this dissociation in AM is exacerbated in individuals who have memory disorders, such as Alzheimer's disease or its precursor, mild cognitive impairment. A promising approach to minimize the effects of episodic AM loss in aging is digital memory augmentation (DMA), whereby a device records information in one's day-to-day life for later review. Despite producing benefits to memory recall, current DMA protocols do not incorporate findings from the cognitive neuroscience literature which have been shown to improve memory. We developed a novel DMA device which takes into account the neurobiology underlying AM and various, well-established principles from cognitive neuroscience outlining how we optimally learn and remember events. Participants used this device to record events and review them back in a speeded and distributed manner throughout the day. Using a cued recall task, we found that this review process specifically improves recall of episodic AM details without affecting recall of non-episodic AM details in older adults, demonstrating that usage of our DMA device selectively restores the deficit in episodic AM with aging. The results of the current study pave the way for an inexpensive, efficient, and scientifically-tested intervention to help improve the quality of life of those affected by memory loss.

Topic Area: LONG-TERM MEMORY: Episodic

Opposing mnemonic and decision-making biases in recognition memory judgments

Poster F68, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Azara Lalla[1], Anuya Patil[1], Jennifer D Ryan[1,2,3], Katherine Duncan[1]; [1]Department of Psychology, University of Toronto, ON, Canada, [2]Rotman Research Institute, Baycrest, Toronto, ON, Canada, [3]Department of Psychiatry, University of Toronto, ON, Canada

Although memory assessments are generally assumed to faithfully quantify mnemonic processing per se, in practice they measure how people make decisions about memory. Yet, the ways in which decision-making biases shape performance is often overlooked and certainly understudied. Here, we uncovered one such bias by investigating how recent memory decisions impact recognition judgments. On a direct test of memory, we found that participants were more likely to judge an image as new after identifying an unrelated preceding image as old ($p<0.05$), and vice versa. The previous judgments did not affect subsequent accuracy; it only shifted the criterion that participants used to make their memory judgments. We replicated this bias across 4 conditions, but none could determine whether the sequential dependency in recognition judgments was in fact driven by a decision-making bias like the gambler's fallacy or if they were due to a contrast effect in memory itself. In a final study, we removed the influence of decision-making by employing an eye-tracking paradigm to indirectly test memory for new and old faces. In stark contrast to our earlier findings, multiple eye-tracking metrics indicated that faces were treated as more novel when preceded by a novel face and as more familiar when preceded by a familiar face ($p<0.05$)—the opposite pattern to what was observed when participants made decisions about their memory. Taken together, these results suggest that decision-making biases have such a strong influence on recognition decisions that they can mask opposing biases in the mnemonic processes itself.

Topic Area: LONG-TERM MEMORY: Episodic

The effects of selective retrieval and selective suppression on spatial memory

Poster F69, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Taylor R. Russo[1], Jessica M. Karanian[2], Brittany M. Jeye[1], Scott D. Slotnick[1]; [1]Boston College, [2]Wesleyan University

In the standard think–no think paradigm, items are presented in pairs during Phase 1. During Phase 2, participants are shown the first item (i.e., a cue) from some of the pairs and are instructed to either remember (think of) or suppress (not think of) the associated item. Some cues are not presented and serve as a baseline measure of memory performance. To our knowledge, no study has assessed whether retrieval or suppression can enhance or impair memory for contextual information, such as spatial location. In Phase 1 of the present paradigm (N = 36 participants), abstract shapes were presented to the left or right of fixation. In Phase 2, two thirds of the shapes from Phase 1 were presented at fixation and participants were instructed to either remember or suppress the spatial location of each shape immediately after it was presented. In Phase 3, all of the shapes were presented at fixation and participants identified whether each shape was previously to the “left” or “right” of fixation. Based on previous associative memory results, we hypothesized that retrieval of spatial location would enhance memory performance and suppression of spatial location would impair memory performance, as compared to the control condition. However, we failed to find an effect of retrieval or suppression on memory for spatial location. The present results suggest that contextual information may be resistant to retrieval or suppression effects. We are currently investigating whether or not retrieval or suppression effects occur for the internal item feature of color.

Topic Area: LONG-TERM MEMORY: Episodic

Tracking the impact of retrieval suppression on individual memory representations

Poster F70, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Ann-Kristin Meyer[1,2], Roland G. Benoit[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]International Max Planck Research School on Neuroscience of Communication

When we experience aversive events, these often turn into unwanted memories. Simple reminders can then trigger the involuntary retrieval of these memories. However, prior evidence indicates that we can also intentionally suppress retrieval to prevent unwanted memories from entering awareness. Such suppression can render memories less vivid and eventually cause forgetting. Here, we test the hypothesis that retrieval suppression weakens memories by compromising their unique neural representations. In an fMRI study, participants memorized associations between reminders and aversive scenes. For some of the reminders, they were instructed to repeatedly suppress the retrieval of the respective scenes. Suppression was associated with increased activation in the right dorsolateral prefrontal cortex and a concomitant decrease in hippocampal activation, a pattern that has been linked to the top-down inhibition of hippocampal retrieval processes. Critically, we assessed the distributed activity patterns of individual memories (as a proxy for their neural representations) both before and after suppression. Using representational similarity analysis, we could thus track changes in the specificity of the neural representations. We observed that memories became less vivid after suppression, and that a stronger decline in vividness was associated with a greater reduction in the specificity of hippocampal memory representations. These preliminary results support the hypothesis that suppression deteriorates memories by compromising their unique neural representations in the hippocampus.

Topic Area: LONG-TERM MEMORY: Episodic

Boosting Face Memory With Targeted Memory Reactivation During Sleep

Poster F71, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Nathan Whitmore[1], Adrianna M. Bassard[1], Ken A. Paller[1]; [1]Northwestern University

Remembering the face of someone you know is an indispensable ability, dependent on proficient perceptual and associative processing at both encoding and retrieval. Storing an enduring memory for a face may also depend on intervening sleep. Sleep has been implicated in other types of memory using auditory cues that selectively reactivate memories during sleep, so here we applied this method for Targeted Memory Reactivation (TMR) following learning of new face-name associations. Participants learned and were tested on 80 face-name associations. Then, a 90-minute nap opportunity was allowed, and 20 spoken names were played during slow-wave sleep. Both before and after sleep, participants were tested for cued recall (producing the name given the face) and recognition (discriminating learned from new faces). The recognition test also assessed perceptual familiarity using learned faces viewed from an unfamiliar angle. At the end of the experiment, participants completed a free recall test for the names they had learned. Results from 24 participants suggested that TMR improved recall selectively for learned names presented during sleep compared to learned names not presented, which showed forgetting overall. The degree to which sleep reactivation preserved memory appeared to depend on the number of times a specific memory trace was reactivated. Learning face-name associations thus appears to profit from memory reactivation during sleep. Further research is needed to elucidate relevant neural mechanisms.

Topic Area: LONG-TERM MEMORY: Episodic

Hippocampal sensitivity to event boundaries in encoding of naturalistic events

Poster F72, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Aya Ben-Yakov[1], Rik Henson[1]; [1]University of Cambridge

How is continuous real-life experience transformed into memory for discrete events? Event Segmentation Theory suggests that moments of prediction error are interpreted as event boundaries and drive encoding. Using functional magnetic resonance imaging (fMRI), we set out to reveal whether occurrence of event boundaries drives encoding, with a specific focus on the hippocampus. First, using short film clips as memoranda, we found that hippocampal activity time-locked to the offset of events is linked to subsequent memory, potentially reflecting the encoding of a bound representation to long-term memory. Notably, when distinct clips were presented in immediate succession, the hippocampus responded at the offset of each event, suggesting hippocampal activity is triggered the occurrence of event boundaries (transition between events). However, while brief film clips mimic several aspects of real-life, they are still discrete events. To determine whether event boundaries drive hippocampal activity in an ongoing experience, we analysed brain activity of over 200 participants who viewed continuous, naturalistic films in two independent experiments, finding that the hippocampus responded both reliably and specifically to shifts between scenes. Taken together, these results suggest that during encoding of a continuous experience, event boundaries drive hippocampal processing, potentially supporting the transformation of the continuous stream of information into distinct episodic representations.

Topic Area: LONG-TERM MEMORY: Episodic

The Durability of Statistical Learning: Direct and Indirect Measures

Poster F73, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Helen Liu[1], Katherine Duncan[1], Amy S. Finn[1]; [1]University of Toronto

Although there is substantial interest in statistical learning as a powerful learning mechanism, results have been inconsistent as to whether statistical learning is long-lasting. This conflicting evidence may be due to statistical learning being dependent on implicit or explicit knowledge. We therefore investigated the durability of statistical learning as measured by both direct and indirect tests immediately after exposure and after a 24-hour delay. Participants were exposed to an artificial language comprised of six statistically coherent trisyllabic unsegmented “words” that were presented in random order. After exposure, participants’ explicit memory of the structure was measured using a direct test which consisted of a recognition task and a confidence judgment, and their implicit memory was measured using an indirect test which consisted of a target detection task measuring their reaction times (Batterink, Reber, Neville, & Paller, 2015). Participants were tested either immediately after exposure or 24-hours later (n=60). The preliminary data analysis suggests that people robustly maintain their knowledge of statistical structure over long delays when tested indirectly, but they are less robust in their maintenance of knowledge when tested directly.

Topic Area: LONG-TERM MEMORY: Other

Social value learning shifts conceptual representations of faces

Poster F74, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Ariana M. Familiar[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania

Values drive our behavioral choices. Ample research has explored the neural underpinnings of value-based computations related to decision-making. Moreover, recent neuroimaging work has shown learning monetary values of novel objects influences neural responses in early visual cortex (Persichetti, Aguirre, & Thompson-Schill, 2015), and results in increased functional coupling between visual and valuation systems (Mattar, Thompson-Schill, & Bassett, 2017). However, behaviorally relevant values that we associate with real-world objects are often not monetary. The present study examines social value learning of naturalistic stimuli. Through a multi-day paradigm, participants learned social values (generosity) associated with different people (face images). Generosity was defined as the proportion of a pool of points shared by a given person on average. Additionally, before and after learning, participants completed a task in which they arranged the face images according to similarity, where distances between faces defined their similarity (e.g. closer together are more similar). The difference in pairwise distances before and after learning was used as a measure of the shift in conceptual space due to learning. Shifts were positively correlated with generosity values, but were not correlated with perceptual similarity or point magnitude. In other words, faces of more similar social values became closer together after learning. Furthermore, shifts were positively correlated with a post-learning index of preference to interact with a person in a future cooperative game. These results indicate that learning social values of faces influences their representations in conceptual space, and such representational changes are related to propensities in future behavior.

Topic Area: LONG-TERM MEMORY: Semantic

Dyslexia and Reading Ability Predict Sequence Learning Impairments

Poster F75, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Brianna Wenande[1], Emily Een[1], Mark A. Gluck[2], Jessica R. Petok[1]; [1]St. Olaf College, [2]Rutgers University

Dyslexia is a learning disability characterized by deficits in word recognition and spelling, and previous research suggests that people with dyslexia may also show deficits in sequence learning, a process important for literacy acquisition. However, results from previous studies have been mixed, with some suggesting that individuals with dyslexia show impairments relative to controls and others suggesting that they do not. Furthermore, the sequence learning tasks used in other studies are often motor sequencing tasks, and so it is unclear whether previous studies reflect true sequence learning deficits or merely motor-based learning impairments. To measure sequence-specific learning in the present study, 39 college-aged students (19 dyslexic, 20 non-dyslexic) completed a non-motor feedback-based task with sequencing and non-sequencing components. Participants with dyslexia made significantly more sequencing errors, but were not impaired on the other non-sequencing phases, compared to control subjects. Participants also completed a battery of neuropsychological tasks to assess reading and spelling ability, and results showed that reading ability of nonsense words, which reflects phonological processing ability, was a significant mediator of the relationship between dyslexia status and sequencing performance. These findings not only support previous literature suggesting that individuals with dyslexia show sequence learning impairments, but also suggest that reading ability may play an important role in sequence learning in healthy adults of all ages.

Topic Area: LONG-TERM MEMORY: Skill learning

Alpha phase modulates the amplitude and variance of suprathreshold TMS-induced motor evoked potentials

Poster F76, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Lukas Schilberg[1,2], Sanne ten Oever[1,2], Teresa Schuhmann[1,2], Alexander T. Sack[1,2]; [1]Maastricht University, [2]Maastricht Brain Imaging Center

Transcranial magnetic stimulation (TMS)-induced motor evoked potentials (MEPs) are frequently examined in research and clinical settings as measures of corticospinal excitability (CSE). Their evaluation promises valuable information about fundamental brain related mechanisms and is applied for clinical monitoring of treatments and surgery procedures. Although reliability of MEPs is of uttermost importance, concerns about high intra-individual variability have rendered MEPs as potentially unreliable measures. One possible cause for high variability of MEPs could be neuronal oscillatory activity at the time and location of TMS administration, which reflects fluctuations of membrane potentials that systematically increase and decrease the excitability of neuronal networks. Here, we investigate the dependence of MEP amplitude and variance on intrinsic oscillation power and phase by combining suprathreshold single pulse TMS (at 120% of resting motor threshold) with electroencephalography (EEG). We show that MEP amplitude is correlated to the phase of the ongoing alpha oscillations (8.9 to 12.4Hz) at TMS site. Moreover, the phase of the 50% highest MEP amplitudes is consistent across participants (centered around -0.5pi). Finally, we show that the magnitudes of MEP amplitude and variability differ between phases of the alpha oscillation. In conclusion, MEP amplitude and variance are dependent on the phase of alpha at the time and location of TMS. Locking TMS to a certain alpha phase could lead to lower variability and increased reliability of MEPs. Our findings are important for the development of essentially reliable measures of CSE. In addition, they can help to increase the efficacy of TMS applications in general.

