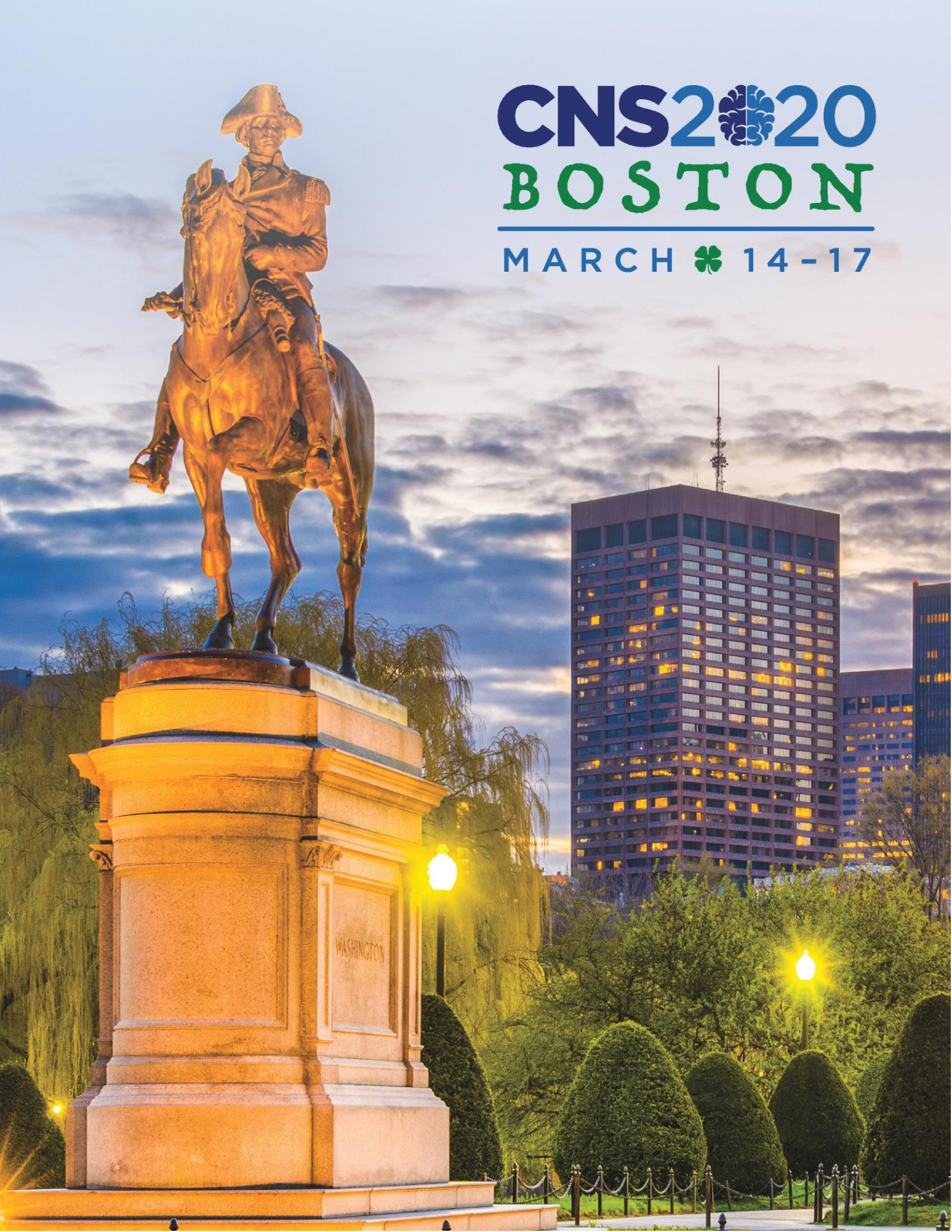
CNS2020
BOSTON
MARCH 14-17
WASHINGTON

Cognitive Neuroscience Society

27th Annual Meeting, March 14-17, 2020
Sheraton Hotel, Boston, Massachusetts

Abstract Book

Contents

A Supplement of the Journal of Cognitive Neuroscience
Cognitive Neuroscience Society
c/o Center for the Mind and Brain
267 Cousteau Place, Davis, CA 95616
ISSN 1096-8857 © CNS
www.cogneurosociety.org

Session A

Saturday, March 14, 3:00–5:00 pm, Exhibit Hall C

A1 Tracking of Continuous Speech in Noisy Auditory Scenes at 7T fMRI

Lars Hausfeld[1], Elia Formisano[1], [1]Maastricht University - Dept. Cognitive Neuroscience

Previous results from ECoG, MEG and EEG measurements studied brain responses to 'cocktail-party'-like listening situations. These studies showed that neural measures tracked ongoing acoustic features (e.g., amplitude of speech envelope, spectrogram, pitch) of the attended speech and, to a lesser extent, unattended speech. Furthermore, it was shown that primary and non-primary auditory cortical regions in STG contributed to the tracking of speech and its modulation by task. However, due to the limited coverage and spatial resolution of these measurements, the specific role of these regions and areas outside auditory cortex require further study. Here, we measure brain responses at high-field fMRI at 7T of participants who selectively attend to one of two speakers in an auditory scene. We show that speech tracking, previously performed at high temporal resolution, is possible with the comparably slow sampling of BOLD activation at 1Hz. Furthermore, the large coverage and high spatial resolution allowed us to map regions tracking the speech envelope features as well as the pitch contours of attended and unattended speakers. Single-participant analyses show that tracking of both attended and unattended speech features occurs in Heschl's gyrus and superior temporal cortex. Contrasting the tracking of attended and unattended speech showed that the attentional modulation (i.e., higher tracking for attended vs. unattended speech) is restricted to non-primary auditory cortical regions in planum temporale and superior temporal gyrus and sulcus. In addition, our results suggest a role of posterior temporal cortex in processing the distractor speaker.

Topic Area: ATTENTION: Auditory

A2 Development of Implicit Location Probability Learning

Saebyul Lee[1], Injae Hong[2], Su Keun Jeong[1],[1] Korea Brain Research Institute, [2]Yonsei University

We explored how statistical regularity of target locations affects visual search in 4- to 9-year-old children and adults. Participants performed a visual search task where a target appeared more often in one screen quadrant than in the other three quadrants. Both children and adults responded faster when the target appeared in the high probability 'rich' quadrant than in the low probability 'sparse' quadrants. This attentional bias toward the rich quadrant rapidly emerged over dozens of trials and persisted even when the target was equally likely to appear in all four quadrants. The magnitude of the bias was constant across various ages of participants and did not depend on individual differences in executive functions. Furthermore, the bias could be transferred to different types of target and distractor stimuli. Taken together, these results suggest that implicit location probability learning ability appears early in childhood and is maintained constant across development like invariant implicit learning ability in other modalities.

Topic: ATTENTION: Development & aging

A3 Multisensory interactions between emotional faces and voices are enhanced by attending to emotion but not gender

Sarah Izen[1], Vivian Ciaramitaro[1], [1]University of Massachusetts Boston

Correctly interpreting the emotional state of others is crucial for successful social interaction. Often, this involves the integration of information from faces and voices. Yet, what is the role of attention in emotional processing? Previous literature is equivocal, with some studies finding that emotional processing is automatic while others find that attention is necessary. The current study used an adaptation paradigm to investigate the role of attention in multisensory emotional processing. Participants first judged a series of faces morphed on a continuum from 80% angry to 80% happy as either happy or angry. Then, participants were adapted to either congruent (happy faces and positive sounds) or incongruent (happy faces and negative sounds) emotions. During adaptation participants attended to either the emotion or the gender of the faces. We calculated the exact face morph judged neutral, when participants were equally likely to judge a face as happy or angry, the point of subjective equality (PSE), and quantified the change in the PSE before versus after adaptation. We expected larger changes in PSE for the congruent versus the incongruent condition but only when emotion was the attended face feature and not when gender was the attended face feature.We found a benefit, enhanced adaptation, for congruent over incongruent emotions, but only when participants attended to the emotion and not the gender of the faces. This suggests that multisensory integration of emotional stimuli does not always occur automatically, but may depend on whether or not attentional resources are available.

Topic: ATTENTION: Multisensory

A4 Qigong moving meditation impacts attention and sensorimotor function in cancer-related fatigue

Simona Temereanca[1], Chloe Zimmerman[1,2], Dylan Daniels[1], Brendan Cullen[3], Howard Hughes[4], Tariq Cannonier[1], Catherine Kerr[1], Stephanie Jones[1], [1]Brown University, [2]Warren Alpert Medical School, [3]University of Oregon, [4]Fordham University

Moving meditation is associated with health benefits, yet little is known about the underlying brain mechanisms and brain-body interactions. Qigong moving meditation combines low-impact body movements with meditation, training the mind to focus and engage those movements. In this pilot randomized controlled clinical trial, we test whether ten-weeks of Qigong training is not inferior to an exercise-nutrition control program in reducing fatigue (FACIT-Fatigue Questionnaire) in 48 female cancer survivors with cancer-related fatigue. The study employs multi-modal physiological measures of brain, cardiorespiratory, muscle dynamics, as well as inflammatory immune markers as secondary outcomes. Here we report treatment effects on sensorimotor function assessed using simultaneous electroencephalography (EEG) and electromyography (EMG) during a tactile discrimination task and a precision grip task. We found that Qigong is not inferior to the exercise-nutrition program in improving fatigue in cancer survivors, with both interventions significantly reducing fatigue. Consistent with previous research, in both groups, cued-attention modulated beta (15-29 Hz) power measured from EEG electrodes over the sensorimotor cortex, showing decreased power 400-1000 ms after attention was cued to the contralateral hand and increased power after attention was cued to the ipsilateral hand. Further, attentional modulation of beta power was different post treatment and across groups. No consistent attentional modulation of alpha (7-14 Hz) power occurred at the population level. Ongoing analysis reveals an impact of treatment on the EMG activity as well as EEG-EMG beta corticomuscular coherence. This study helps identify potential EEG biomarkers of physiological effects of movement therapy on sensorimotor function and attention.

A5 Cortical Attention and Default Mode Networks in Focused Attention Meditators Assessed with fMRI

Kathryn Devaney[1], Emily Levin[2], Sara Lazar[3], David Somers[1], [1]Boston University, [2]Brown University, [3]Harvard Medical School

Meditation experience correlates with improved performance on behavioral assessments of attention, but the neural bases of this improvement are unknown. Two prominent, competing attention networks exist in the human cortex: a dorsal 'focused attention' network and a ventral 'circuit-breaker' network by which stimuli can capture attention. Additionally, a third network, the default mode network, demonstrates deactivation during demanding tasks. Here, we used functional magnetic resonance imaging to contrast cortical network activation between experienced vipassana meditators and controls. Participants performed two standard attention tasks during scanning: a sustained attention task and an attention-capture task. Meditators demonstrated increased magnitude of differential activation in the dorsal attention vs. default mode network in a sustained attention task, relative to controls. In contrast, attentional reorienting did not reveal behavioral or attention network differences between meditators and controls. These results demonstrate increased stability in sustained attention processes without an associated attentional capture cost in meditators.

Topic: ATTENTION: Other

A6 The effects of attention to the contextual integration of objects and scenes

Olga Leticevscaia[1], Talia Brandman[2], Marius Vincent Peelen[3], [1]University of Reading, [2]Wizmann Istitute of Science, [3]Donders Institute for Brain, Cognition and Behaviour

Context of naturalistic scenes has the power to facilitate object processing in the human brain (Brandman & Peelen, 2017). The representation of objects in the human visual cortex is also strongly modulated by selective attention (Cohen & Tong, 2013). How attention influences the contextual integration of objects and scenes, as well as the dynamics of this process, remains unknown. To address this question we recorded brain activity of twenty-nine participants using Magnetoencephalography (MEG) while they were viewing degraded (blurred) objects alone or in their natural background preceded by a fixation cross. To manipulate selective attention we showed the same stimuli display in the center of the screen, but asked participants to perform two interleaved tasks: to respond when they see the fixation cross changing its luminance (object-unattended) or when an oddball appears instead of an image (object-attended). The representation of object category (animate/inanimate) was measured by the multivariate response patterns across the scalp, for each point along the time-course of the neural response. Contextual facilitation was defined as the difference in decoding accuracy between objects with scenes and objects alone. This difference was significant for the object-attended condition at around 300 - 400 ms after stimulus onset and not for object-unattended condition. This reveals that selective attention plays a significant role in the contextual facilitation of objects in scenes in the human brain. The present study demonstrates how the multivariate response patterns from MEG recordings may unveil temporal dynamics of attention effects on the contextual integration of objects in

Topic: ATTENTION: Other

A7 Modeling the Trial-by-Trial Dynamics of Associative Learning: Alpha Power, Pupil Diameter, and Self-Reported Expectancy

Kierstin Riels[1], Andreas Keil[1], [1]University of Florida

There is substantial support for the notion that alpha power is selectively heightened when participants engage in tasks related to internal/anticipatory processing. A major portion of this research has shown that these findings vary greatly with pronounced inter-individual differences. Further hampering efforts to characterize the role of alpha-band oscillations in visual cognition, most studies have relied on trial averaging, which limits the ability test hypotheses regarding cross-session dynamics. Such dynamics are relevant for defining the role of alpha-band oscillations in associative learning. An ongoing, multi-experiment study of alpha-power changes in the human EEG during Pavlovian associative learning aimed to characterize the trial-by-trial covariance between occipital alpha power, pupil diameter, and expectancy ratings using computational methods, including the Rescorla-Wagner (RW) learning model and classification-based techniques. Pupil diameter is directly linked to sympathetic and parasympathetic nervous system activity and reliably increases during defensive mobilization. Here we tested the hypothesis that selective trial-by-trial alpha power enhancement during aversive learning reflects anticipatory processing and updating of contingency representations as postulated by the RW model. Ongoing analyses indicate that the Rescorla-Wagner Learning model accurately predicts trial-by-trial changes in both self-report and neural data (R2 of .26 and .10, respectively). Likewise, pupil diameter varied with expectancy ratings but was not related to alpha power. Furthermore, alpha power topography during cue anticipation discriminated high versus low anticipation trials, but no other frequency band did. Together, the data support the notion that pre-cue alpha power changes during associative learning reflect the trial-wise updating of contingency representations.