Topic Area: METHODS: Electrophysiology

Comparing Functional and Structural Predictors of Cognition via Machine Learning

Poster F77, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

G. Andrew James[1], Ming-Hua Chung[1], Keith A. Bush[1], Clinton D. Kilts[1]; [1]University of Arkansas for Medical Sciences

Neuroscience has long sought to identify the structural and functional correlates of normative cognition, but few datasets have allowed robust comparison of these modalities' predictive ability. The recent growth of large neuroimaging initiatives allows unprecedented opportunities to evaluate brain-cognition relationships. We selected N=982 participants (53% female; ages 21-35) from the WU-Minn Human Connectome Project with complete structural MRI (sMRI), diffusion tensor imaging (DTI), and resting-state functional MRI (rs-fMRI) neuroimaging datasets. The machine learning tool LASSO (least absolute shrinkage and selection operator) was implemented to linearly regress features from each neuroimaging modality (X: sMRI, DTI, rs-fMRI) to seven cognitive measures (Y) derived from the NIH Toolbox. Participants were randomly split into training and testing datasets (N=788 and N=194), stratified by gender and age. For each modality (X) and cognition (Y), LASSO was implemented with 10-fold cross-validation of the training dataset to identify the beta-weights of predictors which best predicted cognition (i.e. the model with minimum MSE). We compared percent variance explained (R2) by each modality-cognition pair for both training and testing datasets. For the training dataset, rs-fMRI explained greater variance in cognition (R2 0.05-0.36) than sMRI (R2 0.00-0.10) or DTI (R2 0.00-0.08; $F(2,18)=8.38$, $p<0.003$). rs-fMRI also explained greater variance in the testing dataset (R2 0.00-0.17) than sMRI or DTI ($F(2,18)=3.80$, $p<0.05$). However, rs-fMRI explained significantly less variance in testing dataset than training (paired $t(6)=4.5$, $p<0.01$), indicating poor generalization possibly due to overfitting. Future work will explore LASSO optimization approaches to improve generalization of findings.

Topic Area: METHODS: Neuroimaging

Streams of Thought: An ICA Methodology for Lagged Resting State Analysis

Poster F78, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Erik Jahner[1,3], Xiao-Fei Yang[2,3], Mary Helen Immordino-Yang[2,3]; [1]University of California Riverside, [2]University of Southern California, [3]Brain and Creativity Institute

The human brain is an ongoing dynamic system not activated by experience but nudged from intrinsic activity into new network configurations during perception and learning. Ongoing neural activity during rest is assumed to reflect these intrinsic dynamics in a relatively closed system state revealing the neural ensembles of thought. Traditionally, inter-regional connectivity in this system is measured by obtaining time-locked correlations in BOLD activity using fMRI. However, we know that neural activity unfolds across time and is not isolatent at some behavioral or perceptual reference point. Indications are that lagged network dynamics are a more fundamental property of network dynamics than the traditional resting-state network approaches. This exploratory study is a theoretical and methodological examination of how a lagged analysis of resting state dynamics in fMRI could expose persistent representations of knowledge in the neocortex. A novel approach using independent component analysis (ICA) on surface maps is applied to resting-state data from 54 adolescents. ICA methodologies allow for the reconstruction of individual representations of the lagged threads for use as regressors with some notable limitations.These methods reveal lagged structures with interpretable but different topographical and temporal information than traditional resting-state analyses. The group level results are symmetrical between hemispheres and early extracted components may represent high level perceptual processes. These results also do not correlate with known traditional resting-state networks further supporting the theory that traditional networks are not internally isolatent.The methods and interpretation of ICA as applied to a lagged matrix of resting state dynamics are presented.

Topic Area: METHODS: Neuroimaging

Cognitive and sensorimotor aspects of handwriting in multiple sclerosis: an fMRI study

Poster F79, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Laura Bonzano[1], Ambra Bisio[1], Ludovico Pedullà[1,2], Giampaolo Brichetto[2], Marco Bove[1]; [1]University of Genoa, Italy, [2]Italian Multiple Sclerosis Foundation, Genoa, Italy

Handwriting requires complex sensorimotor and cognitive functions and can be affected in people with multiple sclerosis (PwMS) causing a sense of frustration and the inability to recognize themselves in the new calligraphy. At present there is not a conventional approach to assess handwriting movements in MS. Aim of this work was to adopt a new methodology for the kinematic analysis of handwriting movements and the investigation of their neural correlates in PwMS. Eighteen PwMS and 18 healthy controls (HC) underwent an fMRI examination, based on a boxcar design paradigm with 30 s of handwriting task alternating with 30 s of rest (three times each). During the handwriting task the subjects had to write the sentence “Il sole scalda” at their spontaneous velocity on an MRI-compatible tablet recording the traces, with a visual feedback of the written traces via a projection mirror system. The traces were analyzed with an ad hoc software tool and showed increased movement duration and spatial variability in PwMS compared to HC. The relationships between the kinematic parameters and the cognitive and motor clinical scores revealed that both motor abilities and cognitive status influenced handwriting skills. The “writing centers” (frontal and parietal areas, cerebellum) were found to be active during handwriting in both groups, while the statistical contrast between groups showed decreased activation of the caudate nucleus, thalamus and insula in the PwMS group. Handwriting is altered in PwMS at both kinematic and neural levels, particularly involving brain structures linked to sensorimotor and reward-related processes.

Topic Area: METHODS: Neuroimaging

Temporal variability of functional brain connectivity predicts individual differences in attention

Poster F80, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Angus Ho Ching Fong[1], Kwangsun Yoo[1], Monica D Rosenberg[1], Marvin M Chun[1]; [1]Yale University

Dynamic functional connectivity (DFC) aims to increase resolvable information from brain scans by considering temporal changes in network structure. Recent work has demonstrated that static (time-invariant) resting-state and task-based FC predicts individual differences in behavior, including attention (Rosenberg et al., 2016, Nature Neurosci; Rosenberg et al., 2017, Trends Cog Sci). Here, we show that DFC predicts attention performance across individuals. Sliding-window FC matrices were generated from fMRI data collected during rest and attention task performance (n=25) by calculating Pearson’s r between every pair of nodes of a whole-brain atlas within overlapping 20-60s time segments. Next, variance in r values across windows was taken to quantify the extent of temporal variability of each connection, resulting in a node-by-node “FC variability (FCV) matrix” for each individual. In a leave-one-subject-out-cross-validation approach, partial-least-square-regression (PLSR) models were then constructed to predict

attention scores from FCV matrices. Predicted and observed attention scores were significantly correlated (task model: r=0.78, p=7.85*10^-6; rest model: r=0.40, p=4.76*10^-2), indicating successful out-of-sample predictions across rest and task conditions. We furthermore show that combining DFC and static FC features improves predictions over either model alone. Combined PLSR models successfully predicted attention in task-(r=0.86, p=2.19*10-6) and rest-(r=0.55, p=5.31*10-3) based scans; in addition, they generalized to two independent data sets (participants performing the Attention Network Task and the stop-signal task). FCV with significant PLSR coefficients clustered in visuo-motor and executive-control brain networks; moreover, most of these coefficients were negative. Thus, better attention may rely on stable (less variable) information flow between regions processing ongoing tasks.

Topic Area: METHODS: Neuroimaging

Optimizing fMRI experimental outcomes via neuroadaptive task designs

Poster F81, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Ming-Hua Chung[1], Bradford Martins[1], G. Andrew James[1], Anthony Privratsky[1], Clinton D. Kilts[1], Keith A. Bush[1]; [1]University of Arkansas for Medical Sciences

Task-based fMRI is a widely-used tool for studying the neural underpinnings of cognition in both healthy and clinical populations. There has been growing interest in mapping individual differences in fMRI task behavior and neural organization, both within and between clinical samples. By utilizing a neuroadaptive task designs accounting for individual differences, the task durations can be optimized and task performance (e.g., classification) may potentially be improved. To test our hypothesis, we first retrospectively tracked the changed beta weights generated from general linear models (GLM) from volume to volume on 97 subjects in a stop-signal task. By analyzing the decaying rates of beta weights for various trials and subjects, we were able to determine minimum scan times (MSTs) for each circumstance. The results showed that not only each individual subject produced different MSTs, various trials (specifically, go trials following successful stop trials, go trials following failed stop trials, successful stop trials and failed stop trials) also generated different MSTs, indicating a need of individualization on task durations. We further implemented support vector machine (SVM) for classification on 67 SUD/control labeled subjects and compared the classification accuracies with and without using MSTs. Among 16 classification accuracies with various MSTs, 2 significantly outperformed the accuracies using full trails, indicating an optimizing fMRI performance was achieved by using MSTs. In conclusion, we demonstrated the potentials of an neuroadaptive task design and we believed such methodology can be widely adapted for other task-based, GLM related experiments.

Topic Area: METHODS: Neuroimaging

Reverse Inference Problem with Task Difficulty and Reaction Times

Poster F82, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Alexander Gordon[1], Mark Straccia[1], Matthew Lieberman[1]; [1]University of California, Los Angeles

Perhaps the most widely used and robust measure of task difficulty is response time and error rate. However, while a more difficult task generally takes longer and has more errors, observing these effects does not guarantee the task is more difficult– a reverse inference claim (since other effects might be the cause). To support this view, we use another robust indicator of task difficulty, increased pupil dilation, to assess (with an eye-tracker) processing load put on participants. We used a paradigm by Gilbert et al. (2012) where participants (n=35) either a) respond if a letter has a curve b) hold in working memory the next letter in a sequence and respond whether it has a curve or c) respond if a novel line drawing has a curve. We replicate Gilbert et al.'s (2012) finding that the novel line drawing trials have the longest reactions times and most errors; however, we also show that participants had the least pupil dilation responding to the novel line drawing and the most pupil dilation to the working memory letter sequence demonstrating more cognitive effort for this task. The pupil dilation pattern observed here suggests that the medial prefrontal pattern observed in Gilbert et al. was due to cognitive demand, in contrast to their account. More importantly our results demonstrate experimenters need to be more aware other factors might cause longer reaction times (e.g., orientation to a stimulus, visual search time, etc.) rather than task difficulty to avoid the reverse inference mistake.

Topic Area: METHODS: Other

Polygenic risk and trajectories of cognitive impairment in schizophrenia: associations limited to the “Cognitively Stable”

Poster F83, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Sofia Zaidman[1], Evan Giangrande[2], Daniel Weinberger[3], Karen Berman[1], Dwight Dickinson[1]; [1]Clinical and Translational Neuroscience Branch, IRP, NIMH, [2]University of Virginia, [3]Lieber Institute for Brain Development

This study evaluated associations between cognition and schizophrenia genetic risk profile scores (RPS) across three cognitive trajectory subgroups of people with schizophrenia (PWS). 769 PWS provided demographic and clinical information and completed cognitive assessments as part of the NIMH Study of Schizophrenia Genetics. We performed a two-step cluster analysis to identify cognitive subgroups, using “premorbid” (WRAT) and “current” (WAIS) IQ as clustering indicators. Schizophrenia RPS for 453 PWS were calculated at 10 p-value thresholds based on illness-associated genetic variants identified by the multi-national Psychiatric Genetics Consortium. Across RPS thresholds, we used planned hierarchical regression to test the association of RPS with general cognitive ability (“g”) for the derived cognitive subgroups, controlling for age, sex, and population stratification. Based on 1000 runs, a three-cluster solution was the most frequent result, suggesting one subgroup with high scores on both WRAT and IQ (Cognitively Stable), one with low scores on both WRAT and IQ (Pre-Adolescent Impairment), and one with high scores on WRAT and low IQ (Adolescent Decline). Only the Cognitively Stable subgroup showed significant associations between RPS and “g” at six of 10 RPS thresholds (e.g., at RPS_0.5 p=.01; R2=0.034). Despite higher mean RPS, RPS was not significantly associated with “g” in either the Pre-Adolescent Impairment subgroup or Adolescent Decline subgroups. Although cognitive impairment is a core characteristic of schizophrenia, an association of cognition with common genetic risk for the condition was only observed in one schizophrenia subgroup, whose members were less affected cognitively in early life or adolescence.

Topic Area: OTHER

Contribution of the prefrontal and parietal regions to time estimation and temporal control: A study of patients with a brain tumor before and after surgery

Poster F84, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Yayoi Shigemune[1,2], Shoko Saito[2], Kentaro Hiromitsu[1,2], Kanako Hamamoto[3], Nobusada Shinoura[4], Ryoji Yamada[4], Akira Midorikawa[1,2,3]; [1]Graduate School of Letters, Chuo University, Tokyo, Japan, [2]1Institute of Cultural Science, Chuo University, Tokyo, Japan, [3]Faculty of Letters, Chuo University, Tokyo, Japan, [4]Tokyo Metropolitan Cancer and Infectious Diseases Center Komagome Hospital, Tokyo, Japan

Time estimation is defined as cognitive processing of duration over a range from seconds to minutes, and is important in terms of temporal action control. Early neuroimaging studies suggested that the prefrontal cortex (PFC) and the parietal lobe (PL) were involved in time estimation. Here, we investigated the effects of brain tumors in the PFC and PL, and surgery treating such tumors, on time estimation and behavioral control. In all, 10 patients with PFC tumors, 9 with PL tumors, and 20 healthy controls were enrolled; they did not differ significantly in terms of age, sex, or performance on a cognitive screening test. All participants underwent 1 min counting and tracing tasks. In the former task, all participants subjectively evaluated the passage of 1 min; the actual elapsed time was recorded using a stopwatch. In the tracing task, all participants traced a square with sides of 20 cm, in a clockwise direction, as slowly as possible for 2 min. Patients with PFC tumors underestimated the passage of 1 min compared to controls, and patients with either PFC or PL tumors exhibited faster tracing speeds than controls. However, the tracing speed was slower after surgery in patients with PL tumors. These results suggest that the PFC plays a critical role in time estimation and that a deficit in temporal behavioral control improves after surgery, associated with preservation of time estimation executed in the PFC.

Topic Area: OTHER

The mediate effect of changes in resting-state functional connectivity on resilience due to short-term intensive meditation: a randomized controlled trial

Poster F85, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Seoyeon Kwak[1], Tae Young Lee[2], Wi Hoon Jung[3], Ji-won Hur[4], Dahye Bae[1], Wu Jeong Hwang[1], Kang Ik K. Cho[2], Kyung-Ok Lim[5], So-Yeon Kim[6], Hye Yoon Park[7], Jun Soo Kwon[7]; [1]Seoul National University, Republic of Korea, [2]SNU-MRC, Republic of Korea, [3]Korea University, Republic of Korea, [4]Chung-Ang University, Republic of Korea, [5]National Institute of Forensic Psychiatry, Ministry of Justice, Republic of Korea, [6]Duksung Women's University, Republic of Korea, [7]Seoul National University Hospital, Republic of Korea

In recent decades, studies have examined the beneficial effects of short-term meditation on stress resilience and related neural substrates. More recent work has explored the maintenance of these effects; however, the underlying neural mechanisms have not yet been investigated. To investigate the neural mechanisms that maintain the beneficial effects of short-term meditation on stress resilience, we conducted a randomized controlled trial of a four-day meditation practice. Thirty participants in meditation practice and 17 participants in a relaxation retreat (control group) underwent MRI scans and self-reported questionnaires [Cognitive and Affective Mindfulness Scale (CAMS) and Resilience Quotient Test (RQT)] at baseline, post-intervention, and 3-month follow-up. Both groups showed increased CAMS and RQT scores immediately after the intervention, but only meditation group maintained the enhancement after 3 months. Furthermore, the resting-state functional connectivity (rsFC) between the left rostral anterior cingulate cortex (rACC) to the dorsomedial prefrontal cortex (dmPFC), precuneus, and angular gyrus was significantly increased immediately after the intervention in meditation group compared with that in the control. Changes in the rACC-dmPFC rsFC mediated the relationship between the changes in CAMS and RQT in the meditation group, and the changes in the rACC-dmPFC rsFC were correlated with the RQT changes at both immediate and 3-month follow-up. Thus, increased rACC-dmPFC rsFC induced by short-term intensive meditation not only mediated the immediate improvement of resilience but also guaranteed its maintenance after 3 months. Thus, short-term meditation may be beneficial to individuals for the improvement of stress-related neural mechanisms, leading to behavioral improvement and its maintenance.

Topic Area: OTHER

Dissociating the functions of delta and beta oscillatory entrainments: from intrapersonal and interpersonal perspectives

Poster F86, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Andrew Chang[1], Dan Bosnyak[1], Laurel Trainor[1,2]; [1]McMaster University, [2]Rotman Research Institute

Prior studies showed that sensory systems proactively predict upcoming information to optimize perceptual and sensorimotor processing. In particular, both the phase of delta oscillations (1-3 Hz) and the power of induced beta oscillations (15-25 Hz) entrain to the temporal regularity of external tone sequence. However, it remains unclear if these two entrainment activities are associated with different functions of temporal entrainment. We aimed to investigate this topic from intrapersonal and interpersonal perspectives. In the first study, we investigated how oscillatory neural activity intrapersonally entrains to an external auditory sequence, and how it relates to perceptual processing. By combining EEG and psychophysical techniques, participants were asked to discriminate a target pitch embedded in rhythmic versus arrhythmic tone sequences. The behavioral results showed that pitch discrimination sensitivity was higher when target tones were embedded in rhythmic than arrhythmic sequences. The EEG-behavioral trial-by-trial analyses showed that the size of pre-target beta entrainment predicted pitch discriminative sensitivity, and the level of delta-beta phase-amplitude coupling predicted reaction time. In the second study, we investigated dynamic sensorimotor processing in a real-world interpersonal interaction, using professional string quartets as a model for interpersonal coordination. We experimentally manipulated leadership roles during performances, and employed causal analyses to investigate the directional coupling among musicians. Analyses on body movements revealed that directional coupling followed assigned leadership (Chang et al., 2017, PNAS), as predicted. Ongoing analyses are examining EEG dynamics, especially in delta and beta band, to investigate oscillatory synchronization and information flow between brains.

Topic Area: PERCEPTION & ACTION: Audition

Hearing Creatively: Default Network Selectively Synchronizes to Auditory Cortex in Jazz Improvising Musicians

Poster F87, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Alexander Belden[1], Tima Zeng[1], Emily Przysinda[1], Psyche Loui[1]; [1]Wesleyan University

Jazz improvisation offers a model for creative cognition as it involves the real-time creation of a novel, information-rich product. Previous research has shown that when jazz musicians improvise, they recruit medial and dorsolateral prefrontal cortices, which are part of the Default Mode (DMN) and Executive Control (ECN) Networks respectively. Here, we ask whether these task-fMRI findings might arise from intrinsic differences in functional connectivity. We compare resting state fcMRI of ECN and DMN among jazz improvisers, classical musicians, and non-musicians. We seeded regions of interest in the medial prefrontal cortex, within the DMN, and the dorsolateral prefrontal cortex from the ECN, and compared the correlation patterns from each ROI across the three subject groups (all results $p<0.05$ cluster-corrected). We found higher resting state connectivity in jazz improvisers than classical musicians and non-musicians between mPFC and the superior temporal gyrus, including the auditory cortex. In contrast, all musicians showed increased connectivity from left dorsolateral prefrontal cortex, a region of the left ECN, to bilateral superior parietal lobule; this was especially higher in classical musicians compared to non-musicians. Results show that long-term training enhances functional connectivity in specific resting state networks. While general musical training is associated with executive control functions, the finding that the Default Mode Network is more synchronized with auditory regions in jazz improvisers is consistent with the hypothesis that real-time musical creativity relies on auditory access to spontaneous thought processes.

Topic Area: PERCEPTION & ACTION: Audition

Structural and Functional Correlates of Musical Anhedonia

Poster F88, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Sean Patterson[1], Monday Zhou[1], Psyche Loui[1]; [1]Wesleyan University

Musical Anhedonia is a condition characterized by a specific lack of reward responses to music, despite normal hedonic responses to other rewarding stimuli. Here we test the hypothesis that musical anhedonia is linked to abnormal structural and/or functional connectivity between auditory regions, specifically the superior temporal gyrus, and reward-sensitive regions such as the nucleus accumbens and anterior insula. We present behavioral, DTI, and rsfMRI results on a subject presenting with this deficiency, BW, compared to 46 neurotypical adults. BW showed extremely anhedonic responses (>5SD from mean) to sound items on the Physical Anhedonia Scale, but was normal in all other hedonic categories. In DTI tractography, BW showed increased FA and lower volume in the tracts between both the left and right auditory cortices and the nucleus accumbens and anterior insula, suggesting that different patterns in white matter pathways between auditory and reward regions could underlie these behavioral differences. Furthermore, rsfMRI was used to compare functional connectivity within and between auditory and reward regions for BW and controls. Results show less functional connectivity between the left and right auditory cortices in BW as compared to controls, further suggesting differences in auditory access to the reward system in musical anhedonics. Together, results suggest that musical anhedonia is associated with both structural and functional differences in connectivity between the auditory and reward systems.

Topic Area: PERCEPTION & ACTION: Audition

Aging in the sensorimotor system: Lower GABA levels are associated with decreased network segregation and impaired behavior

Poster F89, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Kaitlin Cassady[1], Holly Gagnon[1], Poortata Lalwani[1], Molly Simmonite[1], Bradley Foerster[2], Denise Park[3], Myria Petrou[2], Rachael D. Seidler[1,4,5], Stephan Taylor[1,6], Daniel H. Weissman[1], Thad A. Polk[1]; [1]Department of Psychology, University of Michigan, Ann Arbor, MI, USA, [2]Department of Radiology, University of Michigan, Ann Arbor, MI, USA, [3]Research of the Center for Vital Longevity, University of Texas at Dallas, Dallas, TX, USA, [4]School of Kinesiology, University of Michigan, Ann Arbor, MI, USA, [5]Neuroscience Graduate Program, University of Michigan, Ann Arbor, MI, USA, [6]Department of Psychiatry, University of Michigan, Ann Arbor, MI, USA

Normal aging is typically associated with declines in sensorimotor function. Previous studies have linked some age-related behavioral impairments to reductions in network segregation: Compared to young adults, older adults typically exhibit weaker connectivity between brain regions within the same functional network but stronger connectivity between regions belonging to different networks. Based on animal work, we hypothesized that reduced network segregation is linked to age-related reductions in the brain's major inhibitory transmitter, gamma aminobutyric acid (GABA). We performed graph theoretical analysis of resting state functional MRI data to measure network segregation in 16 young adults (ages 18-29) and 16 older adults (ages 65-79). We also used magnetic resonance spectroscopy to measure GABA levels in the sensorimotor cortex and collected a battery of behavioral measures in the same participants. We found that brain networks were less segregated in older compared to young adults and that sensorimotor GABA levels were also reduced. Furthermore, lower GABA levels predicted worse cognitive and sensorimotor performance, and this relationship was mediated by network segregation. These findings suggest a mechanistic link from age-related declines in GABA levels to reductions in network segregation and behavioral impairments in the sensorimotor system.

Topic Area: PERCEPTION & ACTION: Development & aging

Rhythm-based temporal prediction in children with Autism Spectrum Disorder (ASD)

Poster F90, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Shlomit Beker[1,2], John J. Foxe[1,2,3], Sophie Molholm[1,2,3]; [1]The Sheryl and Daniel R. Tishman Cognitive Neurophysiology Laboratory, Department of Pediatrics, Albert Einstein College of Medicine, Bronx, NY., [2]Rose F. Kennedy Intellectual and Developmental Disabilities Research Center (IDDRC), Department of Neuroscience, Albert Einstein College of Medicine, Bronx, NY., [3]The Ernest J. Del Monte Institute for Neuroscience, University of Rochester Medical Center, Rochester, NY

Information in the sensory environment tends to be highly predictive of upcoming events, allowing for online planning and decision-making. The neural processing of predictable stimuli is significantly facilitated compared to non-predictable stimuli. Clinical observations and behavioral tasks suggest that people with ASD have deficits in applying predictive information to generate expectations, leading to a decreased surprise when violated. In spite of this evidence, neuronal correlates of these impaired processes remain to be identified. Using electrophysiology, this study aims to define the neural activity underlying the altered prediction in ASD, through examining the role that impaired neural entrainment might play in reduced prediction of upcoming information, and the generation of the preparatory potential. We tested the integrity of temporal prediction by presenting rhythmic visual and auditory stimuli on children with ASD and age-matched typically developing (TD) controls, while recording from 64 scalp EEG channels. Participants responded to the appearance of an auditory stimulus that was either preceded by predictive rhythmic visual stimuli, or not. Both time- and frequency domains were analyzed. Results show that in contrast to TD, who present preparatory activity in temporal channels prior to the appearance of the auditory target, children with ASD present reduced preparatory activity. In addition, patterns of event-related oscillatory activity differed between the groups, as was evident prior to the predicted event, with greatly altered stimulus-driven resonant oscillations. We offer a possible explanation, based on cortical activity in reaction to rhythmic sensory stimuli, for impaired event prediction in children with ASD.

Topic Area: PERCEPTION & ACTION: Development & aging

Training the human mirror neuron system: An EEG study

Poster F91, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Victoria Brunsdon[1], Elisabeth Bradford[1], Laura Smith[1], Heather Ferguson[1]; [1]University of Kent

When we see another person trip over, we can't help but to wince in pain, mirroring the experience of the other person. This mirroring of actions is performed by a specialised system of neurons found in the motor cortex, forming the mirror neuron system. This study investigated whether experience with hand actions modulates the activity of the mirror neuron system using EEG mu suppression as an index of the mirror neuron system. Initially, all participants completed a pre-task, with a 2-minute resting-state EEG as a reference period, followed by videos of unfamiliar hand actions and static hands. Subsequently, 28 participants completed execution training, and 29 participants completed observation-only training. In the execution training, participants performed the unfamiliar hand actions. In the observation training, participants observed the unfamiliar hand actions being performed. In addition, the frequency of training of each action was varied. Lastly, all participants completed a post-task that was identical to the pre-task. The activation of the mirror neuron system was different dependent on the training conditions. The activity of the mirror neuron system either increased (alpha 8-13Hz) or stayed the same (beta 13-35Hz) from pre- to post- when executing the actions, whereas the activity reduced from pre- to post- when merely observing actions. The frequency of training did not impact on post alpha, suggesting that differences in action familiarity do not modulate mirror neuron activity. This study suggests that practical experience with actions activates the mirror neuron system, and this is not based on familiarity with specific actions.