Topic: ATTENTION: Other

A8 Multiple Object Tracking: The Perception of Object Ensembles

Reem Alzahabi[1], Matthew Cain[1], [1]Tufts University

Multiple object tracking studies consistently reveal attentive tracking limits of approximately 3?5 items. How do factors such as visual grouping and ensemble perception impact these capacity limits? Which heuristics lead to the perception of multiple objects as a group? This work investigates the role of grouping on multiple object tracking ability, and more specifically, in identifying the heuristics that lead to the formation and perception of ensembles within dynamic contexts. First, we show that group tracking limits are approximately 4 groups of objects and are independent of the number of items that compose the groups. Further, we show that group tracking performance declines as inter-object spacing increases. We also demonstrate the role of group rigidity in tracking performance in that disruptions to common fate negatively impact ensemble tracking ability. The findings from this work contribute to our overall understanding of the perception of dynamic groups of objects. They characterize the properties that determine the formation and perception of dynamic object ensembles. In addition, they inform development and design decisions considering cognitive limitations involving tracking groups of objects.

Topic: ATTENTION: Other

A9 Complex naturalistic stimuli maintained in working memory capture attention automatically - an ERP study

Michal Bola[1], Natalia Rutkowska[1], Lucja Doradzinska[1], [1]Nencki Institute of Experimental Biology

Recent studies suggest that a stimulus actively maintained in working memory (WM) automatically captures visual attention when subsequently perceived. However, such a WM guidance effect has been so far observed only for stimuli defined by one simple feature, namely by color. Here we investigated whether the guidance effect occurs also for complex stimuli, which are defined by multiple features and relations among them, specifically for images of faces

and houses. The conducted experiment comprised two conditions ? a WM condition and a mere exposure condition. After remembering or seeing an image subjects performed several dot-probe trials, in which pairs of images were presented laterally as distractors - a remembered or seen on the one side, and a control image on the other. Images were followed by a target dot, to which subjects had to react by pressing a button. We found that subjects' responses were faster when the target dot followed a memorized face (t(25)=-4.08, p

Topic: ATTENTION: Spatial

A10 Investigation of Frequency-Specific Entrainment on Alpha Inhibition on a Single-Trial Basis

Yen-Hsun Chen[1], Chi-Hung Juan[1], Wei-Kuang Liang[1], [1]National Central University

It has been argued that alpha inhibition effect can be entrained by exogenous rhythmic flickering stimulation, thus modifying behavioral performance during the task. Such alpha-modulated activity can be altered by the difference between intrinsic individual alpha frequency (IAF) and external 10 Hz visual flickering stimulation. Moreover, IAF is found to decrease over trials and time. However, it remains unclear how this intrinsic IAF variability influences alpha-modulated activity. To resolve this issue, a modified Eriksen flanker task with frequency-tagging approach (10 Hz flankered with 6 or 15 Hz or vice versa) was adopted to testify whether alpha inhibition would be affected by different frequency combinations and whether reaction times could be predicted by the difference between 10 Hz and IAF in a single-trial level. Independent component analysis with Holo-Hilbert Spectrum Analysis was applied to reveal the full spectra of inter-trial interval EEG signals. The results indicated that when flankers flickered at 10 Hz, participants responded faster on a 15 Hz than a 6 Hz target in incongruent trials, whereas no significant effect was found in 10 Hz target conditions. Moreover, in each 10 Hz flanker condition, a significant positive correlation between incongruent RT and the absolute difference of IAF and 10Hz was found on a single trial basis. These findings suggest the dynamic mechanism underlying the variation of a single trial's IAF and the behavioral performance, also implying different alpha networks are involved in contingent with task demands. Therefore, optimizing detection of IAF is critical for the investigation of visual attention.

Topic: ATTENTION: Spatial

A11 Anticipatory Biasing of Visuospatial Attention in Deaf Adults

Ian DeAndrea-Lazarus[1], Jiayi Xu[1], Maeve Sargeant[2], Edward Freedman[1], John Foxe[1], [1]University of Rochester School of Medicine & Dentistry, [2]Saint Joseph's University

Some compensatory plastic changes as a result of limited auditory input are associated with visuospatial processing. For example, there is greater recruitment of the posterior parietal cortex (PPC) in deaf native American Sign Language signers compared to hearing participants when processing peripheral stimuli. The PPC is believed to act as an attentional gate for the visual system due to fast magnocellular inputs and feedback projections onto early visual areas and thalamic nuclei. Alpha-band activity (8-14 Hz) in the parieto-occipital area has been identified as an attentional suppression mechanism. An earlier onset of alpha-band activity could be an explanation for the heightened attentional skills in deaf native signers. Hearing non-signers (N = 18) and deaf native signers (N = 9) were administered a visuospatial cueing task while continuous electroencephalography (EEG) was recorded using a 128-channel Biosemi ActiveTwo electrode system. An EyeLink eye-tracking system was used to ensure strict eye fixation. Cue-locked ERPs were derived for leftward cues versus rightward cues. Alpha-band activity was characterized in the cue-stimulus interval using the temporal spectral evolution (TSE) technique. A repeated-measures ANOVA was performed with the factors of region-of-interest (left or right hemisphere) and cue direction (left or right) with no significant relationship found. Response times for valid trials were compared using an independent samples t-test, yielding a significant difference between deaf (422.11 +/- 81.11 ms) and hearing participants (493.79 +/- 55.06 ms); t(25)=2.70, p=0.01. However, we found no difference between deaf and hearing participants regarding the onset and magnitude of alpha-band activity.

Topic: ATTENTION: Spatial

A12 Biparietal transcranial direct current stimulation changes functional connectivity and behavioral performance

Kengo Tsujimoto[1], Katsuhiro Mizuno[1], Daisuke Nishida[1], Masatoshi Tahara[2], Meigen Liu[3], [1]National Center of Neurology and Psychiatry Hospital, [2]Saiseikai Higashikanagawa Rehabilitation Hospital, [3]Keio University School of Medicine

It has been reported that pseudo-neglect appears by biparietal transcranial direct current stimulation (biparietal-tDCS) (left anode/ right cathode) in healthy persons. However, few studies have focused on the change in functional connectivity (FC) within the attention networks with biparietal-tDCS. The purpose of this study was to investigate changes in FC after biparietal-tDCS in healthy adults. Participants (n=19) underwent 20 minutes of right hemisphere cathodal and left hemisphere anodal tDCS. fMRI and selective attention task (Task) were recorded before and after sham-tDCS and real-tDCS. Task was used to examine for the presence of pseudo-neglect. The Task consisted of a search array of 10 items (one target and nine distractors or ten distractors) presented. Participants determined if the target was present within the search array and pressed the 'Yes' or 'No' button. Functional brain images were acquired on a 1.5-T MR scanner. A seed-based correlation analysis was performed to investigate the FC in a dorsal attention network (DAN) (frontal eye field and intraparietal sulcus) and ventral attention network (VAN) (middle frontal gyrus and superior temporal sulcus). The result of reaction time of Task after real-tDCS was significantly longer than sham-tDCS. The FC of DAN during real-tDCS was significantly increased compared to the sham-tDCS. The FC of VAN during real-tDCS was significantly decreased compared to the sham-tDCS. Pseudo-neglect appeared with biparietal-tDCS. It was found that biparietal-tDCS changes not only FC of the DAN but also FC of the VAN. These results are important to clarify the neural mechanisms of attention.

Topic: ATTENTION: Spatial

A13 Grasping social development: Right hand use relates to motor, cognitive, and social development in children

Nicole van Rootselaar[1], Jeffrey MacCormack[1], Robbin Gibb[1], Fangfang Li[1], Claudia Gonzalez[1], [1]University of Lethbridge

When toddlers attempt to perform complex grasping actions (i.e. using a pencil), it apparent that their skilled motor control is not fully developed. Research suggests that the trajectory of lateralized grasping predicts the development of other abilities including speech and cognition. Previous studies show that children with greater right-hand use also demonstrate better speech articulation and executive function (EF: ability to regulate behaviour, make decisions and control emotions). An additional developing skill during childhood is social competence (SC). A child's ability to positively interact with peers is linked to measures of EF but has never been examined in relation to lateralized hand use. We assessed right hand grasping for construction in preschool children and compared it to their speech development (vocabulary and articulation), EF (card sorting tasks, parent questionnaires) and SC (child play interactions in pairs, parent questionnaire). We found significant correlations, where higher levels of right-hand use predicted better

performance for measures of speech development, EF, and for the first time, SC. These results reveal an intricate connection between lateralized motor development and abilities often referred to as 'higher-level' cognitive skills. This study is the first step towards elucidating the role of hemispheric lateralization in relation to the development of speech, EF, and SC. Potential applications include investigating right-hand training as an accessible tool to promote development of speech, EF, and SC.

Topic: EMOTION & SOCIAL: Development & aging

A14 Life stress is associated with gray matter thickness in the salience network in female adolescents and early adults

Alyssa Fassett-Carman[1], Harry Smolker[2], Hannah Snyder[1], Benjamin Hankin[3], Marie Banich[2], [1]Brandeis University, [2]University of Colorado Boulder, [3]University of Illinois Urbana Champaign

Life stress leads to depression symptoms and is associated with changes in gray matter (GM) in brain areas associated with stress reactivity and regulation (e.g. amygdala, hippocampus, medial prefrontal cortex [mPFC]). Adolescence and emerging adulthood is a period of heightened onset of depression symptoms and continued gray matter development. Importantly, depression onset and prevalence is higher in girls, and the link between life stress and depression is stronger for girls than boys. However, there is very little research looking into neural correlates of life stress during this time. Understanding gender differences in the neural correlates of life stress may begin to elucidate why girls and boys differ in the relation between life stress and symptoms. We investigated the gray matter correlates of dependent (i.e. self-generated) life stressors in adolescents and emerging adults (N=114, ages 14-22), as dependent stressors are particularly depressogenic. In girls, higher frequency of dependent life stressors in the past 6 months was associated with decreased GM thickness in the salience network (anterior cingulate cortex, insula) and the orbitomedial PFC, and increased GM thickness in the mPFC. Girls and boys together showed lower amygdala GM volume associated with life stress, but boys showed no other gender-specific relations with GM. These results thus highlight a mechanism through which girls may be more stress reactive than boys during this developmental period, as the salience network is crucial for identifying salient events and shaping neural responses via engaging other brain networks.

Topic: EMOTION & SOCIAL: Emotional responding

A15 Identifying Audiovisual Affective Congruence from Brain Activation Patterns

Chuanji Gao[1], Christine Weber[1], Douglas Wedell[1], Svetlana Shinkareva[1], [1]University of South Carolina

Emotional experiences are triggered by signals from multiple sensory modalities that can be either affectively congruent or incongruent. Although sensitivity to audiovisual emotional content of real-life situations is vitally important, the neural substrates of affective congruence across modalities are still unclear. fMRI data (N = 21) were collected while participants watched audiovisual clips with either congruent or incongruent valence across visual and auditory modalities while controlling for arousal. We report three main findings. First, using multivariate pattern analysis, we showed that affective congruence versus incongruence was identifiable on a trial-by-trial basis across participants. Second, using searchlight analysis, we localized representations related to affective congruence and showed that they were widely distributed. Third, areas sensitive to affective congruence largely overlapped with areas sensitive to valence and included superior temporal cortex, cingulate cortex, postcentral gyrus, and supramarginal cortex. The current study provides insights into the neural mechanisms for distinguishing congruent or incongruent affective content across visual and auditory modalities.