Topic Area: PERCEPTION & ACTION: Motor control

Asymmetric Interference Between Cognitive Task Components and Concurrent Sensorimotor Coordination

Poster F92, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Joshua Baker[1], Antonio Castro[1], Andrew K Dunn[1], Suvobrata Mitra[1]; [1]Nottingham Trent University

Everyday human behavior frequently involves continuous sensorimotor coordination (CSC) such as driving, walking or manually operating machinery, while concurrently performing an unrelated cognitive task. Many such dual tasks exhibit interference patterns that are attributed to shared attentional and executive function processes. Most everyday cognitive tasks involve perceptual, attentional as well as executive function components, and the time-course and reciprocity of CSC-cognitive interference are not well understood at the level of these cognitive task components. We used electrophysiology to study the detailed chronometry of dual-task interference between a visual oddball task with covert response (mentally tallying target count) and a visuomanual pursuit-tracking task. Dual-tasking interfered with the oddball task's accuracy and attentional resourcing (attenuated P2 and P3b magnitude, frontal and parietal alpha-band power and fronto-parietal alpha-band coherence). Spectral power over contralateral motor cortex did not change when the oddball task was added to pursuit-tracking. Tracking deviation accumulated at a later time-scale, and only in trials requiring the executive function of updating the target count. These results show that interference in CSC-cognitive dual-tasking can be asymmetric in both timing and information-processing components affected.

Topic Area: PERCEPTION & ACTION: Motor control

Sleep Quality's Effect on EEG Activity Underlying Information Processing during Motor Control

Poster F93, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Katherine A. Hyson[1], Robert S. Ross[1], Wayne J. Smith[1], Ronald V. Croce[1]; [1]University of New Hampshire

Only 9% of the poor sleep population attributes their sleep difficulties to having a diagnosed sleep disorder, yet a majority of people suffer from poor sleep quality. Sleep quality impacts cognitive processing and it is currently unclear how sleep quality impacts motor control. The N1 visual sensory component and the P300 attention and cognitive processing component during motor control may be impacted by sleep quality. The objective of this experiment was to determine if tasks with increasing motor-control requirements altered N1 and P300 latency and amplitude. EEG data were collected during a simple reaction task (SRT), a choice reaction time task (CRT), and a CRT-Dual Task (CRT-Dual). In the SRT, participants were instructed to hit a button after a cue, in the CRT they were instructed to hit different buttons based on varying color cues, and in the CRT-Dual they performed the CRT while counting backwards. Both amplitude and latency of N1 and P300 were compared across all three conditions and in poor

(N=8) and good sleep (N=5) quality groups for electrodes Pz and O2 located over parietal and occipital scalp regions using two 2x3 ANOVAs. Preliminary results indicated a main effect of condition for P300 latency, where latencies increased with task complexity. Results also suggested a trend towards a significant main effect of group for P300 amplitude, where amplitude may be increased in the poor sleep quality group across all conditions. Results suggest sleep quality may impact attention, leading to changes in information processing during reaction-time tasks.

Topic Area: PERCEPTION & ACTION: Motor control

Deficit of Prediction Ability as A Potential Cause of Phantom Noise in Autism Spectrum Disorder

Poster F94, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Jyh-Jong Hsieh[1], Yukie Nagai[2], Minoru Asada[1]; [1]Osaka University, [2]National Institute of Information and Communications Technology

Previous studies report that some people with autism spectrum disorder (ASD) suffer from phantom noise in the visual and/or auditory perception, especially when the environmental stimuli suddenly change. However, the underlying mechanism is still unclear. We propose a hypothesis that the deficit of prediction ability might be a cause of phantom noise because the stochastic resonance in the brain produces stronger noise to compensate the information loss caused by the impaired prediction. We developed a computational model to verify our hypothesis in the acoustic perception. This model adopted a feedback control to determine the optimal noise level that maximize the information content originally exists in the sensory signal. We suggest that the predictor in this model employs the information from preceding signals, other sensory modalities, and/or prior knowledge to recognize incoming signals. We manipulated time window of referred preceding signal to examine its effect on hyper neural responses. Experiments first demonstrated a core benefit of stochastic resonance on the detection of subthreshold stimuli when the time window was long enough. By contrast, when the time window was too short, overly intense noise was induced, which might be perceived as phantom noise. This result supports our hypothesis that the phantom noise could occur with impaired prediction from the preceding signal.

Topic Area: PERCEPTION & ACTION: Multisensory

Full-body ownership illusion elicited by visuo-vestibular integration

Poster F95, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Nora Preuss[1], Henrik Ehrsson[1]; [1]Karolinska Institutet

Vestibular signals allow us to maintain balance and to orient ourselves in space. Integrating this input with information from our five senses contributes to our human self-consciousness and helps us to distinguish ourselves from the external world. The aim of the present study was to investigate how vestibular information contributes to the experience of body ownership using multisensory integration. We conducted three studies using a ‘full-body ownership illusion’ induced by virtual reality technology and galvanic vestibular stimulation, the latter a technique that allows for selective stimulation of vestibular afferents. Participants wearing head-mounted displays saw a mannequin’s body from first-person perspective that was performing a slow swinging movement. At the same time participants were exposed to galvanic vestibular stimulation that elicited vestibular sensations of swinging whole-body movements in the corresponding direction. Perceived ownership of the seen body was measured using questionnaire ratings and skin-conductance responses to a knife threat towards the mannequin. We demonstrated that when participants were exposed to congruent visuo-vestibular information, they perceived stronger ownership for the mannequin’s body compared to unimodal visual and vestibular conditions, a bimodal noise control condition, or an incongruent visuo-vestibular condition. The findings show for the first time that visuo-vestibular congruency is sufficient to induce illusory body ownership.

Topic Area: PERCEPTION & ACTION: Multisensory

Atypical multisensory temporal integration in posterior superior temporal cortex may underlie language, social, and perceptual deficits in autism spectrum disorders

Poster F96, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Naail A. Khan[1], Stephanie M. Lavoie[1], Ryan A. Stevenson[2], Morgan D. Barense[3], Mark T. Wallace[4], James M. Bebko[1], W. Dale Stevens[1]; [1]York University, Toronto, [2]University of Western Ontario, [3]University of Toronto, [4]Vanderbilt University

Individuals with autism spectrum disorders (ASD) exhibit multisensory processing deficits (e.g., atypical temporal integration of auditory-visual information), which may underlie downstream deficits in language, social-cognitive, and perceptual processing. While some evidence suggests that multisensory processing deficits in ASD are language-specific, previous findings are equivocal. Posterior superior temporal cortex (pSTC), a brain region showing anatomical and functional differences in ASD, plays a critical role in auditory-visual temporal integration, as well as linguistic and social processing. However, few studies have directly investigated the neural correlates of multisensory integration in ASD. We recently proposed a novel "temporal synchrony method" for localizing multisensory regions in individual participants using fMRI. Here, we used this method to localize multisensory pSTC regions bilaterally in typically developing (TD: n=17) individuals and those with ASD (n=15). We compared activation in these regions to temporally synchronous vs. asynchronous auditory-visual stimuli (short video clips) with social linguistic (person talking), social non-linguistic (person making non-linguistic sounds), and non-social non-linguistic (marble course) content. The large majority of TD participants showed greater activation for synchronous than asynchronous stimuli in pSTC across hemispheres and content-domains, though most prominently so in the left hemisphere for linguistic content. Critically, individuals with ASD showed a complete reversal of this pattern, with the majority showing more activity for asynchronous than synchronous stimuli across hemispheres and content domains. Our results suggest that 1) atypical multisensory processing in ASD is not language-specific; 2) Multisensory pSTC may be a viable target for neurointervention strategies, such as neurofeedback training and noninvasive brain stimulation.

Topic Area: PERCEPTION & ACTION: Multisensory

Deaf signers' sensorimotor system activity during perception of one and two handed signs

Poster F97, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Emily Kubicek[1], Lorna C. Quandt[1]; [1]Gallaudet University

When a person observes someone else performing an action, the observer's sensorimotor cortex activates as if the observer is the one performing the action, a phenomenon known as action simulation. While this process has been well-established for basic (e.g. grasping) and complex (e.g. dancing) actions, it remains unknown if the framework of action simulation is applicable to visual languages such as American Sign Language (ASL). We performed an EEG experiment to test whether deaf signers' sensorimotor systems are differentially sensitive to signs that are produced with one hand ("1H") or two hands ("2H"). We predicted greater alpha event-related desynchronization (ERD; previously correlated with action simulation) during the perception of 2H ASL signs compared to 1H ASL signs, due to greater demands on sensorimotor processing systems required for producing two-handed actions. The two groups of signs were matched for frequency, iconicity, and flexion. We recorded EEG from deaf participants fluent in ASL as they observed videos of ASL signs, half 1H and half 2H. Event-related spectral perturbations (ERSPs) in the alpha range were computed for the two conditions at central electrode sites overlying the sensorimotor cortex and paired comparisons showed significantly more alpha ERD when participants observed 2H signs as compared to 1H signs (ps <.05, FDR corrected). This finding suggests action simulation processes contribute to deaf fluent signers' observations of ASL, and that these processes are sensitive to linguistic/motoric parameters of sign language. This work provides the first investigation of alpha oscillations during sign language perception.

Topic Area: PERCEPTION & ACTION: Other

Atypical lateralization of intrinsic functional connectivity underlies aberrant face processing in autism spectrum disorders

Poster F98, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Lily M. Solomon-Harris[1], Naail A. Khan[1], Vladyslava Replete[1], Cynthia S. Peng[2], W. Dale Stevens[1], Alex Martin[2]; [1]York University, Toronto, [2]National Institute of Mental Health, National Institutes of Health

Autism spectrum disorders (ASD) are characterized by language and social (e.g., face perception) deficits. However, neuroimaging findings regarding the nature and extent of face processing deficits are inconsistent, possibly due to methodological differences in identifying key regions of interest (ROIs). By functionally localizing face ROIs in individual participants using fMRI, we recently demonstrated that individuals with ASD do not show typical rightward lateralization of face-related activation in the posterior superior temporal sulcus (pSTS). Previous work indicates that aberrant face-related activation in the pSTS might be related to reduced intrinsic (i.e., “resting-state”) functional connectivity (RSFC) with the fusiform face area (FFA). Here, we compared RSFC among group-localized vs. individually localized face-ROIs in typically developing (TD) participants and those with ASD. For individually localized ROIs only, TD participants showed stronger RSFC of the right FFA with the right pSTS than left pSTS. Critically, however, participants with ASD showed no difference in RSFC of the right FFA with the left vs. right pSTS, thus demonstrating no hemispheric asymmetry of RSFC among these ROIs, consistent with the lack of hemispheric asymmetry of face-related activation in the pSTS. The pSTS is critical for processing facial-dynamics, multisensory integration, and theory of mind, all of which can be impaired in ASD. Hemispheric lateralization is a critical component of human brain specialization, as for face processing and language skill. Reduced hemispheric specialization of the pSTS could play a critical role in ASD. Furthermore, our results demonstrate that individual ROI localization is crucial for rigorous study of neurodevelopmental disorders.

Topic Area: PERCEPTION & ACTION: Vision

Stimulus Integrity Modulates the Effect of Context on Object Recognition

Poster F99, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Leslie Y. Lai[1], William C. Heindel[1], Elena K. Festa[1]; [1]Brown University

In naturalistic settings, visual objects never occur in isolation of their scene context. Past research has shown that the visual system can leverage contextual associations during normal object recognition (Oliva & Torralba, 2007). Here, we examined the joint effects of stimulus integrity and contextual color association on rapid object recognition. This experiment used a two-alternative forced-choice saccadic task in which participants were shown a target word followed by two simultaneous images on either side of fixation. They were asked to make saccades as quickly as possible toward the image containing the target object. Objects were shown as either intact or distorted (warped), and were presented on a color background defining either neutral or meaningful contextual associations. Participants were more accurate at recognizing intact than distorted objects overall, and a significant stimulus integrity by contextual association interaction was observed for saccade latency. Saccade latencies were shorter for the intact than distorted objects when presented on a neutral background, but not when presented on a meaningful background. For intact objects, saccade latencies were longer when objects were presented on a meaningful background than on a neutral background, whereas for distorted objects, no significant effect of contextual association on saccade latency was observed. An ex-Gaussian analysis indicated that this interaction was being driven by the slower exponential component (tau) of the saccade latency distribution. Results suggest that the top-down influence of contextual color association during object recognition is mutually dependent on the integrity of bottom-up stimulus information.