Topic: EMOTION & SOCIAL: Emotional responding

A16 Dynamic resting connectivity of the mesolimbic system is associated with individual differences in reward sensitivity

Sarah Kark[1], Joren Adams[1], Liv McMillan[1], Michael Yassa[1], [1]University of California, Irvine

Reward sensitivity is modulated by activation of the mesolimbic system. While traditional quantification of resting state functional connectivity (RSFC) has linked reward sensitivity with static measures of mesolimbic RSFC, communication between network nodes can change over time in meaningful ways. Dynamic approaches allow for quantification of change and variability in RSFC. Here, we test if individual differences in reward sensitivity are associated with dynamic RSFC within the mesolimbic system. In the current study, sixty adult participants (ages 18-37) underwent resting state functional magnetic resonance imaging and completed mood and reward-sensitivity surveys, including the Behavioral Inhibition/Approach System (BIS/BAS) Scale. We used sliding-window analysis as well as a data-driven analysis approach (i.e., k-means clustering) to quantify dynamic RSFC amongst mesolimbic nodes. Overall, the results converge on links between dynamic RSFC of mesolimbic regions and reward sensitivity. Specifically, we found that greater variability of amygdala-nucleus accumbens (nAcc) RSFC across windows was associated with a reduced desire to seek novel rewards (BAS-Fun Seeking). Importantly, analysis of static amygdala-nAcc RSFC showed no relation with reward sensitivity. Results of the data-driven approach demonstrated the degree to which an individual experiences positive response to rewards (BAS-Reward Responsiveness) is related to a more directional progression through mesolimbic network configurations (i.e., preferred brain state transitions vs. traversing configurations with equal probability). Correlations survived controlling for negative mood symptoms. These findings suggest that reward sensitivity is related to the coalescence and dissolution of mesolimbic network configurations over time and highlight the utility of dynamic RSFC approaches.

Topic: EMOTION & SOCIAL: Emotional responding

A17 The effects of insular resection on the cardiac interoception and emotion recognition

Yuri Terasawa[1], Kazuya Motomura[2], Toshihiko Wakabayashi[2], Satoshi Umeda[1], [1]Keio University, [2]Nagoya University

In this study, we examined the role of the insular cortex for cardiac interoception and recognizing emotions from facial expressions by comparing before and after a surgical operation for 18 patients with glial tumors or brain metastases associated with the insular lobe. We assumed that this method would allow us to examine the insular role of interoception and recognizing emotion with minimum influence of individual differences. Participants completed the heartbeat perception task and the emotional sensitivity task at the pre- and the post-surgical operation. Regarding the heartbeat perception task, discrepancies between the number of reported and actual heartbeats during the measurement periods were defined as the error rates. In the emotional sensitivity task, photos of various degrees of four emotional expressions (angry, happy, disgust and sad) were presented to test the participants' ability for detecting emotions from facial expressions. The difference in the performance of those tasks and the relationship between them was analyzed. Though the significant difference in the performance of the heartbeat perception task was not observed between two phases, there were significant associations between the interoceptive accuracy and the sensitivity to anger and happiness expression. Increased error rates of the

heartbeat perception task at the post operation phase were associated with the decreased accuracy of anger and happiness recognition. Although the effect of insular resection on interoceptive accuracy varied across individuals in this study, the association with the emotional sensitivity is evidence for supporting that insula underlies the subjective experience of emotions through interoception.

A18 Art as creative inspiration

Edward Vessel[1], Dominik Welke[1], Isaac Purton[2], [1]Max Planck Institute for Empirical Aesthetics, [2]New York University

What inspires you? Moments of creative inspiration (externally evoked motivation for creative activity) are critical pivot points that mark the transition from creative ideation to actualization of an idea. We hypothesize that the state of being aesthetically moved, a critical moment during aesthetic reception, is similar to the state of being creatively inspired. If this is the case, then being aesthetically moved may serve as an effective prime for creative inspiration. We designed an experimental paradigm in which participants wrote short pieces of creative text in response to visual prompts that varied in their subjective aesthetic appeal. Following each writing phase, participants rated how inspired they felt when beginning their writing. In Experiment 1 (25 participants), prompts consisted of paintings that each participant previously rated as highly liked (aesthetic prompts) or triads of unrelated words (non-aesthetic prompts). Mixed linear modelling revealed higher self-reported inspiration for aesthetic vs non-aesthetic prompts ($p < 0.001$). In Experiment 2 (34 paricipants), prompts consisted of paintings that each participant previously rated as highly liked or as disliked, plus novel paintings. Self-reported inspiration was higher for liked paintings than for disliked paintings ($p < 0.001$), with novel paintings producing intermediate ratings of inspiration. Yet even for novel paintings, inspiration ratings were positively associated with post-hoc aesthetic ratings. Thus aesthetic appeal, but not stimulus familiarity, influenced felt inspiration, suggesting that being aesthetically moved can act as a trigger for creative inspiration. Aesthetic engagement may be a potent tool for increasing individuals' likelihood to engage in creative production.

Topic: EMOTION & SOCIAL: Emotional responding

A19 Preparing for the Worst: Evidence that Older Adults Proactively Downregulate Negative Affect

Brittany Corbett[1], Natasha Rajah[2], Audrey Duarte[1], [1]Georgia Institute of Technology, [2]McGill University

Previous studies have only investigated age-related differences in emotional processing and encoding in response to, not in anticipation of, emotional stimuli. In the current study, we investigated age-related differences in the impact of emotional anticipation on affective responses and episodic memory for emotional images. Young and older adults were scanned while encoding negative and neutral images preceded by cues that were either valid or invalid predictors of image valence. Participants were asked to rate the emotional intensity of the images and to complete a recognition task. Using multivariate behavioral PLS analysis, we found that greater anticipatory recruitment of the amygdala, vmPFC, and hippocampus in older adults predicted reduced memory for negative than neutral images and the opposite for young adults. Seed PLS analysis further showed that following negative cues, older adults, but not young adults, exhibited greater activation of vmPFC, reduced activation of amygdala, and worse memory for negative, compared to neutral images. To the best of our knowledge, this is the first study to provide evidence that the 'positivity effect' seen in older adults' memory performance may be related to the spontaneous emotional suppression of negative affect in anticipation of, not just in response to, negative stimuli.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

A20 Impact of maternal trauma history on child cognitive performance at 5 years by child internalizing symptoms at 3.5 year

Molly Cunningham[1], Abigail Bosse[1], Carter R. Petty[1], Rosalind J. Wright[2], Michelle Bosquet Enlow[1], [1]Boston Children's Hospital, [2]Mount Sinai Hospital

A growing body of research indicates that maternal lifetime traumatic experiences, including experiences prior to the child's conception, may have intergenerational effects on a range of offspring neurodevelopmental outcomes throughout the life course. Numerous mechanisms have been proposed to account for these effects. The current study tested the hypothesis that maternal trauma history influences child intellectual functioning by middle childhood via child mental health in early childhood. Specifically, analyses tested the associations of maternal lifetime trauma exposures, child anxious/depressed and externalizing symptoms at 3.5 years, and child cognitive performance at 5 years, controlling for maternal education and family income, in a sociodemographically diverse pregnancy cohort of mother-child dyads (N=185). Mediation models with full-information maximum likelihood showed a significant indirect effect of maternal trauma history on child performance on the WPPSI Information subtest through child anxious/depressed symptoms (beta=-0.07, 95% CI [-0.12,-0.01], p=0.012], but not through child externalizing symptoms (beta=-0.05, 95% CI [-0.09,0.001], p=0.055). Family income exerted a mediating effect independent of child anxious/depressed symptoms (beta=0.14, 95% CI [0.002, 0.29], p=0.047). Sex-stratified analyses revealed that these findings were specific to female children. These results suggest that maternal trauma history may increase child risk for elevated anxiety and depressive symptoms, which, in turn, may impair child long-term memory and the acquirement of general knowledge. Potential underlying biological and behavioral mechanisms for these associations will be discussed. The findings have implications for identifying at-risk families and providing early intervention services to maximize children's emotional wellbeing and cognitive development.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

A21 Social reward-threat conflict influences amygdala activation underlying automatic actions in social avoidance

Travis Evans[1], Jennifer Britton[2], [1]VA Boston Healthcare System, [2]University of Miami

Dual-process models of social behavior propose that social rewards (e.g., happy face) elicit automatic approach actions and social threats (e.g., angry face) elicit automatic avoidance actions via the ventral striatum and amygdala, respectively. Frequently, automatic actions must be modulated in response to ambiguous faces that vary in social reward (e.g., 50%Happy), social threat (e.g., 50%Angry), or social reward-threat conflict (e.g., 50%Happy/50%Angry). Social avoidance behavior (SAB) may be associated with impaired modulation of automatic actions and striatal-amygdala circuitry. Thirty adults (18 ? 30 years, 16 females) in demographically-matched SAB groups (clinical, moderate, and minimal, n = 10 per group) completed an approach-avoidance task (AAT) during fMRI scanning. Based on background color, participants used button presses to increase/decrease (approach/avoid) the size of parametrically morphed ambiguous faces. In response to social reward-threat conflict, SAB was associated with slower automatic avoidance actions ($p = 0.03$), lower left ($k = 69$; 23, 5, -15) and right ($k = 68$; -24, 5, -15) anatomically-defined amygdala activation (p's < 0.03), and weaker connectivity between the right amygdala and rostral anterior cingulate cortex (rACC; $k = 82$, 8, -43, 3; FWE $p < 0.05$). No SAB associations were observed for the ventral striatum (p's > 0.61). In response to ambiguous social reward and social threat, SAB was not associated with automatic actions or striatal-amygdala circuit activation (p's > 0.51). Results suggest that SAB is characterized by impaired

modulation of avoidance actions to social reward-threat conflict, which may be attributable to conflict adaptation supported by the amygdala and rACC.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

A22 Tendency to Ruminate Predicts Higher Alpha Power During Resting State

Nicole Forner[1], [1]University of New Hampshire

When an individual is ruminating, they get stuck on a particular thought and replay the thought over and over again. A higher tendency to ruminate is associated with cognitive inflexibility and higher power in the alpha oscillatory band (8-12 Hz) during recognition memory. Observing the relationship between tendency to ruminate and alpha power at rest would demonstrate whether individuals with a higher tendency to ruminate have a stronger internal focus of attention. Participants (n=43) in our study completed the ruminative responses scale revised (RRS-R), Beck depression inventory II (BDI-II), and Beck anxiety inventory (BAI) followed by six minutes of quiet wakefulness with eyes open while their brain activity was recorded using EEG. Standard linear regressions were used to assess the relationship between tendency to ruminate and alpha power controlling for depression and anxiety levels, particularly in left frontal and posterior parietal brain regions based on previous work. A greater tendency to ruminate predicts higher alpha power in left frontal regions (sr2=.097, b=.300, SEb=.15, standardized beta= .348; t(36)=2.007, p=.052). The same pattern approached significance in posterior parietal regions (sr2=.092, b=.341, SEb=.172, standardized beta= .339; t(36)=1.986, p=.055). Higher alpha power associated with a greater tendency to ruminate could suggest that these individuals may tend to focus their attention inwards and may have a harder time flexibly shifting their attention towards task-demands.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

A23 Effects of Individual Differences in Disgust Sensitivity on Responses to Taboo Speech

Alexandra Kelly[1], Maurice Flurie[2], Bonnie Zuckerman[2], Jamie Reilly[2], [1]Drexel University, [2]Temple University

Disgust is an emotion that potentially evolved to support avoidance of contamination, but its significance may also extend to the sociomoral domain in response to stimuli including sexual deviance and body violations. Disgust has been cited as one of the core dimensions guiding the semantics of taboo speech, corroborated by prior research revealing that words denoting body parts, disease, and body acts are consistently perceived as among the most taboo. Disgust is also tightly linked with physiological arousal, with highly disgust-sensitive individuals demonstrating an increased arousal response. Here we examine the relationship between individual differences in disgust sensitivity as well as several other behavioral predictors of response to taboo words and compare them with pupillary responses as an index of arousal. Neurotypical adults (N = 31) read aloud, as quickly as possible, lists composed of taboo and non-taboo words while pupil diameter was continuously recorded. Participants' scores on the DS-R, a measure of disgust sensitivity, were significantly correlated with their self-reported use of profanity in childhood as well as their scores on a religiosity scale. We also examined the wihin-subject relationship between disgust sensitivity and baseline pupil size measured over a one-minute period of rest, as well as baseline pupil size and the peak pupil amplitude evoked by taboo stimuli. Our findings revealed no effects of individual differences on the pupillary arousal response. We will discuss implications of these findings for the relationship between disgust and taboo speech.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

A24 Efficacy of Consumer-Based EEG Devices for Conducting Future Research

Claire Simmons[1], Shenyang Huang[1], William Krenzer[1], Nita Farahany[1], [1]Duke University

Numerous electroencephalogram (EEG) studies have been done to detect fluctuations in individuals' emotions, but few studies have been conducted which use cost effective consumer-based EEG devices to detect these emotions. Our goal for this study is to use a consumer-based EEG device, the Emotiv Insight, to detect fluctuations in individuals' emotional states. To do so, we had participants (N = 20) passively view 60 images from the IAPS database that were equally separated into three emotional blocks: positive, negative, and neutral. After each block, participants were asked to self-report their emotional state using the Self-Assessment Manikan scale, all while the Emotiv Insight device recorded their neuronal activity. Preliminary results from a Repeated Measures ANOVA with the variables emotional stimuli (Positive, Negative, and Neutral), waveband (Alpha, Beta, Delta, Theta), and electrode (AF3, T7, Pz, T8, AF4) showed the interaction between emotional stimuli and waveband was trending towards significant, $F(6, 66) = 1.856$, $p = .17$. This effect is being driven by the difference in Alpha power between the Positive and Neutral stimuli, $t(66) = 3.57$, $p = .015$. While we are continuing to collect data, this specific 5-channel consumer-based EEG device may not arcuately detect emotion at a level consistent with use in research. Future research in our lab will look to see if other consumer-based devices may be better suited for detecting fluctuations in emotional states.

Topic: EMOTION & SOCIAL: Other

A25 Neural representation of social craving following isolation in the human brain

Livia Tomova[1], Kim Wang[1], Kay Tye[2], Rebecca Saxe[1], [1]Massachusetts Institute of Technology, [2]Salk Institute

Social motivation has been conceptualized as a fundamental drive in humans (Baumeister 1995, Sheldon 2009), yet little is known about neural mechanisms underlying the motivation to re-engage in social interaction after acute isolation, here called social craving. In a mouse model, dopamine neurons of the dorsal raphe nucleus code for the drive to re-engage in social interactions following acute social isolation (Matthews 2016). Here we used functional magnetic resonance imaging (fMRI) to investigate the neural representation of social craving in the human brain. Socially connected and extroverted typically-developing human adults (n=40) were acutely socially isolated and subsequently underwent fMRI scanning with a cue-induced craving paradigm. We found that isolation causes self-reported feelings of social craving and loneliness (average increase of ~30% after 10 hours of isolation). Furthermore, the caudate nucleus (i.e., a part of the striatum and a core area of the motivation circuitry (Berridge 2012)) showed increased activation in response to social cues following isolation. These results are in line with evidence that activity in dorsal striatum in humans is correlated with craving for food and drugs after deprivation (Volkow 2002, 2006; Noori 2016). However, within the same individual participants, we found partially non-overlapping neural responses to food craving after 10 hours of fasting. Our results suggest both overlapping and distinct neural representations of social craving and food craving after deprivation.

Topic: EMOTION & SOCIAL: Other

A26 Tell me the truth: the effect of feedback reliability in praise words on neural activation in reward system

Shotaro Fujiwara[1], Ryo Ishibashi[1], Azumi Tanabe-Ishibashi[1], Ryuta Kawashima[1], Motoaki Sugiura[1], [1]Tohoku University

Verbal praise, a type of positive feedback in social interaction, is known to activate the reward system in the brain, such as bilateral nucleus accumbens (NAc), bilateral medial orbitofrontal cortices, and posterior cingulate cortex (PCC). The praises, however, do not always reflect real evaluation by others. Their reliability could vary from high (sincere praises) to low (flattery). To study if sincere praises and flattery are processed differently in the reward system, we examined the neural activity using functional magnetic resonance imaging (fMRI). In the experiment, subjects performed a visual search task and received three different types of feedbacks; sincere praise, flattery, and meaningless feedbacks. Each feedback was associated with a face icon in different colors to make the three types discernable to each other. Activations in five major ROIs in the reward system were examined. The results showed that the right NAc and the PCC were activated when subjects received sincere praises, but not when receiving flattery. There was also a significant correlation between the activity level of PCC and the degree of reliability the subjects felt with the sincere feedbacks ($r=0.43$ p

Topic: EMOTION & SOCIAL: Person perception

A28 Neural differences in the theory of mind network during socially awkward events in schizophrenia

Emily Przysinda[1], Emily Dudek[1], Bridget Shovestul[1], Abhishek Saxena[1], J. Steven Lamberti[1], David Dodell-feder[1], [1]University of Rochester

People with schizophrenia experience marked and persistent difficulties with social information processing that contribute to functional impairment. Although these social deficits can manifest behaviorally in a way that appears similar to autism spectrum disorder (ASD), the underlying pathophysiological mechanisms may be different, which would carry important treatment implications. Further, these underlying pathophysiological mechanisms may best be revealed with passive viewing of naturalistic social stimuli that are not confounded by factors unrelated to social deficits. Along these lines, a recent study (Pantelis et al., 2015) found that people with ASD exhibited hypoactivation of theory-of-mind-related brain regions while passively viewing an episode of the TV show 'The Office'. Here, using the same stimulus and analysis procedures as those in Pantelis et al., we evaluated whether people with schizophrenia show social information processing deficits similar to those observed in ASD. Our analysis across all subjects replicates Pantelis et al.'s findings showing that areas of the theory-of-mind network were consistently activated during awkward moments. Preliminary analyses show that during awkward moments, when compared to controls, people with schizophrenia demonstrate less activation of the dorsal medial prefrontal cortex, a region involved in processing enduring social and psychological characteristics. Importantly, this contrasts with the findings of Pantelis et al. who found decreased activity in the right superior temporal sulcus and temporo-parietal junction, regions involved in more explicit, cognitive social judgements of transient mental states. These data suggest there may be different neural correlates of social dysfunction between schizophrenia and ASD, despite similar behavioral social deficits.

Topic: EMOTION & SOCIAL: Person perception

A29 Seeing humanness in older people

Toshiki Saito[1], Rui Nouchi[1], Ryo Ishibashi[1], Kosuke Motoki[2], Yutaka Matsuzaki[1], Akiko Kobayashi[1], Motoaki Sugiura[1], Ryuta Kawashima[1], [1]Tohoku University, [2]Miyagi University

Although age is a primary characteristic in social cognition, the effect of the target's age on the perception of humanness has not been thoroughly examined. Furthermore, whether the neural activity for humanization is different for specific targets (i.e. older people) compared to others (i.e. younger people) is still unknown. We investigated the effect of target age on perceived humanness: experience and agency, and the neural activity when people perceive the humanness of older and younger targets. Participants (n = 35) performed two types of humanness judgments (agency and experience), and judgments of two other characteristics (attractiveness and belonging) regarding older and younger target faces in an MRI scanner. The results indicated that participants rated older targets as having more experience than younger targets. Subsequent functional MRI analyses revealed that no brain regions were parametrically correlated with any of the ratings. However, we found two significant functional-connectivity differences between older and younger targets during experience rating. First, there was a significant negative functional-connectivity between the ventral and dorsal medial prefrontal cortex. This connectivity might reflect that the activity of the ventral part related to humanization has a role to deactivate the dorsal part. Because the dorsal part activates when inferring thoughts of outgroup, and older people tend to be perceived as outgroup. Second, we found the positive functional-connectivity between the left inferior frontal gyrus and the supramarginal gyrus. This connectivity might indicate a compensative role of the supramarginal gyrus for the dehumanization-related activity of the left inferior frontal gyrus.

Topic: EMOTION & SOCIAL: Person perception

A30 Are Two Activities Better Than One? Effects of Music Training and Physical Activity on Cognitive Development

Yaen Chen[1], Lauren Raine[1], Arthur Kramer[1], Charles Hillman[1], Psyche Loui[1], [1]Northeastern University

Music and exercise have both been associated with improved cognitive and academic performance, but it is unknown if benefits from music and exercise might interact or overlap in the brain. Here we evaluate relative effects of musical training and physical activity (PA) intervention on the same population using data from the FITKids2 study (Chaddock-Heyman et al, 2018). Preadolescents aged 7-9 (n=175 analyzed) were randomized to participate in either a nine-month PA intervention (n=88, 25 musicians and 63 non-musicians) or a no-intervention waitlist (n=87, 24 musicians and 63 non-musicians). Cognitive abilities were tested with the Woodcock-Johnson Psycho-Educational Battery (WJIII), working memory was measured with the Operation Span Task (OSPAN), and academic achievement was assessed with the Kaufman Test of Educational Achievement (KTEAII) before and after the nine-month period. Participants with musical training showed higher maximal oxygen consumption (VO2max), indicating greater aerobic fitness. Participants with musical training had higher average KTEAII, WJIII, and OSPAN standardized scores across all subtests. Participants who received PA intervention showed increased scores on multiple WJIII subtests, especially among musicians who received PA intervention compared to musicians in the no-intervention waitlist. WJIII subtests all showed main effects of PA intervention and musical training. All results remained significant after including age, sex, and socioeconomic status as covariates. Additionally, Sound Blending and Thinking Ability subtests of the WJIII showed significant interactions between PA and musical training. These results suggest that exercise and musical training both improve a variety of cognitive abilities with synergistic benefits in select auditory-motor and executive functions.

Topic: EXECUTIVE PROCESSES: Development &aging

A31 Amount of daily sleep moderates the relationship between family SES and children's inhibitory control skills

Srishti Nayak[1], Amanda Tarullo[2], [1]Princeton University, [2]Boston University

"Robust associations have been demonstrated between family socioeconomic status (SES) and executive function (EF) skills such as inhibitory control (IC). What specific mechanisms carry out these effects on the structure, function,

and development of the EF system? Sleep is recently emerging as an important factor in understanding EF in both normal and clinical populations. In this study we ask: are daily sleep habits and behavior one such mechanism in children? We measured 109 children's (6-8 yrs) inhibitory control skills through a visual Stroop task which elicited a Stroop Effects score. Parents completed the Child Sleep Habits Questionnaire alongside. As predicted, lower family SES was associated with higher Stroop effects in our sample (p"

Topic: EXECUTIVE PROCESSES: Development &aging

A32 Individual differences in GABA modulate brain activation during cognitive control differently in teen males and females

Louisa Smith[1], Harry Smolker[1], Hilary Traut[1], Rebecca Helmuth[1], Boman Groff[1], Mark Brown[1,2], Hannah Snyder[3], Benjamin Hankin[4], Marie Banich[1], [1]CU Boulder, [2]Anschutz Medical Campus, [3]Brandeis University, [4]University of Illinois Urbana-Champaign

This study examined whether individual differences in levels of lateral GABA+ and GLX (glutamate + glutamine) are associated with brain activation during two distinct cognitive control tasks in ninety adolescents (47 female, age 14.3-22.2, M=17.2, SD=1.5). One task, a Word-Picture Stroop, was used to assess participants' ability to actively maintain a task goal, while the other task, a Verb Generation task, was used to assess the ability to select amongst competing goal-relevant responses. PRESS and MEGAPRESS sequences were used to determine GABA+ and GLX concentrations (accounting for grey matter) in each of a dorsolateral prefrontal (dlPFC) voxel and a ventrolateral prefrontal (vlPFC) voxel for each participant while at rest. Results indicated strong gender differences in the associations between neurotransmitter levels and brain activation. Specific to girls, increased dlPFC GABA+ (when also accounting for GLX) was associated with decreased activation during goal maintenance in regions of the frontoparietal network and anterior insula. In contrast, increased dlPFC GABA+ (when also accounting for GLX) was associated with decreased activation in premotor and inferior frontal regions within the salience network during selection in boys. In both cases, dlPFC GLX (when accounting for GABA+) showed weaker and opposite relationships to those observed with GABA+. No associations were found for neurotransmitter levels within the ventral voxel. Given that GABA is thought to play a role in neural sculpting during adolescence, these findings raise the possibility that neural plasticity may affect brain networks involved in cognitive control differently across gender during the teen years.

Topic: EXECUTIVE PROCESSES: Development &aging

A33 Criterion shift association of Electroencephalography, in a recognition memory security patrol paradigm.

Christina Boardman[1], Evan Layher[1], Jean Vettel[2], Michael Miller[1], [1]University of California Santa Barbara, [2]Army Reserch Labratory

Depending on the situation, it may be prudent to switch between a liberal and a conservative criterion. For instance, security personnel should maintain a liberal criterion when questioning individuals at a security checkpoint. However, when use of physical force on suspected individuals is anticipated, a conservative criterion should be used to minimize the risk of harming a potentially innocent person. Aminoff et al. (2015) found that maintaining a conservative criterion is associated with increased fronto-parietal fMRI activity. We expand on this finding using EEG to explore the temporal dynamics associated with maintaining a conservative versus liberal criterion during a recognition security patrol task. We predicted that maintaining a conservative versus liberal criterion would be associated with a large positive event-related potential (ERP) peak around 300ms after stimulus onset (P3). In a screening task, we identified 38 EEG participants who sufficiently shifted their criterion when instructed to focus on avoiding targeting innocent people in the conservative condition and to focus on avoiding missing suspicious people in the liberal condition. We found that maintaining a conservative versus liberal criterion is associated with a modest increase in frontal power (F=9.14, pliberal contrast waveforms. Additionally, in an Event Related Spectral Perturbation analysis we observed greater posterior power in the theta frequency band. Our results indicate maintaining a conservative criterion is associated with P3 and criterion shifting affects appear in oscillatory dynamics.

Topic: EXECUTIVE PROCESSES: Goal maintenance & switching

A34 Multiple-demands & cognitive control: activation during task-switching is not specific to anterior prefrontal cortex.

Richard Daws[1], Yuqi Li[1], Eyal Soreq[1], John Duncan[2], Stefano Sandrone[1], Adam Hampshire[1], [1]Imperial College London, [2]Cambridge University

Several theories have postulated a hierarchical organisation within the frontal lobes that follows an anterior-posterior gradient, with the anterior prefrontal cortex (aPFC) supporting more abstract representations [1,2]. However, we and others have reported distributed activation patterns, including aPFC, during contexts of high task difficulty [3], the initial stages of instruction-based learning [4] and even during tasks that lack abstraction [5]. Here, we test these competing theories using a custom task-switching paradigm where each trial required a switch that varied by difficulty / switching distance. We collected 15-minute functional MRI recordings from 15 healthy adults (mean age=27) while they performed the task. We used response speed as difficulty-marker and found slower responses for rule and task switching relative to switches to lower-level stimulus features. Switching activated a distributed set of aPFC, lateral frontoparietal and cerebellar regions, with greater activation for more difficult switches across these regions. Directly comparing activation for switches with high and low requirements for abstraction showed differences in occipital cortices, but not in aPFC. Our results challenge the abstract-concrete notion of frontal lobe organisation, and support the distributed processing multiple-demands perspective on cognitive control. 1. Koechlin, and Summerfield, 2007. TICS; 2. Badre, and D'esposito, 2009. Nature Reviews Neuroscience; 3. Parkin, et al., 2015. Journal of Neuroscience; 4. Hampshire, et al., 2019. Neuroimage; 5. Crittenden, and Duncan, 2012. Cerebral Cortex.