Topic Area: PERCEPTION & ACTION: Vision

Color categorization without color naming: neuropsychological evidence

Poster F100, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Katarzyna Siuda-Krzywicka[1], Christoph Witzel[2], Emma Chabani[1], Myriam Taga[3], Laurent Cohen[1,4], Paolo Bartolomeo[1]; [1]1. Inserm U 1127, CNRS UMR 7225, Sorbonne Universités, UPMC Univ Paris 06 UMR S 1127, Institut du Cerveau et de la Moelle épinière, ICM, Hôpital de la Pitié-Salpêtrière, Paris, France, [2]Justus-Liebig-Universität Gießen, [3]University of East London, [4]Hôpital de la Pitié Salpêtrière Paris, France

Colors vary continuously, however we group them into distinct categories associated with specific color names (green, blue, etc.). It is an open question whether color categories are a product of linguistic labeling and thus, if categorizing colors requires transferring color information between visual and language areas. To answer this question, we investigated color categorization in a brain-damaged patient with a rare, selective impairment of color naming. The patient's lesion affected the left mesial occipitotemporal areas and the splenium of corpus callosum, abolishing direct communication between the bilateral visual cortex and language areas in the left hemisphere. We designed a new task measuring color categorization without explicit color naming. On each trial, we presented two color pairs, one from the same category (e.g. light-green, dark-green), the other from different categories (e.g. orange and yellow). The patient and a group of healthy controls (n=50) had to indicate pairs containing same-category colors. In a control experiment, the patient and healthy controls (n=12) named the colors from the color-categorization task. The patient performed normally on color categorization. Yet, his color naming was severely impaired only in chromatic, but not achromatic colors (black, white, grey). This chromaticity-effect was considerably weaker in color-categorization. Our results challenge the hypothesis that color categorization, like naming, involves language system. Our findings also indicate that compared with color categorization, color naming strongly segregates chromatic and achromatic information. Given that color names refer to color categories, our findings suggest that the processes of non-linguistic categorization are fundamental for color naming.

Topic Area: PERCEPTION & ACTION: Vision

Correlation of memory regions with face and object regions differentially predict performance on face/object memory tasks

Poster F101, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Michal Ramot[1], Catherine Walsh[1], Alex Martin[1]; [1]National Institute of Mental Health, National Institutes of Health

There is great degree of variance in the population in face memory capabilities, with congenital prosopagnosia at one end, and "super-recognizers" on the other. In this study, we sought to characterize the networks underlying face memory, as measured by the Cambridge Face Memory Test (CFMT). To control for the specificity of the observed network for face / face memory processes, we also administered the Cambridge Car Memory Test, and the Glasgow Face Matching Test (GFMT) to investigate whether effects generalize across other face memory tasks. Healthy volunteers completed the three memory tasks outside the scanner, and then underwent a 3T fMRI scan, comprised of rest scans, a face/scene localizer, and passive viewing of a movie clip. We found that correlations during rest between the ventral face patches and memory related regions, specifically the hippocampus and surrounding parahippocampal tissue, strongly predict performance on the CFMT task performed outside the scanner (r=0.55), and to a lesser extent performance the GFMT. Correlations of the same parahippocampal region with object regions during rest predict performance on the CCMT. Correlations between the ventral face patches and face regions of somatosensory cortex were also strongly predictive of performance on the CFMT (r=0.52), but this somatosensory region did not predict performance on the CCMT. A similar but weaker pattern was found during the movie. These results suggest that performance on memory tasks has both general and domain specific substrates, and that the specific nature of the memory task affects the networks involved.

Topic Area: PERCEPTION & ACTION: Vision

Predicting Automation Aid Response Time from EEG versus Low Cost Wearable Devices

Poster F102, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Dean Cisler[1], Carryl Baldwin[1], Pamela Greenwood[1], Ryan McKendrick[2]; [1]George Mason University, [2]Northrop Grumman

The increasing availability of both autonomous systems and low cost wearable devices capable of collecting physiological metrics from operators (e.g., EEG, heart rate [HR], eye movements) presents new opportunities of closing the loop between humans and complex systems. In the current investigation we compared the predictive capability of spectral analyses obtained from a laboratory grade EEG system (NuAmps) to the predictive capability of low cost wearable devices (heart rate variability obtained from the ZepherTM Biomodule strap and gaze dispersion from eye tracking glasses developed by Pupil Labs). Participants performed five autonomous driving sessions (drives) (~11 min each) during which they monitored an autonomous vehicle lane change task and made manual responses to indicate detection of infrequent (20%) automation aid failures signaled by a visual display. Separate Linear Mixed-Effects (LMEs) analyses were used to predict response time (RT) to detection failures using spectral analysis of Pz alpha-band in comparison to HR, vertical and horizontal gaze dispersion. Both LMEs indicated that the metrics were significant predictors of RT across five consecutive drives. Bayesian information criterion (BIC) was calculated to compare the fit of both models. Results indicated the model predicting RT with Pz alpha across drives (df(7), BIC = 1914.59) as the better fitting model. However, the model using low cost wearable devices was less robust (df(19), BIC = 1970.66) indicating that at present, improved sensor technologies are required before wearable devices can achieve the same predictive capabilities of more traditional laboratory physiological metrics.

Topic Area: PERCEPTION & ACTION: Vision

Prefrontal Cortex Supports the Transfer of Hierarchical Task Structure to Novel Environments

Poster F103, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Adam Eichenbaum[1], Jason Scimeca[1], Mark D'Esposito[1]; [1]Helen Wills Neuroscience Institute, University of California - Berkeley

Humans can rapidly learn hierarchical rule structures. The learning and execution of hierarchical rules is supported by frontal cortex such that increasingly abstract hierarchical rules recruit increasingly rostral areas of frontal cortex. This rule learning can be bolstered by applying knowledge of previously learned rules to novel environments that share a common hierarchical structure. However, the neural systems that support this structure transfer remain unknown. In the current study, we used fMRI to characterize the contributions of frontal cortex to the transfer of hierarchical rule structure. Participants performed 4 blocks of a reinforcement-learning task in which a hierarchical rule structure could be learned from deterministic binary feedback. Stimuli were composed of features from several dimensions (shapes, colors, and textures). Each block used novel features for each dimension but shared a second-order hierarchical rule structure: shapes cued first-order rules based on either color or texture. Behavioral learning metrics showed that approximately half of participants improved learning by transferring higher-order structure across blocks. Participants whose behavior indicated a high degree of structure transfer showed increased BOLD signal in the left anterior dorsal premotor cortex (prePMd) and the more rostral left inferior frontal sulcus. Participants who failed to exhibit transfer showed robust activation only in the more caudal left dorsal premotor cortex (PMd). These results are consistent with existing models of hierarchical gradients in the frontal cortex and provide novel evidence that more rostral areas previously linked to hierarchical task execution also support the generalization of structured knowledge to novel contexts.

Topic Area: THINKING: Decision making

The Effects of rTMS on Criterion Shifting during Memory Recognition

Poster F104, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Evan Layher[1], Lukas Volz[1], Tyler Santander[1], Michael Miller[1]; [1]University of California Santa Barbara

Previous recognition memory fMRI studies revealed that the successful retrieval effect (SRE) contrast (hits > correct rejections) is associated with increased activity across the inferior and middle frontal gyri (IFG and MFG) when people establish a cautious versus lax decision criterion. To expand on this finding, we used offline repetitive transcranial magnetic stimulation (rTMS) to inhibit cortical regions within the right IFG and MFG in an attempt to disrupt the maintenance of a cautious criterion. Participants (N=20) conducted memory recognition tasks during fMRI scanning, which included a cautious decision bias (only 30% of test images were

studied). This provided us with subject-specific rTMS target sites based on peak activity within the right IFG and MFG from the SRE contrast. On 3 separate research visits, participants performed memory recognition tasks before and after rTMS. During a single visit, participants performed two study/test cycles that included studying 100 face images (300ms each) followed by two recognition tests with either 30% (cautious) or 70% (lax) of test items being previously studied. In between the study and test phases of the second cycle, participants underwent rTMS of the IFG, MFG, or occipital vertex (sham). Contrary to our predictions, we observed that participants established a more cautious decision criterion following rTMS of the right IFG ($p<0.05$), but no difference in criterion shifting following rTMS of the right MFG relative to sham stimulation. These results suggest that rTMS of the right IFG can causally manipulate a decision criterion (although in the opposite direction as predicted).

Topic Area: THINKING: Decision making

Why did Pandora open the box? When curiosity overrides prospective risk

Poster F105, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Johnny King Lau[1], Hiroki Ozono[2], Anthony Haffey[1], Kei Kuratomi[3], Asuka Komiya[4], Kou Murayama[1]; [1]The Centre for Integrative Neuroscience and Neurodynamics, University of Reading, UK, [2]Kagoshima University, Japan, [3]Kochi University of Technology, Japan, [4]Hiroshima University, Japan

This study examined how curiosity biases decision-making, even in the face of physical risk, and evaluated the underlying neural mechanisms using fMRI. Thirty-one right-handed participants were presented with videos of magic trick (N=36) performed by professional magicians and images of food in a 3-Tesla Siemens scanner. In every trial, after viewing a trick, participants were shown a wheel of fortune which visualized the probability of winning (and losing), and were asked to decide whether to gamble. If they gambled and won, they were provided with a ticket to see the solution. They were instructed that if they lost, they would receive a mild electric shock after the experiment. Participants could also skip the gamble. For each trick, participants rated how curious they were to know the solution. Based on a generalised linear mixed-effects model, increased probability of expecting no shock, as well as curiosity, heightened individual’s tendency to take risk. Neuroimaging analysis compared the neural activations of the ‘accepted’ and ‘rejected’ trials at the time of decision making. In both magic and food trials, the acceptance (versus rejection) of the risky gamble was associated with greater activity in striatum, indicating that decision making driven by curiosity and extrinsic rewards are both supported by the brain’s reward system. A further functional connectivity analysis using the beta-series correlation method shows that striatal activity is coupled with posterior insula, a structure traditionally associated with the coding of negative stimuli and events.

Topic Area: THINKING: Decision making

The influence of expected reward and efficacy on cognitive effort allocation

Poster F106, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Carolyn K. Dean Wolf[1], Elizabeth V. Cory[1], Amitai Shenhav[1]; [1]Brown University

To achieve most high-level goals, people must utilize cognitive control. However, cognitive control is effortful, and individuals vary in their ability and/or desire to exert such cognitive effort. We have recently developed a computational model that describes how people decide how much cognitive effort to invest at a particular time (Shenhav et al., 2013). This model posits two key factors that are critical for deciding how much effort to invest in a task: (1) the reward one expects for succeeding at the task; (2) how likely they think they are to succeed given a particular level of cognitive effort (the perceived efficacy of that effort investment). Here we sought to validate these predictions by testing whether participants would change their level of cognitive effort depending on the expected levels of reward and efficacy, and to examine how people vary in their sensitivity to these two factors (which could provide insight into the basis of clinical impairments in motivation). Participants performed a Stroop task, and were cued on each trial with (1) the amount of reward available and (2) the degree to which reward attainment was determined by performance (efficacy). Across two studies, we find that participants exert more effort (measured by speed of correct responses) when reward is higher and when efficacy is higher. Importantly, we also find that participants’ sensitivity to reward is uncorrelated with their sensitivity to

efficacy, consistent with the prediction that these two factors arise from separate mechanisms and might, therefore, separately contribute to motivational deficits.

Topic Area: THINKING: Decision making

Children Engage Semantic Processes to Verify Arithmetic Facts: Evidence from the N400

Poster F107, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Amandine E. Grenier[1], Vanessa Cerda[1], Danielle S. Dickson[1], Bianca O. Obinyan[1], Jacob P. Momsen[2,3], Nicole Y.Y. Wicha[1]; [1]The University of Texas at San Antonio, [2]University of California San Diego, [3]San Diego State University

Arithmetic facts, like multiplication tables, are thought to be encoded into verbal memory, and children who develop a memory retrieval strategy perform better in math through high school. Semantic memory retrieval is usually indexed by a modulation of the N400 component. However, when adults verify the solution to simple multiplication problems (2x3=6 versus 2x3=7), correct solutions elicit a P300. The adult P300 may reflect the overlearning of math facts, wherein the correct solutions are interpreted as target items. This study measured ERPs in children during a similar multiplication verification task to examine cognitive processing in early stages of learning math facts. Third through fifth graders judged the correctness of multiplication problems. Each problem was presented one number at a time, as Arabic numerals with no symbols (e.g., 2 4 8). Half of the solutions were correct and half were incorrect (e.g., 2 4 12). Results show that both correct and incorrect solutions elicit an N400, with larger (more negative) amplitude for the incorrect solutions. This N400 pattern is similar to what is observed when people process the meaning of words in a sentence. No P300 was observed for correct solutions, indicating that the development of this skill continues after fifth grade. This ERP pattern may reflect that children rely more on semantic level processes than adults when verifying math facts.

Topic Area: THINKING: Development & aging

Network Topology of Symbolic and Nonsymbolic Number Processing: A 7T fMRI Study

Poster F108, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Benjamin N. Conrad[1], Eric D. Wilkey[1], Gavin R. Price[1]; [1]Peabody College, Vanderbilt University

There is a longstanding debate regarding the extent to which symbolic (e.g. Arabic digits) and nonsymbolic (e.g. dot arrays) numbers engage shared versus distinct neural mechanisms. Previous functional magnetic resonance imaging (fMRI) studies have almost exclusively assessed regional activation with only a few evaluating functional connectivity via psychophysiological interaction analysis. Graph theory provides a methodological framework for describing the network architecture of the brain, with potential to shed new light on the symbolic/nonsymbolic number debate. Here, we employ graph theoretical measures to assess the networks engaged during symbolic and nonsymbolic number processing. We conducted an event-related 7T fMRI study with healthy subjects (n=40, 19.5 $\pm$ 0.9 years). Participants performed a number comparison task in which they decided whether Arabic digits or dot arrays were more/less than five. To assess task-related functional connectivity, we performed beta series correlations. Average beta series were extracted from a whole-brain, 246 region atlas and separated based on condition. Connectivity matrices were constructed for each subject/condition and regions were partitioned into functional modules according to consensus clustering. For both conditions, six modules were delineated including a fronto-parietal, default mode, visual, sensorimotor, temporal and subcortical network. 26 of 246 regions were assigned to different modules between conditions. These differences were primarily characterized by a more distributed fronto-parietal network in the nonsymbolic condition, with 19 additional regions from parietal, frontal, and temporal areas being included in this network compared to the symbolic condition. Our findings suggest organizational differences in whole-brain functional network architecture between nonsymbolic and symbolic processing.

Topic Area: THINKING: Other

High and low-frequency activity in intracranial electroencephalography reflect the difficulty of mental arithmetic operations

Poster F109, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Michael J. Randazzo[1], Youssef Ezzyat[1], Michael J. Kahana[1]; [1]University of Pennsylvania

Mental arithmetic is fundamental to many everyday behaviors and is hypothesized by several models to be accomplished through either fact retrieval or direct computation, determined primarily based on task difficulty. Recent functional magnetic resonance imaging (fMRI) literature has provided evidence for the existence of both a fronto-parietal network mediating computation and a temporal-hippocampal network mediating recall. In this study, we sought to characterize these two pathways by describing the spectral correlates underlying easy and difficult arithmetic using intracranial electroencephalography. Three hundred thirty-five patients with intractable epilepsy undergoing seizure monitoring completed self-paced calculations requiring addition of three, single-digit numerals. To estimate problem difficulty, a model was fit to response times for all subjects, and trials were subsequently defined as easy or difficult compared to predicted times. Spectral power differences between conditions were computed using a Morlet wavelet decomposition for frequencies between 3-180 Hz, and electrodes were anatomically classified. A significant, overall pattern emerged across regions throughout the frontal and parietal cortices, whereby difficult trials comparably exhibited reduced low frequency power (3–17 Hz) and enhanced high frequency power (56–180 Hz). Furthermore, this pattern was drastically attenuated or reversed in medial temporal lobe and hippocampus. Our results suggest that difficult arithmetic elicits local activation along with a global desynchronization in regions associated with working memory and numerical manipulation, while similar activity in areas implicated in memory recall is predominantly observed during easy arithmetic. These findings support prior fMRI hypotheses with whole-brain spectral evidence of competing pathways for performing mental calculation.

Topic Area: THINKING: Problem solving

A right-hemispheric advantage for fast inferential reasoning

Poster F110, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Maria Eckstein[1], Silvia A. Bunge[1]; [1]University of California, Berkeley

It has long been known that the two hemispheres contribute differentially to cognition, most prominently in language. In the field of inferential reasoning, one hypothesis is that the left hemisphere produces inferences whenever there are gaps in logic, and that the right hemisphere rejects those inferences that lead to conflict (Marinsek et al., 2014). To shed more light on the hemispheric division of labor, we asked 37 right-handed participants to work on an inferential reasoning task, in which stimuli were presented laterally at a fast pace, such that one hemisphere had a processing advantage compared to the other. The task required participants to determine whether a series of stimuli conformed to pre-specified rules ("SET") or whether it violated these rules ("noSET"). We found that participants recognized SETs faster when stimuli were presented to the right than left hemisphere, $F(1,55)=5.0$, $p=0.028$. A similar advantage arose when participants used their (non-dominant) left hand, controlled by the right hemisphere, $F(1,33)=8.5$, $p=0.0064$. Accuracy showed the same, albeit non-significant, right-hemispheric advantage for recognizing SETs. No hemispheric differences were evident for noSETs. This suggests that in the current paradigm, the right hemisphere was specifically involved in confirming inferences, an extension to the framework introduced above (Marinsek et al., 2014). This advantage for recognizing regular patterns among a set of stimuli is in accordance with the right hemisphere's role in global processing (Robertson & Lamb, 1991). Our results further suggest a role of the right hemisphere in rapid (versus slow) computation, more generally.

Topic Area: THINKING: Reasoning

Associations between cortical thickness and reasoning vary by socioeconomic status in early childhood

Poster F111, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Julia A. Leonard[1], Rachel R. Romeo[1], Anne T. Park[2], Megumi Takada[1], Sydney T. Robinson[2], John D.E. Gabrieli[1], Allyson P. Mackey[2]; [1]Massachusetts Institute of Technology, [2]University of Pennsylvania

Although lower socioeconomic status (SES) is generally associated with lower performance on tests of cognitive skills, many children from lower SES backgrounds perform as well as their peers from higher SES backgrounds. Yet little research has explored whether the neural correlates of these individual differences in cognition vary with SES. The current study explores whether relationships between cortical structure and fluid reasoning differ by SES in early childhood. Fluid reasoning is supported by a distributed frontoparietal network, with evidence for a specific role of the rostral-lateral prefrontal cortex (RLPFC) in relational reasoning. In a sample of 115 4-7 year olds, we found that reasoning positively correlates with SES ($r = .31$, $p<.001$), but there remained significant variation of ability within SES brackets. In exploratory whole-brain cortical thickness analyses, bilateral thickness of the RLPFC differentially related to reasoning by SES (correcting for multiple corrections with FreeSurfer Monte Carlo simulation at $p < .005$). Specifically, thicker bilateral RLPFC positively correlated with reasoning in children from lower-SES backgrounds, whereas there was a slightly negative relationship in children from higher-SES backgrounds. Although RLPFC slowly thins across development, children from lower-SES backgrounds with higher reasoning ability showed a positive relationship between RLPFC thickness and age, while those with low reasoning ability showed a negative relationship. This work shows that slower RLPFC development may confer greater cognitive abilities in low, but not high, SES children and adds to a growing body of work showing that positive brain development may differ by environmental context.

Topic Area: THINKING: Reasoning

Timing the automatic activation and the early and late inhibition of the actions associated to a real object with event-related brain potentials

Poster F112, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

J. Bruno Debruille[1], Molly Touzel[2], Christine Snidal[3], Julia Segal[4]; [1]Dpt of Psychiatry, McGill University, [2]Dpt of Neuroscience, McGill University, [3]Dpt of Neuroscience, McGill University, [4]Dpt of Neuroscience, McGill University

Stimuli of the environment automatically activate the actions they are associated to. These activations occur extremely fast, which might sometimes be critical to survival. Nevertheless, in most cases, these actions are then inhibited, as suggested by recent behavioral data showing that the inhibition could occur, as soon as 100 ms after the occurrence of the stimulus. We thus tested whether this inhibition could be indexed by the anterior N1 event-related brain potential (ERP). To achieve that goal, ERPs elicited by an object, that is, the occurrence of a real space bar of a keyboard out of the dark, were recorded in three block-conditions: a look-only task, a count-task and a press task. ERPs to the third of the trials with the fastest presses were isolated and compared a) with the ERPs to the third of the trials where presses were the slowest and b) with the ERPs of the two other block-conditions, where the space bar pressing had to be prevented. Fronto-central N1s (FC-N1s) were found to be minimal for the fastest presses, for which parieto-central P1s were greater. FC-N1 amplitudes were intermediate for slowest presses and maximal for the two no-press conditions. We thus conclude to the possibility that FC-N1s index the early, systematic and short lasting, inhibition of object-activated actions and that parieto-central P1s index the initial activation of these actions. On the other hand, consistent with the idea that N300s index late inhibition processes, they were quasi absent for fast presses trials and large in other conditions.

Topic Area: PERCEPTION & ACTION: Motor control

Neuroimaging of Functional Movement Disorders Before and After Treatment

Poster F113, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Leonard Faul[1], Brendan Depue[2], Alexandra Jacob[2], Darryl Kaelin[2], Alberto Espay[3], Kathrin LaFaver[2]; [1]Duke University, [2]University of Louisville, [3]University of Cincinnati

Functional Movement Disorders (FMD) are common, yet poorly understood disorders of abnormal motor control presenting with tremor, dystonia, gait or speech problems. The pathophysiological substrates underlying FMD remain largely unknown, which limits

the development of targeted treatments. However, there is emerging evidence implicating alterations in brain circuits involved in emotional and sensorimotor processing. Using fMRI, we studied 9 FMD patients performing an emotional Go/No-Go task before and after undergoing a one-week inpatient multidisciplinary Motor Retraining (MoRe) program. Data was analyzed to examine main effects (pre>post, post>pre, within the fear>baseline contrast, as this elicited the greatest power). Data was further analyzed by including regressions with a behavioral indicator of treatment success (from a blinded rater using the psychogenic movement disorder rating scale - PMDRS), as well as functional connectivity. All analyses were thresholded at voxel-wise = p<.005 and cluster-wise = p<.05. Only post>pre changes remained significant after correction, indicating that after completing the treatment program, individuals with FMD: 1) showed increased activity in the dorsomedial prefrontal cortex (dmPFC), supplementary motor area (SMA), and primary motor cortex (PMC), 2) showed increased activation of premotor cortex (pMC), PMC, and putamen with increased motor improvement outcome, and 3) showed increased connectivity between the dmPFC and amygdala. These findings highlight an effect of the treatment program that appears to increase control over emotional response (activation of dmPFC and connectivity between dmPFC and amygdala), as well as increased integration of motor planning and response in the pMC, PMC, SMA, and putamen after treatment was performed.

Topic Area: PERCEPTION & ACTION: Motor control

Learning to control unstable dynamics via movement sonification improves generalization

Poster F114, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Dobromir Dotov[1]; [1]McMaster University

As per motor learning theory, unpredictability of training improves generalization. Predictive processing suggests that interactive synchronization facilitates learning of complex patterns. Movement sonification in relation to designated movement trajectories has proven useful in refining error-driven motor learning, due to multimodal integration by associative cortical areas and novel feedback pathways. To test the roles of unpredictability and mutual synchronization in a sonification paradigm, we designed a task of controlling an unstable (chaotic) system by synchronizing with it. Hand movement was sonified in the left channel and the unstable system was sonified in the right. In an unstable but interactive condition of training (U-I) the stimulus was weakly driven by the participant's movement, making it possible to achieve mutual synchronization if the participant learned to predict the short-term course of the chaotic system. In an unpredictable non-interactive condition (U-NI) the same system was delivered in decoupled mode. In a predictable non-interactive (P-NI) condition a sine wave pattern was used. Learning was evaluated in a design with pre-test, training, and immediate post-test. Tests comprised of non-interactive harmonic and unstable stimuli. Transfer entropy, cross-correlation, and average error showed that performance during training improved in P-NI (predictable non-interactive) and U-I (unstable interactive) but not in U-NI. We found transfer to the non-trained stimuli in the U-I group, some transfer but to fewer stimuli in P-NI, and no transfer in U-NI. Predictive processing can explain why unstable (unpredictable) stimuli hamper learning but a synergistic effect is produced if interaction is added to unstable stimuli.

Topic Area: PERCEPTION & ACTION: Motor control

Making plans in wonderland: Sensorimotor alterations increase temporal similarity of motor planning and imagery

Poster F115, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Rotem Bennet[1], Miriam Reiner[1]; [1]Technion

Numerous studies have shown correlations of motor imagery (MI) chronometry with actual movement kinematics, and found strong evidence for the mutual use of similar brain areas and mechanisms. Nevertheless, the neural theory behind this connection is still undetermined, and no kinematic parameter was found to explain the high between-subject variability of MI performance, and to enable reliable prediction of individual MI capacities. In our study we suggest the cerebellar forward-model as a fundamental shared mechanism, through its dual-role in both MI and motor-planning (MP) processes. We conjectured that sensorimotor alteration will

intensify the forward-model involvement in MP, and therefore increase MP-MI similarity. In the experiment, two groups of subjects (n=46) performed mental and manual rotation in a highly immersive, motion-captured, virtual environment, while their sensorimotor dynamics were altered by physical-virtual speed modification (x2, and control - x1). Individual mental-rotation, MI, capacities were assessed before and after 3 short blocks of manual-rotation, where MP durations were measured. The results show that sensorimotor alteration of x2 group has indeed extremely increased their MP-MI correlation (r=0.9, p<.0001), significantly more than for the control group (r=0.47), and most prominently for females (r=0.95). In addition, x2 subjects with initially slow MI have gained significantly higher performance improvement (-1.7s) following the physical blocks. Our results point to MP stage as the key MI-prediction motion parameter, and suggest virtual sensorimotor-alteration as a novel methodology to increase MP-MI convergence. These findings may enable accurate and seamless cognitive evaluation, and enhancement, through tracking the kinematics of ongoing natural behavior.