Topic: EXECUTIVE PROCESSES: Goal maintenance & switching

A35 tDCS Increases Cognitive Flexibility by Decreasing Task Set Inertia

Peyton Taylor[1], Joseph Orr[1], Michael Imburgio[1], [1]Texas A&M University

Previous work indicates that a balance in striatal and prefrontal dopamine might underlie the balance between cognitive flexibility and cognitive stability. Meanwhile, PET studies have reported that prefrontal tDCS can increase striatal dopamine. The current work replicated the tDCS montage from these PET studies to assess whether prefrontal tDCS might increase flexibility. A within-subjects design was used in which participants (N = 29) underwent both active and sham stimulation at least a week apart. Afterward, participants completed a voluntary task switching paradigm in which monetary reward was used to create an environment that encouraged flexibility. Drift diffusion models were fit to task performance to assess stimulation's effects on task set preparation, task set inertia, response caution. Participants chose to switch significantly more often following active stimulation, indicating that tDCS increased cognitive flexibility. tDCS also increased reaction times overall. This effect was larger on repeats, consistent with manipulations that reduce task set inertia in voluntary task switching. Modeling results supported this interpretation; stimulation reduced the effect of switching on drift rate, thought to quantify the contribution of inertia to switch costs. Finally, stimulation also caused more cautious response patterns independent of increased switching,

possibly indicative of an overall shift towards a flexible mindset. The study indicates that prefrontal tDCS might increase cognitive flexibility by reducing the effect of irrelevant task sets on performance. Future work should examine the degree to which this effect might be related to changes in striatal dopamine following stimulation.

Topic: EXECUTIVE PROCESSES: Goal maintenance & switching

A36 Learning more when attending less: Poor attentional states enhance peripheral learning

Michael Dubois[1], Alexandra Decker[1], Katherine Duncan[1], Amy Finn[1], [1]University of Toronto

Sustained attention not only facilitates the ability to successfully complete task goals but also drastically enhances learning and memory. However, sustained attention is not stable, but fluctuates from moment-to-moment. How these fluctuations influence what information we sample and learn from in our environment is unclear. One possibility is that in superior attentional states, we selectively process motivationally relevant input, while inhibiting less relevant input, whereas in poor attentional states we process both, and even integrate across these sources of information.To test how fluctuations in sustained attention influenced whether people process extraneous information, participants completed a correlated flanker task, in which they identified the category of a central target (a letter or a number), while ignoring distractor symbols in the periphery that had hidden probabilistic relationships with the central targets. We asked (1) whether people who had poorer sustained attention overall processed the distractors better than those with better sustained attention; and (2) whether shifts to poor attentional states within individuals led to more processing of the distractors. We found that participants with poorer sustained attention learned the probabilistic target-flanker correlations better than participants with superior attention, suggesting they processed both task relevant and irrelevant information and integrated across these sources. Furthermore, within-subjects analyses revealed that participants processed the extraneous information more in a poor attentional state. Thus, sustained attention fluctuations influence what type of information we sample: in a poor attentional state, we attend to information that is not strictly relevant and use it to guide behaviour.

Topic: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A37 Network Coupling & Task Performance

Derek M. Smith[1], Thackery I. Brown[2], Eric H. Schumacher[2], [1]Northwestern University, [2]Georgia Institute of Technology

Both the Frontoparietal Network (FPN) and the Cingulo-Opercular Network (CON) have been associated with elements of cognitive control. These networks have been proposed to act in parallel or to interact in a closed loop. The aim of this study was to gain a better understanding of how the interaction of these two networks contributes to conflict processing and conflict adaptation. It was hypothesized that the degree of coupling between the CON and the FPN would be positively related to task performance. Thirty-Three subjects completed a color flanker task while in a magnetic resonance imaging scanner. Functional connectivity between and within the FPN and the CON was measured using the beta series correlation technique. Inter-network connectivity was shown to be greater prior to relatively fast trials for a subset of subjects. The results do not lend support to a strict parallel systems account of CON and FPN functioning.

Topic: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A38 IDENTIFYING THE COGNITIVE UNDERPINNINGS OF VOICE-HEARING BY COMPARING NEVER, PAST AND CURRENT VOICE-HEARERS

Wei Lin Toh[1], Eric Tan[1], Erica Neill[2], Tamsyn Van Rheenen[2], Caroline Gurvich[3], Philip Sumner[1], Sean Carruthers[1], Elizabeth Thomas[4], Susan Rossell[1], [1]Swinburne University of Technology, [2]University of Melbourne, [3]Monash Alfred Psychiatry Research Centre, [4]Monash University

The current study aimed to compare specific cognitive profiles corresponding to AVH status, and elucidate which pattern of cognitive deficits may predict persistence of voice symptoms. Clinical participants with schizophrenia spectrum disorders were partitioned into: i) Current voice-hearers (n=46), ii) Past voice-hearers (n=37), and iii) Never voice-hearers (n=40), and compared with 319 non-clinical controls. Cognitive assessment employed the MATRICS Consensus Cognitive Battery (MCCB), supplemented by the Delis-Kaplan Executive Function System (DKEFS) Colour-Word Interference Test (Stroop) as a robust measure of executive function. On the Visual Learning domain, current and past voice-hearers had significantly poorer performance relative to never voice-hearers, who in turn had significantly poorer performance than non-clinical controls. Current and never voice-hearers had significantly poorer performance on the Social Cognition domain relative to non-clinical controls. Current voice-hearers also had significantly poorer performance on the Inhibition domain relative to non-clinical controls. Binary logistic regression revealed that Visual Learning was the only significant cognitive predictor of AVH presence. Visual learning, and potentially inhibition, may be viable therapeutic targets when addressing cognitive mechanisms associated with AVHs. Future research should focus on investigating additional cognitive mechanisms, employing diverse voice-hearing populations, and embarking on related longitudinal studies.

Topic: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A39 Artificial neural networks reveal multivariate integration of information from multiple category-selective regions

Mengting Fang[1], Aidas Aglinskas[1], Yichen Li[2], Stefano Anzellotti[1], [1]Boston College, [2]New York University

Human visual cortex is organized into regions that respond preferentially to different categories of objects (i.e. faces, bodies, artifacts, scenes). However, often people need to integrate information about objects from different categories to make inferences about the world. How does the brain integrate information represented in different category-selective regions? In this work, we investigated this question taking advantage of a new analysis approach. Using artificial neural networks, we modeled the multivariate statistical dependence between fMRI responses in different brain regions. Regions whose responses were predicted significantly better by a combination of multiple category-selective regions than by the best-predicting category-selective region taken individually were identified as integration hubs. We used this approach to analyze fMRI responses to complex dynamic stimuli (the movie Forrest Gump), and identified five integration hubs: 1) the posterior medial thalamus, 2) the middle cingulate gyrus, 3) the posterior cingulate gyrus, 4) the angular gyrus, and 5) the cerebellum. Hubs were identified robustly across different artificial neural network architectures. Furthermore, representational similarity analysis revealed that, unlike in category-selective regions, representational geometry in integration hubs is not driven by the animate/inanimate distinction. These results indicate that a small set of localized regions integrates visual information about different object categories, and suggests that integration across multiple categories leads to a transformation of the similarity structure of neural representations.

Topic: EXECUTIVE PROCESSES: Other

A40 NSF Funding Opportunities for Cognitive Neuroscience

Kurt Thoroughman, NSF

A41 WITHDRAWN

A42 Decomposition of EEG reveals a diversity of beta-band responses to a single pulse of TMS

Jacqueline Fulvio[1], Saskia Haegens[2], Nathan Rose[3], Bradley Postle[1], [1]University of Wisconsin – Madison, [2]Columbia University, [3]University of Notre Dame

In two-item visual working memory with prioritization cues, a single pulse of transcranial magnetic stimulation (TMS) reinstates multivariate decodability of the unprioritized memory item (UMI) from concurrently measured electroencephalogram (EEG), and increases false alarm rates to the UMI. Although this effect has been isolated to the beta band (16-24 Hz; Rose et al., 2016), it is unknown whether it is due to 'induced' activity in networks that were active prior to TMS, or to evoked activity akin to endogenous reactivation (Spitzer & Haegens, 2017). Moreover, it is unknown whether beta-band oscillations mediate behavioral consequences of TMS. To address these questions, we carried out a decomposition of EEG signals from Rose et al. (2016) using a Spatially distributed PhAse Coupling Extraction with Frequency Specific Phases Model (SPACE-FSP; van der Meij et al., 2015; 2016). This allowed us to disentangle oscillatory components with differing temporospatial profiles, which remain intermixed with conventional methods. We extracted ~350 components in the 1-40 Hz band, 90 of which were prominent in beta. Comparison of components post- versus pre-TMS revealed an even split between stronger and weaker loading of beta components after TMS was delivered, further emphasizing the value of this fine-grained analysis in disentangling contributions from different sources. Some of these beta components were also negatively correlated with behavior. These results are consistent with the idea that dynamics in the beta band accompany transitions between activation states in working memory and support the ability of TMS to reactivate UMIs through diverse responses in those dynamics.

Topic: EXECUTIVE PROCESSES: Working memory

A43 Prefrontal lesions disrupt oscillatory signatures of feature binding in working memory

Elizabeth Johnson[1], Mohsen Parto Dezfouli[2], Saeideh Davoudi[2], Robert Knight[1], Mohammad Reza Daliri[2], [1]University of California, Berkeley, [2]Iran University of Science and Technology

How does the human brain bind features from different stimulus dimensions together into a unified representation? We define the oscillatory signatures of binding 'where' and 'when' features in working memory (WM), and then investigate the role of lateral prefrontal cortex (PFC) in spatiotemporal feature binding. Fourteen individuals with discrete PFC damage and 20 healthy controls completed a visuospatial WM task while electroencephalography (EEG) data were recorded. On each trial, two shapes were presented sequentially in a top/bottom spatial orientation. We defined EEG signatures of feature binding by comparing the maintenance of two possible spatiotemporal configurations: the first shape presented on top and the reverse. Anterior delta-theta (2-7 Hz) power, anterior-posterior delta-theta functional connectivity, and posterior alpha (8-12 Hz) phase-to-gamma (30-50 Hz) amplitude coupling dissociated the two configurations in controls. WM performance and all oscillatory signatures of feature binding were diminished with PFC lesions. These findings reveal that neural oscillations support spatiotemporal feature binding under top-down PFC control.

Topic: EXECUTIVE PROCESSES: Working memory

A44 Understanding the neurocognitive mechanisms of maintenance and disengagement in a complex working memory task

Malayka Mottarella[1], Chantel Prat[1], [1]University of Washington

Working memory capacity (WMC) has been associated with the ability to filter out distractor items and to maintain task goals. The present study expands on this work by investigating the neurocognitive basis of individual differences in a complex, cued working memory task, with distractor items. We collected fMRI from 61 participants completing a task in which words appeared on a 3x3 grid. Cues at the beginning of each trial indicated whether all words, or only words belonging to a specific semantic category, should be retained. Manipulation of distractors (present or absent) and load (3 or 5 words) varied orthogonally. The neural bases of three interrelated processes and their relation to behavioral task performance were investigated: goal maintenance (increased activation for cues indicating distractor trials), target maintenance (increased activation with increasing load), and disengagement (reduced activation for distractor trials indexing maintenance of task-relevant items only). Results revealed that goal maintenance was associated with increased parietal activation, and greater goal maintenance in parietal cortex correlated with better filtering accuracy. Target maintenance was associated with increased activity in prefrontal, parietal, and basal ganglia regions with increasing load; however, smaller increases in parietal activation with load correlated with better overall task accuracy. Effects of disengagement at the group level were not significant; however better disengagement, indexed by smaller differences in response times for trials with and without distrators, correlated with increased activation in prefrontal, parietal, and basal ganglia regions during distractor present compared to distractor absent trials.

Topic: EXECUTIVE PROCESSES: Working memory

A45 EEG Correlates of Dynamic Decision Parameters of Input and Output Gating

Rachel Ratz-Lubashevsky[1], Michael Frank[1], [1]Brown University

Computational models of fronto-striatal circuitry propose that working memory (WM) is controlled through a selective gating mechanism which is modifiable by reinforcement learning. This gating mechanism is hypothesized to operate at multiple levels. The input gating mechanism controls whether and how new information is updated in WM. The output gating mechanism controls which information within WM is selected to guide behavior. Finally, the motor gating controls the selection of actions. In the present study, the referenceâ?'back task was adapted to learn about the mechanisms that underlie input and output gating in humans. The reference-back is composed of two trial-types: reference trials, which require updating of WM, and comparison trials, which require continued maintenance of existing information. Switching between the two trial-types requires input gating while switching between two possible stimulus categories required output gating. EEG recordings were used to examine how the control functions involved in gating are mapped to different neural signatures. Behavioral and EEG analyses revealed separable evidence for input and output gating. Using a multivariate decoding analysis of the EEG data with the drift-diffusion model of decision making, we showed that trial-by-trial increase in neural activity related to WM updating predicted an increase in the decision threshold (the threshold for evidence accumulation). This result is consistent with the proposed hierarchical model of the fronto-striatal network and suggests that an 'updating conflict' leads to the inhibition of actions by raising the threshold until WM gating was completed.

Topic: EXECUTIVE PROCESSES: Working memory

A46 Frontoparietal contributions to visual working memory precision

Ainsley Temudo[1], Kartik Sreenivasan[1], [1]New York University Abu Dhabi

Constraints on visual working memory (VWM) limit not only the quantity, but the quality (i.e., precision) of items held in memory. Understanding the factors that determine the precision of VWM is, therefore, a crucial step in elucidating the neural mechanisms that give rise to VWM. We explored the hypothesis that VWM precision is mediated by areas of frontal and parietal cortices that provide top-down input in order to tune VWM representations stored in sensory cortices. Support for this idea has been limited in part by standard VWM tasks that conflate VWM accuracy and VWM precision.We dissociated these two factors utilizing a novel delayed report task while measuring brain activation associated with VWM maintenance using fMRI. On each trial, subjects maintained the direction of moving dot stimuli and reproduced this maintained direction after a delay. Instead of making a single report, subjects indicated the contents of their memory by placing 6 'bets' over 360-degree direction space. The spread of these 6 bets was used as a proxy for trial-wise VWM precision. A multivoxel searchlight analysis revealed information about VWM content stored in early visual cortex, but not frontoparietal cortex. Importantly, the magnitude of BOLD activation during the memory delay was positively correlated with VWM precision (but not VWM accuracy) in superior precentral sulcus (putative human frontal eye fields) and posterior parietal cortex. These results suggest that these regions are important for understanding VWM precision and are consistent with the notion that frontoparietal activity modulates the quality of VWM representations.

Topic: EXECUTIVE PROCESSES: Working memory

A47 Deep learning model of field imaging data provides insight on neurobiology of childhood literacy in rural Ivory Coast

Justus Matteson[1], Jiamian Wang[1], Victoria Bobowska[1], Benjamin Zinszer[1], Kaja Jasinska[1], [1]University of Delaware

For many children in low-literacy communities like rural Ivory Coast, reading outcomes remain poor overall, but can vary widely. Little is known about how the brain acquires literacy in such contexts and the neurobiological underpinnings of children's variable outcomes. To address this, we tested a deep learning model trained to classify children (n=46, age 7-14 years) by reading ability, based on their neural responses during a passive speech and reading task measured at schools with functional near-infrared spectroscopy (fNIRS) neuroimaging. Similar machine learning approaches have produced accurate classifications with fNIRS data in other domains, but rarely with children. Our classifier combined convolutional neural net and long short-term memory models to capture both spatial and temporal features of the fNIRS data. We trained the model on data from 45 channels overlaying bilateral prefrontal and temporal cortex (5x9 spatial layout), collected in six 10-second-long blocks during each task run. We divided the children into three groups based on a standard literacy assessment (Early Grade Reading Assessment): non-literate (80%). Our model accurately classified 59% of non-literate, 46% of semi-literate, and 25% of literate children's data, respectively. Although classification accuracy did not exceed chance, specificity for identifying Literate children was high (Sensitivity=.25, Specificity=.89), suggesting that literate children converge toward a distinct pattern of neural activation when reading. We explore features encoded in each layer of the model to evaluate the importance of localized brain regions and temporal dynamics of the neural response that predict children's literacy status.

Topic: LANGUAGE: Development & aging

A48 WITHDRAWN

A49 Planning nouns and verbs across semantic categories

Miriam Hauptman[1,2], Esti Blanco-Elorrieta[1, 2], Liina Pylkkänen[1, 2], [1]New York University, [2]NYUAD Research Institute

'Noun' and 'verb' are core categories in human language and thus differentiating between them is a central part of language planning. Despite the essential nature of this grammatical distinction, establishing the neural correlates of nouns and verbs is notoriously challenging given the object-dominant meanings of nouns and action-dominant meanings of verbs. Using a simple and semi-naturalistic production paradigm, we investigated whether the neural correlates of noun vs. verb production could be best explained by their syntactic properties or by patterns in word meaning. To accomplish this, we elicited productions of words orthogonalized both by semantic content (abstract cognition, visual motion, manual motion) and word class (noun, verb, category-ambiguous) in their inflected and uninflected forms while magnetoencephalography (MEG) activity was recorded. Preliminary results (n=10) show that regardless of word class, a distinct representation of manual concepts emerged in the inferior temporal cortex. Additionally, a trend toward distinct processing of verbs and nouns, independent of their semantic content, was found in the left inferior frontal gyrus. Thus, we offer a tentative dissociation of the cortical representation of semantic and syntactic properties of the fundamental building blocks of language across both time and space.

Topic: LANGUAGE: Lexicon

A50 Left lateral temporal cortex mediates cross-language translation in logographic reading

Kexin Xiong[1], Kouji Takano[2], Sachiko Kiyama[1], Michiru Makuuchi[2], Kimihiro Nakamura[2], [1]Tohoku University, [2]National Rehabilitation Center for Persons with Disabilities

Bilingual word recognition is known to be facilitated for cognates or words shared between the first (L1) and second languages (L2) relative to other, non-cognate words. While typical cognates in alphabetic scripts share orthography, phonology, and meaning between two languages (e.g. 'tomato' in English and 'tomaat' in Dutch), cognates in logographic scripts have sublexical morphemic, rather than phonological, overlap with each other (e.g., '??' in Chinese and '??' in Japanese). Using a cross-language priming paradigm with fMRI, we investigated neural correlates of cognate priming during logographic reading. Chinese-Japanese bilinguals made semantic judgments about target words in L2 preceded by masked prime words in L1. L1 primes and L2 targets could be either orthographically identical cognates (IC), orthographically similar cognates (SC), orthographically dissimilar translation equivalents or non-cognates (NC) or unrelated to each other (UR). Behaviorally, participants responded more quickly (1) to IC than to OC and NC and (2) to SC and NC than to UR. At the neural level, IC relative to SC and NC broadly produced activation reduction in the left lateral frontal and parietotemporal regions. SC and NC relative to UR produced response adaptation in more restricted parts of the left inferior frontal gyrus (IFG), middle temporal gyrus (MTG) and inferior parietal lobe. Although undetectable at the behavioral level, NC showed greater effects of priming in the left IFG and MTG relative to SC. These results suggest that the left IFG-MTG network subserves lexical access after morpheme activation in reading.

Topic: LANGUAGE: Lexicon

A51 Transcranial Direct Current Stimulation Influences Reliance on Declarative vs. Procedural Learning

Kinsey Bice[1], Chantel Prat[1], [1]University of Washington

Successful language learning requires an intricate and dynamic balance between declarative and procedural mechanisms, yet individuals may rely

differentially on one or the other in less than optimal ways. The goal of the current experiment was to determine whether transcranial direct current stimulation (tDCS) can tip the balance, specifically facilitating declarative or procedural learning. Previous research has shown that left temporal stimulation improves word retrieval in healthy adults, and that frontal stimulation augments brain activity related to reinforcement learning. We therefore predicted that anodal stimulation of the left temporal lobe would enhance an individual's reliance on declarative memory, whereas anodal stimulation of the medial/left-lateralized frontal lobe would enhance an individual's reliance on procedural learning. Seventy-nine subjects (31 no stimulation, 16 sham stimulation, 16 frontal stimulation, 16 temporal stimulation) completed an artificial grammar learning task followed by a two-alternative forced-choice test that measured sensitivity to the underlying artificial grammar versus features of the surface form. The results confirmed our predictions. Frontal stimulation resulted in more frequent selection of grammatical strings than baseline (ß = .03, t = 2.09, p = .04) or temporal stimulation groups (t(30) = 1.77, p = .04). In contrast, left temporal stimulation resulted in higher selection of strings with familiar surface features than baseline (ß = .03, t = 2.13, p = .04) or frontal stimulation groups (t(30) = 1.95, p = .03). We conclude that tDCS may be used to facilitate engagement of different learning systems required for language learning.

Topic: LANGUAGE: Other

A52 An fNIRS Investigation of Fluent and Stuttered Continuous Speech in Adults Who Stutter

Allison Hancock[1], Carla I Orellana[1], Sushma Alphonsa[2], Tyson Barrett[1], Ron Gillam[1], [1]Utah State University, [2]University of Nevada Reno

This study was to assess the nature of the hemodynamic response function in adults who stutter (AWS) and adults who do not stutter (AWNS) during fluent and disfluent continuous speech. Functional near-infrared spectroscopy (fNIRS) was used to record the hemodynamic response from14 adults (seven AWS, seven AWNS) during a telephone conversation. The area under the curve (AUC) was extracted for each channel for both oxygenated (HbO) and deoxygenated (HbR) hemoglobin waveforms in five regions of interest (ROI): inferior frontal cortex (IFC), superior temporal cortex (STC), inferior parietal lobule (IPL), primary motor cortex (M1), and supplementary motor cortex (SMC). Using linear mixed effects (LME) modeling of HbO and HbR, we found a three-way interaction between group, condition, and ROI. AWNS had similar activation across all conditions and ROIs. Within the AWS group, activation was highest during the disfluent condition in IFG, STG, and IPL. We also used functional connectivity analysis using LME regression, controlling for the previous time point, to obtain significant covariance values for the five ROIs. Connectivity analyses revealed that the AWS group tended, across tasks, to have several regions connected to SMA while the AWNS did not. For the fluent task, AWNS had stronger connectivity with IFG, while the AWS had weak connectivity. For the disfluent task, AWNS had stronger connectivity in each region while the AWS group had high connectivity in SMA. Taken together, these results suggest that AWS exhibit differences in cortical activation and neural connectivity during continuous fluent and disfluent speech compared to AWNS.

Topic: LANGUAGE: Other

A53 Macro-Linguistic Gestural Facilitation for Narrative Discourse in Aphasia

Ted Jenkins[1],[1]Rhode Island College

Hand gestures frequently communicate non-redundant information in tandem with spoken language. Embodied cognition theory often links such manual movements to reducing the cognitive load associated with certain language tasks. Previous studies have provided evidence of gestural facilitation in both typical and atypical populations in micro-linguistic measures (e.g., lexical retrieval), but often do not consider macro-linguistic ones (e.g., narrative organization). Persons With Aphasia (PWA), a population associated with issues of linguistic processing following neurological damage, are often observed to have increased gesture frequency during language production compared with controls. However, it is not known whether this increased gesture rate still plays a similar facilitative role in macro-linguistic production. The current study examined whether active gesture can predict increased narrative discourse production (micro- and macro-) between three different PWA groups (i.e., Anomic, n=15; Broca's, n=15; Wernicke's, n=15) and a typical control group (age and gender matched). Using a linear regression analysis of narrative retellings of the story of Cinderella, it was predicted that representational gestures (e.g., iconics), vs. non-representational ones (i.e., simple beats), would be linked to increased micro- and macro-discourse production. The results revealed for all groups that there was not the typical significant relationship between micro-linguistic production, but with macro-linguistic measures (p

Topic: LANGUAGE: Other

A54 Distinct Event-Related Potentials Elicited by Incongruent Phonetics, Incorrect Allomorphs, and Incorrect Phonemes

Lisa Sanders[1], Margaret Ugolini[1], Miriam Muñoz[1], Bethany Dickerson[1], Joe Pater[1], [1]University of Massachusetts Amherst

We need measures of specific auditory and phonological processes that are actually used when listening to speech for comprehension to be able to identify when deficits in these processes contribute to language disorder. We presented two-word spoken phrases and manipulated: 1) congruency of phonetic cues, 2) whether the suffix on plural nouns was a correct or incorrect allomorph, and 3) whether the suffix was instead a completely incorrect phoneme. Adults listening to incongruent phonetic cues to word-final voicing, the length of the syllable nucleus before /z/ and voicing and length of the sibilant of /s/, show a centrally distributed positivity around 100 ms after onset. This effect is evident regardless of phonotactic status (e.g., 'girl/z-s/' and dog/z-s/), and is also observed when the incongruency is in a full narrative. In contrast, pronounced incorrect allomorphs (e.g., 'girl/s/') elicit a Phonological Mapping Negativity with a latency that is dependent on whether number on the noun is predictable (e.g., 'two girl/s/') or unpredictable (e.g., 'the girl/s/'), and whether the incorrect allomorph occurs in a short phrase or a full narrative. Incorrect phonemes that render the plural nouns nonwords (e.g., 'girl/v/') elicit an N400. Each of these measures can be made while listeners do nothing more than listen to speech for comprehension. As such, these ERP indices can be used to isolate specific auditory and phonological processes from other abilities required by more traditional measures of language performance, including phonological awareness tasks.