Topic Area: PERCEPTION & ACTION: Motor control

Timbre Impacts the Consistency of Music-Color Synesthesia

Poster F116, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Radhika S. Gosavi[1], Rory Bade[1], Edward M. Hubbard[1]; [1]University of Wisconsin-Madison

Several popular musicians have noted that “seeing” music enhances their compositions. These musicians experience synesthesia, a condition in which stimulation of one sensory modality evokes experiences in a second, unstimulated modality (Simner & Hubbard, 2013). While music-color associations have been observed in nonsynesthetes (Palmer et al., 2013), synesthetes make these associations with significantly higher consistency (Ward, 2006). Here, we tested whether group differences in consistency were driven by musical properties. We investigated music-color associations in nine synesthetes and nine nonsynesthetes by instructing participants to pick the color that best matched a sound. We presented musical stimuli that systematically varied by pitch, composition (chords, notes) and timbre (tuba, piano, saxophone, violin). Consistency was calculated as the difference between the colors chosen for the first and second stimulus presentations on the dimensions of hue/color, saturation/intensity and value/lightness. We found that synesthetes were significantly more consistent for all color dimensions, but that group differences were greatest in the hue dimension for saxophone (p=0.004) and violin (p=0.02), and in the value dimension for tuba (p=0.02) and piano (p=0.02). These findings show that synesthetic music-color associations are modulated by timbre, suggesting that later auditory regions, beyond primary auditory cortex, may form the neural basis of music-color synesthesia. Previous studies have noted timbre processing occurs in the superior temporal sulcus (STS), which is also involved in audiovisual integration (Beauchamp et al., 2004; Menon et al., 2002). Future studies should test whether cross-activation involving the STS is the neural basis of music-color synesthesia (Hubbard et al., 2011).

Topic Area: PERCEPTION & ACTION: Multisensory

Getting ready for Mars: how the brain perceives new gravitational environments

Poster F117, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Maria Gallagher[1], Agoston Torok[2], Camille Lasbareilles[1], Elisa Raffaella Ferrè[1]; [1]Royal Holloway, University of London, [2]Hungarian Academy of Sciences

On Earth, we are continually exposed to the force of gravity. Gravity is detected by vision, the vestibular system, proprioception, and viscera. This sensory information is integrated along with prior information to form an internal model of gravity. Understanding whether our internal model of gravity is able to flexibly adapt to new gravitational environments is vital as humans push the boundaries of space exploration. Here we explored whether the internal model of gravity could be applied to a new visually-simulated gravitational environment. Under Earth gravity, observers are more accurate at judging the speed of falling versus rising objects, as they comply with the physical laws of gravity. We investigated whether participants would show the same “gravitational advantage” when they observed objects moving under a visually-simulated Mars gravity environment. Participants were presented with a visual scene in which a ball moved upwards or downwards under Earth (9.81 m/s2) or Mars (3.71 m/s2) gravity. Participants first memorised the speed of the ball moving at a constant speed, then judged whether trials which varied in speed were faster or slower than the memorised speed. Analysis revealed that participants showed the same perceptual advantage for falling stimuli under both Earth and Mars gravity: downwards movement was more accurately detected than upwards movement. Although the internal model of gravity has been built up under Earth gravity, our results suggest that it can quickly adapt to a new gravitational environment.

Topic Area: PERCEPTION & ACTION: Multisensory

The relation between affective touch and pupil size

Poster F118, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Chris Dijkerman[1], Roel van Hooijdonk[1], Sebastiaan Mathot[2], Evelien Schat[1], Hannah Spencer[1], Stefan van der Stigchel[1]; [1]Utrecht University, The Netherlands, [2]University of Groningen, the Netherlands

Interpersonal touch is known to influence human communication and emotion. Affective touch is defined as soft stroke on hairy skin with a velocity of 1-10cms-1. This type of touch activates low-threshold unmyelinated mechanoreceptors, known as C-tactile afferents, which have been proposed to play a unique role in hedonic valence and emotion of touch. For other sensory modalities, hedonic processing has been associated with pupil dilation. However, it is unclear whether pupil dilation can be modulated by hedonic touch. The current study investigated how pupil size reacts to both affective and non-affective stroking. Pupil size data was obtained to investigate differences between stroking conditions. Additionally, an adjusted version of the Touch Perception Task (TPT) was used to assess subjective touch pleasantness ratings. Affective (3cms-1) and non-affective stroking (0.3 and 30cms-1) stroking was applied to the dorsal side of the right hand. Results revealed that stroking velocity had a significant effect on TPT-item scores, showing higher positive and lower negative ratings for the affective touch compared to non-affective touch, thereby replicating previous studies. Results, however, revealed no specific pupil dilation for the 3cms-1 condition, instead a logarithmic relation was found between pupil size dilation and stroking velocity. Theze results suggest that pupil size dilation is related to stimulus intensity (e.g. stroking velocity) rather than specific c-tactile stimulation.

Topic Area: PERCEPTION & ACTION: Multisensory

Functional Specificity and Sex Differences in the Neural Circuits Supporting the Inhibition of Automatic Imitation

Poster F119, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Kohinoor M. Darda[1], Emily E. Butler[1], Richard Ramsey[1]; [1]Bangor University

Humans automatically copy other’s actions, building rapport and social closeness in the process. In many social situations, however, imitation can be maladaptive and requires inhibiting. In the last two decades, studies investigating neural correlates associated with imitation-inhibition have produced mixed findings. Some studies showed specialised engagement of the theory-of-mind (ToM) network, while others showed more general engagement of the multiple demand (MD) network. Further, behavioural evidence suggests that imitative tendencies vary as a function of sex, but no neuroscience research has directly investigated this proposal. Across 2 fMRI experiments, we investigated the extent to which imitation-inhibition relies on a functionally-specific circuit, which varies its response according to sex. Experiment 1 (N = 28) used a whole-brain approach and demonstrated recruitment of the MD network for imitation-inhibition. Based on these findings and subsequent power analyses, in Experiment 2 (N = 50; >80% power) we independently localised MD and ToM networks in individuals, before investigating the response profile during inhibition of automatic imitative and spatial response tendencies. The MD network was sensitive to both imitative and spatial compatibility, but there was no engagement of the ToM network. Females showed a greater spatial compatibility effect behaviourally, but there were no neural sex differences. Our findings provide the most convincing neuroimaging evidence to date that imitation control relies on a domain-general conflict monitoring system as opposed to a domain-specific system that supports social cognition. The findings suggest that previous models of imitation control require revision and sex differences in imitation require further investigation.

Topic Area: PERCEPTION & ACTION: Other

Frequency modulation of neural oscillations according to visual task demands

Poster F120, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Jason Samaha[1], Andreas Wutz[2,3], Bradley Postle[1], David Melcher[2]; [1]University of Wisconsin-Madison, [2]University of Trento, [3]Massachusetts Institute of Technology

Temporal integration in visual perception is thought to occur within cycles of occipital alpha-band (8-12 Hz) oscillations. Successive stimuli may be integrated when they fall within the same alpha cycle and segregated for different alpha cycles. Consequently, the speed of alpha oscillations correlates with the temporal resolution of perception, such that lower alpha frequencies provide longer time windows for perceptual integration and higher alpha frequencies correspond to faster sampling and segregation. Can the brain's rhythmic activity be dynamically controlled to adjust its processing speed according to different visual task demands? We recorded magnetoencephalography (MEG) while participants switched between task instructions for temporal integration and segregation, holding stimuli and task difficulty constant. We found that the peak frequency of alpha oscillations decreased when visual task demands required temporal integration as compared to segregation. Alpha frequency was strategically modulated immediately prior to and during stimulus processing, suggesting a preparatory top-down source of modulation. Its neural generators were located in occipital and infero-temporal cortex. The frequency modulation was specific to alpha oscillations and did not occur in the theta (3-7 Hz), beta (15-30 Hz) or gamma (30-50 Hz) frequency range. These results show that alpha frequency is under top-down control to increase or decrease the temporal resolution of visual perception.

Topic Area: PERCEPTION & ACTION: Vision

Serial dependence in numerosity perception.

Poster F121, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Michele Fornaciai[1], Joonkoo Park[1,2]; [1]University of Massachusetts, Amherst, MA, USA., [2]Commonwealth Honors College, Amherst, MA, USA.

Attractive serial dependence represents an adaptive change in the representation of sensory information, whereby current stimuli appear more similar to previous ones. Here, we characterize the behavioral and neural signatures of serial dependence in numerosity perception, demonstrating that the perceived numerosity of dot-array stimuli in different numerical ranges is biased by a preceding irrelevant stimulus ("inducer") in an attractive way. First, we show that this effect has a weak spatial specificity and a relatively broad tuning for numerosity, and that it has a clear cortical origin (rather than subcortical). Second, we show that the attractive effect is stronger when a discrimination task involves a sequential presentation of the stimuli, rather than a simultaneous presentation, suggesting that the biases are potentially amplified at a decisional stage. Nevertheless, using electroencephalogram and a passive-viewing paradigm, we show that a neural signature of attractive serial dependence emerges even in the absence of an explicit task early in the visual stream, suggesting that serial dependence has a clear perceptual origin independently from a decision process. Our results collectively suggest that serial dependence results from a cortical neural computation starting from an early level of perceptual processing potentially subserving perceptual stability and influencing downstream cognitive stages.

Topic Area: PERCEPTION & ACTION: Vision

Impact of Working Memory Load and Stimulus Movement on Non-symbolic Number Perception

Poster F122, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Justin Bonny[1]; [1]Morgan State University

Models of non-symbolic number perception, the ability to estimate the number of objects in a set (e.g., about how many students are in a classroom) without counting, suggest the process of forming a numerical representation is relatively independent of working memory. However, research studies have predominantly used static, stationary images when assessing number perception. With evidence that working memory can be recruited during the visual processing of moving scenes, it remains to be determined whether it is involved in the perception of number of dynamic, moving, objects. In the present study, modified verbal and spatial operation span tasks that simultaneously required approximate number judgments were used to assess the degree to which working memory load and stimulus movement influenced non-symbolic number judgment performance. Across participants, two approximate number arrays were either static, moving with all elements in view, or, moving with elements briefly within view (e.g., moving behind a window) while the numerical ratio difference varied. Psychophysical models revealed the slopes of response curves, plotted as a function of number ratio, were influenced by working memory and movement type. The results indicate that the precision of approximate number representations was influenced by stimulus movement and having to concurrently maintain and recall specific types of information. This suggests that working memory may be involved in the perception of number in moving, but not stationary, stimuli. This raises questions regarding how models of number perception can account for differences in representational precision when stimuli are static versus dynamic.

Topic Area: PERCEPTION & ACTION: Vision

The Psychophysics of Make-up Changes in Female Faces

Poster F123, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Gregor Hayn-Leichsenring[1], Anjan Chatterjee[1]; [1]University of Pennsylvania

Perception and evaluation of photographed faces are linked to psychophysical properties such as spatial frequencies. One measure of the distribution of these frequencies is the slope of a function in a log-log plot of radially average Fourier power spectra. An ERP study of face learning has shown that digitally modified faces with shallower Fourier slopes (enhanced high spatial frequencies) elicit larger N170 and N250 amplitudes (Blickhan et al., 2011). Additionally, such faces are behaviorally preferred by raters (Menzel et al., 2015). In everyday life, people use facial cosmetics to change their appearances, which can lead to more female-looking (Russell, 2009) and younger-looking (Jones et al., 2015) faces. Here, we analyzed a dataset of paired photographs from 45 women (with and without self-applied make-up; Jones et al., 2015). The analysis revealed a systematic shallower Fourier slope (enhanced high spatial frequencies) for photographs of women with make-up (-3.16) as compared with photographs of the same women without make-up (-3.25); $t(44) = -3.170$, $p = .003$. A shallower Fourier slope in face photographs – as generated by the application of make-up – can lead to a better face learning and higher ratings for subjective attractiveness. The specific neural circuitry modulated by these psychophysical and perceptual changes remains to be determined.

Topic Area: PERCEPTION & ACTION: Vision

Effects of directed attention on stimulus attribute weighting: An ERP study

Poster F124, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Alison Harris[1], Aleena Young[1]; [1]Claremont McKenna College

There is growing consensus that, in order to make choices, decision-makers use attention to differentially weight choice-relevant attributes based on current goals. However, despite extensive research on the time course of attention and valuation, little work to date has directly examined the temporal dynamics of brain activity when attention is intentionally directed to different stimulus attributes. Here we measured event-related potentials (ERP) while hungry participants made dietary choices under three different attentional cueing conditions: responding naturally, focusing on taste, or focusing on health. All three conditions were presented in randomly interleaved blocks within a single session. Regardless of the attentional cue, participants were explicitly instructed to respond freely based on their preferences. Behaviorally, participants demonstrated significant shifts in attribute weighting consistent with the attentional cue. Likewise, ERP signals typically associated with decision value 500-650 ms after stimulus onset showed a significant interaction of decision value and attentional cueing, with increased neural responses in the Health cueing condition relative to Taste. Rather than reflecting increased effortful processing in the Health cue condition, the magnitude of this

neural interaction effect was negatively correlated with individual differences in speed of processing health versus taste attributes, such that larger enhancements of the ERP signal were observed in individuals who were faster at rating healthiness versus taste in a separate task. Together, these data support the role of attention in attribute weighting, while further suggesting that ERP correlates of valuation during directed attention reflect ease of processing rather than effortful cognitive regulation.