Topic: LANGUAGE: Other

A55 Speech pause behavior in traumatic brain injury is driven by comorbid cognitive impairment and task demand

Hayden Ventresca[1], Jordan R. Green[1], Viktoria Pereira Mayer[2], Daniel de Carvalho[2], Caroline Mafra[2], Willingson Silva Paiva[2], Ana Luiza Zaninotto[1], [1]MGH Institute of Health Professions, [2]Faculdade de Medicina da Universidade de Sao Paulo (FM-USP)

Diagnosing speech impairment in traumatic brain injury (TBI) is difficult, as speech outcomes may be confounded by comorbid cognitive impairment. However, accurate diagnosis is necessary for selecting interventions and predicting outcomes. This study examines the contribution of cognitive impairment to speech outcomes in TBI. Twenty patients with moderate to

severe TBI and nine controls participated. TBI patients were divided by cognitive scores: severe (MoCA 26). Speech outcomes of interest included: percent of pause (% pause) in reading sentences (short, 4-5 words; long, 10-14 words), spontaneous speech (cookie figure description), and recitation (prayer); articulation rate; diadochokinetic (DDK) rate; maximum phonation time (MPT); and maximum metronomic counting time (MCT). DDK rates were lower in TBI than in controls. Patients with severe cognitive sequelae showed higher % pause than controls in all the speech tasks. Patients with moderate cognitive sequelae showed higher % pause than controls in spontaneous speech and recitation, but not in sentence reading tasks. Across all groups, % pause was highest in spontaneous speech and lowest in short sentence reading. No between-group differences were observed in articulation rate, MCT, and MPT. Results show a distinctive pattern of % pause that varies with cognitive impairment and task demand. The absence of differences in articulation rate, MCT, and MPT is indicative of preserved neuromotor control, in which cognition seems to play no role. Poor speech-motor outcomes in TBI, particularly delayed speaking rate, may be primarily driven by cognitive impairment.

Topic: LANGUAGE: Other

A56 Simple composition: Towards a magnetoencephalography functional localizer

Graham Flick[1], Liina Pylkkänen[1], [1]New York University

A useful approach in neuroscientific studies of language processing involves the contrast of minimal word combinations (red + boat) with non-combinatory baselines to identify neural correlates of composition across a group of participants, as introduced in Bemis & Pylkkänen (2011). We investigated the use of this approach as a functional localizer for participant-specific correlates of composition with magnetoencephalography (MEG) and minimum-norm source estimates. Twenty-eight participants read two-word phrases, two-word lists, and one-word baselines during 12-minute MEG sessions. In split-half analyses, individual functional masks were defined on each participant's cortical surface using a subtraction-based contrast of phrases vs. single words in half of the trials from each condition. These masks were then used in analyses of held-out data, revealing significant generalization of phrasal composition effects (phrases eliciting greater activity than lists and single words) within the masks, in windows spanning 200-250 and 400-600 ms after onset of the second word on each trial. Generalization was also found in data from a subsequent experiment that compared phrases and single words, with responses localized to the masks again showing significantly increased biphasic activation in response to phrases (200-300 ms; 450-600 ms). Analyses of responses across participants revealed similar activations in multiple left hemisphere regions, including the left anterior temporal lobe, temporal-parietal junction, and inferior frontal gyrus. Overall, this work lays the foundation for using the minimal composition MEG paradigm as a functional localizer for correlates of composition and provides an updated spatiotemporal characterization of composition-related responses in left-hemisphere language regions.

Topic: LANGUAGE: Semantic

A57 Tracking lexical consolidation of novel word meanings: ERP and time frequency analyses

Yushuang Liu[1], Janet van Hell[1], [1]The Pennsylvania State University

The Complementary Learning Systems Theory (Davis & Gaskell, 2009) proposes that novel words are initially encoded by the hippocampal learning system; after a period of consolidation, memory representation stabilizes in the neocortical network. Measuring EEG in multilingual speakers, Bakker, Takashima, van Hell, Janzen, and McQueen (2015) found supporting evidence for the role of offline consolidation on the semantic integration process. Here, we tested monolinguals, with little foreign language learning experience, to examine the extent to which consolidation patterns differ between inexperienced and experienced (tested by Bakker et al., 2015) foreign language learners. We examined the offline consolidation effect in semantic integration both 24-hours after learning and one-week after learning, using ERP and time frequency analyses. Thirty monolingual English speakers learned novel words with meanings on Day-1, and another set of novel words with meanings on Day-2. Immediately after word learning on Day-2, they completed two EEG semantic tasks, including words learned on both Day-1 and Day-2. Participants returned on Day-8 and received the same tasks. Only for novel words learned 24-hours before testing, ERP analysis revealed a semantic priming LPC effect; this semantic priming effect reliably emerged in both sets of novel words on Day-8. Time-frequency analysis (TFR) revealed increased theta synchronization and alpha desynchronization after a period of consolidation. Taken together, offline consolidation effects also emerged in inexperienced learners learning novel words with meanings. Novel word meaning lexicalization is thus a gradual process for both inexperienced and experienced learners, but prior language learning experience seems to expedite this process.

Topic: LANGUAGE: Semantic

A58 The neural basis of the negativity bias: Insights from computational models and spatial similarity analysis of EEG

Victoria Sharpe[1], Lin Wang[1], Nathaniel Delaney-Busch[1], Gina Kuperberg[1, 2], [1]Tufts University, [2]Massachusetts General Hospital

When evaluating emotional valence, we devote more attentional resources to processing negative than positive or neutral stimuli. Neurally, this manifests as a larger late positivity ERP evoked by negative, relative to positive or neutral inputs. Here we used computational models, and EEG in combination with a Representational Similarity Analysis to probe the nature of this neural 'negativity bias'. We first used semantic vectors generated by word2vec, a computational model trained to predict words based on their linguistic context, to assess the similarity structure of over 13,000 words. We showed that the similarity among negative words was greater than among positive or neutral words. We replicated this finding, and extended it using a computational model of associative-based similarity, in a set of 467 words, which varied in their valence, but were tightly matched on their arousal and lexical properties. We then recorded EEG as 22 healthy adults read and judged the valence of this same set of words. ERPs confirmed that negative words evoked a larger late positivity between 500-800ms than neutral or positive words. A spatial representational similarity analysis showed that between 600-700ms, the spatial pattern of neural activity produced by the negative words was more similar than that produced by either the positive or the neutral words. Together, these data suggest that the enhanced and prolonged neural processing associated with negatively-valenced stimuli may reflect a deep evaluation of their underlying associative-based semantic representations.

Topic: LANGUAGE: Semantic

A59 Finding Meaning in Music: N400 Indices of the Semantics of Musical Intervals

Seth Eggleston[1], Courtney Stevens[1], [1]Willamette University

Previous event-related brain potential (ERP) research suggests overlap in the neural systems subserving semantic processing in music and language. For example, prior research indicates that 1- to 10-second clips of classical music can establish a semantic context, with larger N400 responses to 'unrelated' versus 'related' visual word targets (Daltrozzo & Schön, 2008; Koelsch et al., 2004). Here, we examined whether a smaller unit of music, the two-note

musical interval, could similarly establish a semantic context that affects the processing of subsequently presented single word targets. A total of 144 pairs of interval-word stimuli (e.g., octave [perfect 8th] - 'sunshine') were developed through two pilot studies. In the ERP study, adult participants (n=21) listened to a single musical interval lasting 1700 msec followed by visual presentation of a single word for 1500 msec. Participants made binary judgments to indicate whether they considered the word 'related' or 'unrelated' to the auditory prime. All target words appeared in both the 'related' and 'unrelated' position in three different interval conditions (harmonic, ascending, or descending). Similar to previous research that used musical excerpts as primes, results indicated that the two-note interval primes resulted in an enhanced negativity for predetermined unrelated versus related target words ($p < .05$, Cohen's $d = +0.47$). This effect was evident from 600-800 msec over central and parietal-occipital electrodes. These results suggest that discrete units of music as small as two-note musical intervals can carry semantic weight and influence the processing of words with established meanings.

Topic: LANGUAGE: Semantic

A60 Native language sounds in new, foreign words boost grammar processing: ERP evidence of transfer in initial acquisition

Sabine Gosselke Berthelsen[1], Merle Horne[1], Yury Shtyrov[2], Mikael Roll[1], [1]Centre for Languages and Literature, Lund University, [2]Center of Functionally Integrative Neuroscience, Aarhus Uni.

Many aspects of a new language can be acquired and processed within minutes. Learners can rapidly acquire the skill to segment words, understand phonological regularities and identify meaning and grammar. Rapid learning is reflected neurophysiologically in quickly emerging event-related potential (ERP) patterns, affecting early, pre-attentive and later, more conscious processing. However, only words with native-language (L1)-like phonology influence the pre-attentive ERPs. We set out to investigate whether native language phonology also influences how novice learners respond to incorrect grammar in the newly acquired language. In a word-picture association-learning paradigm, learners (tonal and non-tonal speakers) were taught artificial words that contained grammatical features (number and gender) embedded in vowels and tones. Occasional pictures that were inconsistent with one of the preceding word's phonological cues always elicited an N400 in learners with a tonal L1. Learners from a non-tonal background, however, only produced an N400 when the mismatch was based on the word's vowel, not the tone. Furthermore, we did not find any classical grammar-related ERP components (E/LAN, P600). The observed N400 could be thought to signal that an anticipated grammatical feature did not appear in the picture. This is supported by a correlation of N400 amplitude and response times. Learners with, e.g., a larger N400 for vowel-based mismatches, were faster at classifying the picture as incorrect when the vowel-related feature was mismatched. Importantly, only L1-like phonological cues could evoke predictions about associated features in upcoming pictures, emphasising the importance of transfer in initial second language acquisition.

Topic: LANGUAGE: Syntax

A61 Encoding-retrieval similarity of perceptually related items and their relation to false memories in aging

Jordan Chamberlain[1], Nancy Dennis[1], [1]The Pennsylvania State University

Perceptual similarity across items leads to increased difficulty when discriminating between previously seen (targets) items and new (lures) items. Previous work from our lab demonstrates that as this perceptual overlap increases, so do false memory rates. This effect is particularly pronounced in older adults, and influences univariate BOLD activity in fronto-parietal regions. Recent research from our lab suggests differences exist between the neural pattern similarity across encoding and retrieval of lure and target items, but we have yet to examine the influence of perceptual overlap on encoding-retrieval similarity (ERS) and its relation to false memories. To build upon this research, we used fMRI and ERS analyses in a sample of younger and older adults on faces seen at encoding that were systematically morphed with other faces at retrieval. Behaviorally, false memory rates increased linearly as the perceptual relatedness increased. At the level of single items, we observed age-related reductions in ERS for target items in the hippocampus as well as temporal and visual face-processing regions. At the set level, we observed additional age reductions in visual processing regions for targets and lures, as well as age related ERS increases in anterior temporal regions and relationships with behavioral discriminability. Results have implications on the recapitulation of erroneous neural patterns and their relation to false memories.

Topic: LONG-TERM MEMORY: Development & aging

A62 Resting State Functional MRI in Parkinson Disease: Alterations in Connectivity Based on Cognitive Impairment

Brenda Hanna-Pladdy[1], Li Jiang[1], Rao Gullapalli[1], [1]University of Maryland School of Medicine

Disruptions in functional connectivity have been associated with Parkinson disease (PD) in comparison to healthy controls. Thus, it remains unclear if network alterations are reflective of asymmetric motor features or cognitive aspects of variable disease presentation. To investigate the differential networks affected based on extent of motor versus cognitive features of PD, we evaluated 50 PD patients (ages 57 - 77) stratified on extent of cognitive impairment and displaying right or left motor onset disease (LMO = 25; RMO = 25). PD patients received a comprehensive neuropsychological assessment, and were compared in resting-state functional connectivity MRI (rs-fcMRI) based on classifications of normal cognition or mild cognitive impairment in single or multiple domains including memory (PD-NC=15, PD-MCIs=17, PD-MCIm=18). rs-fcMRI data was processed with CONN Tool box (v18) and group comparisons conducted with the GLM with significance levels set at a voxel threshold of p-value of 0.008 (uncorrected) and cluster threshold of FDR p-value of 0.05 (corrected). Seed-based connectivity analyses from bilateral insula revealed bilateral and widespread increased (PD-MCIs > PD-NC) and decreased (PD-MCIs < PD-NC) connectivity in attention and executive networks bilaterally for patients with single domain MCI. In contrast, patients at higher risk for conversion to dementia displayed bilateral hippocampal medial temporal lobe network increased connectivity reflective of compensation for abnormal memory function (PD-MCIm > PD-NC). These findings support differential network connectivity changes reflective of clinical features of the disease, and suggest that network changes have potential to predict variable patterns of disease progression.

Topic: LONG-TERM MEMORY: Development & aging

A63 Eye movements reveal age differences in the use of retrieved content during pattern completion

Jordana Wynn[1], Bradley Buchsbaum[1], Jennifer Ryan[1], [1]Rotman Research Institute, University of Toronto

Older adults often mistake new information as 'old', especially when that information feels familiar. This response bias has been thought to reflect pattern completion, the reactivation of a previously encoded stimulus in response to partial input. Yet, the degree to which this behaviour and the proposed underlying cognitive operation are related, and change with age, remains unclear. We used eye movement monitoring in conjunction with behavioural responses to quantify older adults' pattern completion bias as a function of eye movements during encoding and partially-cued retrieval. Analysis of eye movements revealed decreased encoding efficiency and

increased retrieval-related reinstatement by older adults relative to younger adults. However, whereas younger adults utilized the reinstated encoding experience (i.e., gaze patterns) to support behavioural pattern completion (i.e., lure false alarms), older adults instead relied on reinstated encoded content (i.e., salient image regions). These findings provide critical evidence that age-related declines in pattern completion, and recollection more broadly, can be attributed to changes in both the content of encoded and retrieved representations, and the processes by which they support explicit memory judgements.