Topic Area: THINKING: Decision making

Perceptual decision making is supported by a hierarchical processing cascade, in both biological and artificial neural networks

Poster F125, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Laura Gwilliams[1,2], Jean-Rémi King[3,1]; [1]New York University, [2]NYU Abu Dhabi, [3]Frankfurt Institute for Advanced Studies

Models of perceptual decision making have historically been designed to maximally explain behaviour and brain activity independently of their ability to actually perform tasks. More recently, performance-optimised models have been shown to correlate with brain responses to images and thus present a complementary approach to understand perceptual processes. In the present study, we compare how these approaches account for the spatio-temporal organisation of neural responses elicited by ambiguous visual stimuli. Forty-six healthy human subjects made perceptual decisions on briefly flashed stimuli constructed from ambiguous characters. The stimuli were designed to have 7 orthogonal properties, ranging from low-sensory levels (e.g. spatial location of the stimulus) to conceptual (whether stimulus is a letter or a digit) and task levels (i.e. required hand movement). Magneto-encephalography source and decoding analyses revealed that these 7 levels of representation are sequentially encoded by the cortical hierarchy, and actively maintained until the subject responds. This hierarchy appeared poorly correlated with a normative, drift-diffusion, and 5-layer convolutional neural network (CNN) optimised to accurately categorise alpha-numeric characters, but partially matched the sequence of activations of 3/6 state-of-the-art CNNs trained for natural image labeling (VGG-16, VGG-19, MobileNet). Additionally, we identify several systematic discrepancies between these neural networks and brain activity, revealing the importance of single-trial learning and recurrent processing. Overall, our results strengthen the notion that performance-optimised algorithms can converge towards the computational solution implemented by the human visual system, and open possible avenues to improve artificial perceptual decision making.

Topic Area: THINKING: Decision making

The influence of negotiation style during online negotiations: an event-related potential (ERP) study

Poster F126, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Suzana de França Dantas Daher[1,2], Jadielson Alves de Moura[1,2]; [1]Universidade Federal de Pernambuco, [2]Center for Decision Systems and Information Development - CDSID

Previous studies have shown that effectiveness and efficiency of online negotiations depend on the synergy among how individuals communicate, how much information is available and the technology to support problem solving. The establishment of negotiation strategies is strongly influenced by a combination of such synergy. However, online negotiators need to deal with the absence of visual cues about the opponent which influences the ability to understand the feelings and needs of another and calibrate their negotiation strategies. Moreover, it is not clear how negotiator's brain reacts when interacting with different negotiation strategies during online negotiations. This study sought to investigate the relation between brain activities reactions and negotiation styles in a simulated online negotiation. Twelve adults (ages 19-35) interacted with three different intelligent agents (counter-party) programmed to adopted three different negotiation strategies: neutral, assertive and collaborative. Each participant using an EEG received a negotiation task to act as sellers in a fixed time window to finish or decline of the negotiation. Positive deflections occurring approximately 200 ms (P200) were detected and in error-related negativity (ERN) as well. The highest peak in P200 occurs when subjects interact with a collaborative agent in which an unexpected counteroffer value, greater than the expected one, was made. The events observed 50-100ms after the stimulus corroborates to a win/loss perception in expected/unexpected

outcomes. These findings suggest that negotiation style adopted by the other party influences in how individuals brain reacts during gambling interactions.

Topic Area: THINKING: Decision making

Neural Correlates of Encoding and Retrieving Probabilities of Event Occurrences.

Poster F127, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

I-Tzu Hung[1], Joshua Oon Soo Goh[1,2]; [1]National Taiwan University, Taipei, Taiwan, [2]National Institute on Aging, Baltimore, MD, USA

Knowledge of the probability of events facilitates better decision-making behaviors. However, how the brain encodes and retrieves information about event frequencies remains unclear. In this functional magnetic resonance imaging experiment, 19 participants (mean age (SD): 22.53 (2.46) yrs; age range: 20-29 yrs; 9 females) viewed series of 1s and 0s with different probability levels (10%, 30%, 50%) of occurrence and then reported subjective perceptions of event probabilities. Judgments showed a significant main effect of probability ($F = 6.544$, $p < 0.05$), with rare events evoking an overestimation bias that decreased as event frequency increased towards chance levels (mean (SD) 10%: +5.44 (4.67); 30%: +2.92 (4.36); 50%: +0.48 (7.18)). Judgment variability was highest at chance. Encoding brain responses were higher for 10% than 30% conditions in right middle and anterior medial frontal, bilateral parietal, and precuneus regions, and higher for 50% than 30% conditions in right middle frontal and bilateral inferior occipito-temporal regions. Neural responses were higher for 50% than 10% conditions. Thus, encoding of rare and chance events engaged distinct brain processes and the intermediate case recruited lowest neural activity. For retrieval, brain responses were higher for 10% than both 30% and 50% conditions in bilateral parieto-occipital, lingual, and right orbitofrontal regions. Such difference in retrieval activity across probability might stem from differential encoding of rare to chance event frequencies, with rare events involving more heuristic biases. Our findings have implications for theories on neural representation of probability and uncertainty for decisions.

Topic Area: THINKING: Decision making

Distribution of Relative Quantities in Nature and Human Culture

Poster F128, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Santiago Alonso-Diaz[1], Luis Alejandro Lee-Penagos[1], Gabriel Ignacio Penagos-Londoño[1]; [1]Department of Economics, Universidad Javeriana, Bogotá Colombia

The comparison of relative quantities is central for behavior (prey over occupied area), perception (Weber law), and human culture (math). Little is known about the distribution of their components. For instance, when a ratio is the larger in a pair it could have the larger numerator and smaller denominator, or perhaps, the smaller numerator and denominator. We present evidence that the distribution is not uniform across the potential cases. In a large array of databases we found that natural occurring proportions, such as the ones computed from animal morphology, neuron morphology, food distribution, and others, the larger (or smaller) proportion always had some numerosity advantage in one of its components. A similar pattern emerged in human-related activity. In economic measures (e.g. GDP per capita), intellectual activity (e.g. citations per paper), and education (e.g. ratios in Physics textbooks), it was not possible to find a uniform distribution. Numerical results revealed that if the numerator and denominator are independent and identically distributed then the probability that one of them is bigger in the larger fraction is greater than chance. We further test with a simulation that such statistical structure in the natural world induces numerosity-based strategies that are optimal. The non-uniformity of the distribution in such large array of databases suggests the existence of a previously unknown constrain in how ratios emerge (akin to Benford's Law) and suggest that numerosity-based strategies in education and decision-making have a rationale.

Topic Area: THINKING: Decision making

FEEDBACK PROCESSING AND RISK TAKING IN HIGH-ACHIEVING ADOLESCENTS

Poster F129, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Kayla Talbot[1], Taylor Valentin[1], Max Lobel[1], Danielle diFilipo[1,2], Jill Grose-Fifer[1,2]; [1]John Jay College of Criminal Justice, CUNY, [2]The Graduate Center, CUNY

Research suggests that heightened risk taking during adolescence is probably attributable to the interplay of an immature cognitive control network and a hyper-reactive socioemotional network. In order to investigate how adolescents and adults process feedback to help them learn associations, we recorded EEG from adolescents (13 to 17 years) and adults (25 to 35 years) while they completed a probabilistic learning task and were then tested on what they had learned. We replicated previous research showing larger feedback-related negativities (FRNs) to negative feedback than to positive feedback, and larger response-related negativities after erroneous responses (ERNs) than correct responses (CRNs). However, we found some highly surprising age-related differences. Adults in our sample engaged in more risky health behaviors than our adolescents, and showed less differentiation in their FRNs to positive and negative feedback than adolescents, suggesting that they might learn less effectively from feedback than the younger participants. We attribute these findings to the fact that our adolescents were probably not representative of typical adolescents in that most attended an extremely selective high school for high academic achievers.

Topic Area: THINKING: Development & aging

An event-related potential study of number format and the problem-size effect in arithmetic

Poster F130, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Danielle S. Dickson[1], Bianca O. Obinyan[1], Nicole Y. Y. Wicha[1]; [1]University of Texas at San Antonio

Arithmetic problems differ in difficulty, with 9x7 posing more of a challenge than 3x2. Adults are slower at solving and recognizing the solutions to problems with larger solutions, a phenomenon which has been named the problem-size effect. Number format ("nine" vs "9") also influences arithmetic processing efficiency, with faster RTs for problems presented using Arabic digit numerals. It has been difficult to trace the cognitive source(s) of these effects with behavioral data alone, leading to multiple similarly plausible theoretical explanations. Here, we measured ERPs at the solutions to multiplication problems that varied in both problem size and number format (2x2 design). Two operands were presented as either spoken number words or as sequential Arabic numerals. Adults verified the correctness of the Arabic numeral solution – whose size was used to classify the problem as large (>25) or small. Consistent with prior results, correct solutions elicited a more positive response than incorrect solutions. This effect was driven by a P300 to correct solutions, as well as by a co-occurring N400 effect when number words were the operands. Problem size manifested largely on the incorrect solutions, with a larger late positivity (LPC) for small problems than large. This LPC was more prominent when the operands were digits than number words. There was also a substantial main effect of operand format, with its own characteristic timing and scalp distribution. Our findings suggest that both problem size and number format independently influence arithmetic answer recognition at differing timescales and at different levels of cognition.

Topic Area: THINKING: Problem solving

Individual differences in information processing predict distinct structural connectivity patterns

Poster F131, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Justin C. Hayes[1], Katherine L. Alfred[1], David J. M. Kraemer[1]; [1]Dartmouth College

Is habitual use of cognitive processing that favors visuospatial cognition or verbal cognition associated with differences in structural connectivity patterns in specific brain networks? To test this hypothesis, we collected diffusion tensor imaging (DTI) data from 28 participants, as well as their scores on behavioral assessments, including the Verbalizer-Visualizer Questionnaire (VVQ), Wechsler Abbreviated Intelligence Scale (WAIS), Automated Working Memory Assessment (AWMA), and a verbal/visual response task (VVRT; intended to assess response-based modality specific processing preferences). Principal components analysis (PCA) was used to evaluate the structure of these behavioral scores. Results indicate 3 dimensions: working memory (AWMA), intelligence (WAIS), and a dimension that reflects habits of thought (HT), including variance from self-report surveys, objective measures of cognitive abilities, and attentional biases related to processing visuospatial and verbal information. Next, we used scores on the HT dimension (ranging from “strongly visuospatial” to “neutral” to “strongly verbal”) to associate with patterns in DTI. Consistent with our hypothesis, results indicate that HT scores correlate with specific networks of structural connectivity. Highly verbal HT scores were associated with greater fractional anisotropy (FA) values in white matter tracts associated with language processing (e.g., left perisylvian cortex). In contrast, highly visuospatial HT scores were associated with greater FA values in dorsal tracts traversing bilateral occipitoparietal cortex. The results suggest that connectivity within white matter tracts associated with processing verbal or visual information varies as a function of an individual’s habitual thought patterns.

Topic Area: THINKING: Problem solving

No gender differences in neural processing of mathematics in early childhood

Poster F132, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Alyssa J. Kersey[1], Kelsey D. Csumitta[1], Jessica F. Cantlon[1]; [1]University of Rochester

Recent public discussions have suggested that fewer women than men pursue careers in science, technology, engineering, and mathematics (STEM) due to intrinsic differences in aptitude. However, in adults, it is difficult to disentangle intrinsic differences from cultural influences. If intrinsic differences drive the under-representation of women in STEM careers, these differences should be evident in the neural processing of STEM concepts in early childhood. To test this prediction, we measured the neural maturity of boys’ and girls’ processing of mathematical concepts by calculating intersubject correlations between children (3- to 10-year-olds; 55 girls, 49 boys) and adults (35 women, 28 men) who watched mathematics videos during functional magnetic resonance imaging (fMRI). To compare boys and girls, we tested for statistical differences and statistical equivalence in mean neural maturity, statistical differences in the variability of neural maturity, and statistical differences in the relation between boys’ and girls’ math ability and their processing of mathematics concepts. Analyses were conducted within an independently defined mathematics network (bilateral intraparietal sulcus, bilateral frontal gyrus, and anterior cingulate cortex). Across all analyses boys and girls showed no differences in mathematical processing, and in fact, showed statistical equivalence in all regions of the mathematics network. This is the first study to test for statistical equivalence and differences in variability between gender groups in the brain. These results show that any observed gender differences in adults’ mathematics ability or mathematics-related neural activity do not arise from early childhood and thus, do not have an early biological origin.

Topic Area: THINKING: Reasoning

Neural Activity While Listening to Sentences Predicts University STEM Educational Outcomes

Poster F133, Tuesday, March 27, 8:00-10:00 am, Exhibit Hall C

Richard J. Daker[1], H. Moriah Sokolowski[2], Ian M. Lyons[1]; [1]Georgetown University, Department of Psychology, [2]University of Western Ontario, Brain and Mind Institute

Past work has demonstrated that attitudes and ability pertaining to math and spatial reasoning predict STEM outcomes, and much of successful reasoning in math is spatial in nature. To date, there has been no work examining how the level of similarity between math and spatial processing relates to educational outcomes. The current study uses representational similarity analysis (RSA) to investigate whether the degree to which different brain regions represent math and spatial content similarly predicts real STEM outcomes in college. Incoming first-year university students (N = 49) completed behavioral and self-report measures of math and

spatial performance and attitudes. In the scanner, each participant listened to sentences with math, spatial, or reading content. Academic records from the students' first two years of university, including all courses taken and grades earned, were provided by the university. Results showed that individual differences in the similarity of neural representations of math, spatial, and reading sentences predicted math and spatial attitudes (math/spatial anxiety, motivation) and real college STEM outcomes, including number of STEM courses taken and STEM GPA. A key result showed that the degree to which the right superior parietal lobule, an area implicated in both math and spatial reasoning, represented math and spatial sentences as similar significantly predicted grades earned in university math classes. This work provides additional support that successful math processing is spatial in nature and shows that even passively listening to sentences about math and spatial content elicits patterns of neural activity that are predictive of real-world STEM outcomes.