Topic: LONG-TERM MEMORY: Development & aging

A64 Resting-state functional connectivity differences in memory networks of autism spectrum disorder

Hayley Clocksin[1], John Scofield[1], David Beversdorf[1], Cory Riecken[1], Shawn Christ[1], Jeffrey Johnson[1], [1]University of Missouri

Autism spectrum disorder (ASD) is a neurodevelopmental disorder traditionally characterized by impaired social interaction and communication, and restricted and repetitive behaviors and interests, but more recently has been associated with altered brain functional connectivity. A growing number of studies have further demonstrated that individuals with ASD exhibit a variety of impairments on long-term memory tasks. Given that a broad network of posterior medial, anterior temporal (collectively, the PM/AT network), and ventral frontal and parietal (VFP) regions have been shown to support the content and quality of episodic and semantic memory, understanding the altered connectivity within this network may help elucidate the nature of memory deficits in ASD. Here, we analyzed resting-state fMRI data in this network in over 200 individuals with ASD and age-matched controls, drawn from the Autism Brain Imaging Data Exchange (ABIDE I and II) and our own studies. Using multivariate pattern analysis (MVPA), we were able to decode ASD diagnosis with over 80% accuracy based on connectivity across the PM/AT and VFP networks, with classification being highest when based on across- relative to within-network connectivity. Additionally, we observed distinct patterns of results for adolescents (13-17 years) compared to young adults (18-30 years), consistent with prior evidence that these age groups should be considered separately. These findings of intrinsic organizational differences involving memory subnetworks are discussed in terms of guiding our understanding of behavioral memory deficits in ASD.

Topic: LONG-TERM MEMORY: Episodic

A65 Progression from feature-specific brain activity to hippocampal binding during episodic encoding

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

The hallmark of episodic memory is recollecting multiple perceptual details tied to a specific spatial-temporal context. To remember an event, it is therefore necessary to integrate such details into a coherent representation during initial encoding. Here we tested how the brain encodes and binds multiple, distinct kinds of features in parallel, and how this process evolves over time during the event itself. We analyzed data from 27 subjects who learned a series of objects uniquely associated with a color, a panoramic scene location, and an emotional sound while functional magnetic resonance imaging data were collected. By modeling how brain activity relates to memory for upcoming or just-viewed information, we were able to test how the neural signatures of individual features as well as the integrated event changed over the course of encoding. We observed a striking dissociation between early and late encoding processes: left inferior frontal and visuo-perceptual signals at the onset of an event tracked the amount of detail subsequently recalled and were dissociable based on distinct remembered features. In contrast, memory-related brain activity shifted to the left hippocampus toward the end of an event, which was particularly sensitive to binding item color and sound associations with spatial information. These results provide evidence of early, simultaneous feature-specific neural responses during episodic encoding that predict later remembering and suggest that the hippocampus integrates these features into a coherent experience at an event transition.

Topic: LONG-TERM MEMORY: Episodic

A66 Association between details and spatiotemporal structure in free recall of real-world episodes

Nicholas Diamond[1], Brian Levine[2], [1]University of Pennsylvania, [2]Rotman Research Institute, Baycrest Health Sciences

Recall dynamics reveal underlying structure in memory. Decades of research demonstrates the importance of temporal structure in recall of laboratory stimuli (i.e. word lists) at delays of seconds or minutes. Little is known, however, about such structure in recall of real-world experiences (i.e. autobiographical memory) at longer delays, where temporal organization is unknown and the focus is usually on the types and quantities of details recalled. We designed immersive yet controlled real-world encoding events, allowing us to measure recall dynamics and details within single extended recall narratives using analytical tools derived from list-learning and autobiographical memory paradigms, respectively. 119 younger and older participants freely recalled such events at delays of two days or one week. Aging was associated with large reductions in both episodic detail and spatiotemporal context reinstatement, as indicated by reduced clustering and forward asymmetry in recall transitions, but no difference which items were recalled nor where recall was initiated. Controlling for group, measures of detail and spatiotemporal organization were positively associated, suggesting a connection between the structure of an episode in memory and the richness with which it is relived. These results provide empirical evidence for a theorized link between recollection of specific details and recovery of their surrounding spatiotemporal context (Howard & Eichenbaum, 2013). More broadly, they provide a more fully articulated and ecologically valid description of episodic memory and how it declines.

Topic: LONG-TERM MEMORY: Episodic

A67 Parallel Networks Dissociate Episodic and Social Functions Across Distributed Cortical Regions Within Individuals

Lauren DiNicola[1], Rodrigo Braga[2], Randy Buckner[1], [1]Harvard University, [2]Stanford University

Recent within-individual analyses revealed that two parallel networks exist within the bounds of the canonically-defined default network (DN). These networks (A and B) are juxtaposed but distinct across distributed cortical zones (e.g., Braga & Buckner 2017 Neuron). Preliminary work examining these networks' functions revealed that Network A, linked to parahippocampal cortex, is preferentially recruited for Episodic Projection tasks (e.g., remembering), while Network B, linked to the temporoparietal junction, preferentially subserves Theory of Mind (ToM) tasks (DiNicola et al. 2019 bioRxiv). The present work sought to quantify whether such distinctions were limited to specific regions, aligning with prior, group-averaged work, or were present across distributed network zones. In an initial dataset, we scanned 6 individuals 4 times each and replicated a functional dissociation between Networks A and B, which preferentially subserved Episodic Projection and ToM tasks, respectively. Using a trial-level approach, we estimated 60 Episodic Projection and 40 ToM contrasts per network, for 5 distributed cortical regions within each individual. Across individuals, 18 of 30 region-specific tests found significant network by domain interactions (60.0%). 5 individuals showed interactions in 3 or more regions, including those along the midline previously considered DN hubs. Equivalent analyses of null data yielded only

one false positive result (3.3%). After establishing analysis procedures, we replicated the approach and findings in an independent sample of 6 additional individuals (70.0% of regions show interaction effects; 0 false positives). These results refine understanding of how parallel, distributed networks in association cortex are organized to support task processing demands.

Topic: LONG-TERM MEMORY: Episodic

A68 Drift diffusion modelling in big data: Lower episodic memory abilities are associated with better reasoning performance

Carina Fan[1], Brian Levine[1], Michael Mack[2], [1]Rotman Research Institute, [2]University of Toronto

People differ in how they remember the past: some richly re-experience details from memories, while others recall only the gist of past episodes. Episodic memory contributes to a variety of functions such as future imagination and problem solving, but strong episodic memory abilities and a focus on specific details may hinder performance on tasks that require generalization or inference. As such, individual differences in episodic memory could relate to differences in more domain-general cognitive mechanisms of decision making. We measured self-reported episodic memory abilities in over two thousand participants and tested their performance on a grammatical reasoning task. There was a slight negative correlation between overall task performance and episodic memory ability, and we applied hierarchical drift diffusion models (DDM) to better understand the cognitive mechanisms that may underlie this effect. We compared the fit of three models, each regressing one DDM parameter on episodic memory abilities: drift rate (v), boundary separation (?), and non-decision time (t). The best model fit drift rate to memory abilities, indicating that individuals with lower episodic memory abilities were quicker to accumulate task-relevant evidence in making a correct decision. This suggests that individual differences in memory abilities can manifest in post-encoding stages and in putatively non-mnemonic tasks. These results not only have theoretical implications for understanding individual differences in memory and how they relate to other areas of cognition, but they also extend the application of DDM to large datasets composed of many participants but few trials per participant.

Topic: LONG-TERM MEMORY: Episodic

A69 FMRI correlates of spoken autobiographical memory retrieval associated with spatial, temporal, and self-referential proc

Charles Ferris[1], Sarah Taha[1], Erin Morrow[1], Cory Inman[2], Stephan Hamann[1], [1]Emory University, [2]UCLA

Autobiographical memory (AM) is a complex form of episodic memory that involves multiple brain regions. We examined whether autobiographical memory retrieval dynamically recruits content specific brain regions at a second-to-second time scale. Specifically, we tested the hypothesis that overtly retrieved (spoken) memory content transiently activates brain regions that mediate processing of corresponding content categories. Subjects retrieved unrehearsed AMs during extended retrieval periods and concurrently narrated their memories within the scanner. Memories were coded for words from four key AM content categories: 1) spatial (e.g., within, over), 2) temporal (e.g., yesterday, later), 3) self (e.g., I, me), and 4) other (e.g., Dad, Nick) used to characterize neural activity associated with AM content retrieval. Overt AM retrieval was associated with category-specific activation for several content categories investigated in previous fMRI studies of imagery, perception, and memory. Each content category was separately contrasted against a baseline of all other spoken AM speech. We observed activation consistent with studies of cognitive processes involving these specific content categories. Spatial words were associated with activation of the basal ganglia and retrosplenial cortex. Temporal words were associated with activation in inferior parietal cortex and the ventrolateral prefrontal cortex. Self words were associated with activation in the medial prefrontal cortex and the insula. Words in the 'other' content category were associated with activation of the right temporoparietal junction and the superior temporal sulcus. These results suggest that AM retrieval dynamically recruits functionally specific brain regions as different categories of memory content are retrieved from moment to moment.

Topic: LONG-TERM MEMORY: Episodic

A70 Distinct patterns of hippocampal activity are associated with spatial memory and color memory

Haley Fritch[1], Preston Thakral[2], Scott Slotnick[1], Robert Ross[3], [1]Boston College, [2]Harvard University, [3]University of New Hampshire

The hippocampus is known to be involved in source memory, and particularly, spatial source memory. However, it is unknown whether different types of source information are differentially processed in the hippocampus. The current fMRI study aimed to determine whether patterns of activity in the hippocampus differed for two types of source memory: memory for spatial location and memory for background color. Participants completed three runs of a spatial memory task and three runs of a color memory task. During the study phase, 32 line drawings of common objects and animals were presented to either the left or right of fixation for the spatial memory task, or on either a red or green background for the color memory task. During the test phase of both tasks, 48 nouns were presented in the center of the screen and participants classified each item as old and previously on the 'left'/on a 'green' background, old and previously on the 'right'/on a 'red' background, or 'new'. A multi-voxel pattern analysis (MVPA) was conducted to determine if distinct patterns of activity in the hippocampus were associated with each type of source during retrieval. Classification was implemented using the Princeton MVPA toolbox and individual trial activity in the hippocampus, defined anatomically for each participant. MVPA revealed that patterns of activity could classify color memory and spatial memory with above-chance accuracy (54.66%, $t(16) = 2.20$, $p < 0.05$). This finding indicates that different types of source memory are represented by distinct patterns of activity in the hippocampus.

Topic: LONG-TERM MEMORY: Episodic

A71 Gist and detailed mnemonic discrimination of highly similar scenes along the hippocampal longitudinal axis

Nghi (Nick) Hoang[1, 2], Fahad N. Ahmad[2], ZhongXu Liu[3], Marilyne Ziegler[1], Morris Moscovitch[1,2], [1]University of Toronto, [2]Rotman Research Institute, [3]University of Michigan - Dearborn

Human neuroimaging research on the longitudinal axis of the hippocampus (HPC) has highlighted an anteroposterior gradient (APG) in episodic memory processing, from gist in the anterior to details in the posterior. The purpose of this fMRI study was to evaluate this interpretation of the HPC APG by adopting the Mnemonic Similarity Task (MST) for multiple exemplars of a given scene category, at both encoding and retrieval. The MST measures recognition memory at retrieval for repeated items (targets), items that are similar to the repeated items (lures), and completely new items (foils). In an event-related, 3T-fMRI design, 26 undergraduate students were scanned while they studied three exemplars per scene category, and were tested on 24 targets, 24 lures, and 24 foils. With multiple exemplars, we replicated Stark and Stark's (2017) findings of a significant lure discrimination difficulty; however, participants were nonetheless capable of distinguishing lures from foils as measured by the Lure Discrimination Index, which corrects for response biases to lures. For region of interest activations per accurate responses, we found significantly greater HPC posterior than anterior activation that was modulated by stimulus type. Relative to accurate targets and lures, the APG difference was smallest

for accurate foils, which preferentially activated the anterior hippocampus. These findings confirm our hypothesis that the posterior region may be required for detailed discrimination of targets and lures, whereas foils, which can be distinguished from targets and lures on the basis of gist information, preferentially activate the anterior region.

Topic: LONG-TERM MEMORY: Episodic

A72 Replay of novel spatial routes improves navigation in older adults

Bryan Hong[1], Miranda Chang[1], Shayna Rosenbaum[2, 3], Morgan Barense[1, 3], [1]University of Toronto, [2]York University, [3]Rotman Research Institute

The ability to successfully learn and navigate through new spatial routes is compromised with age. This can have a profound impact on personal autonomy and quality of life, emphasizing the importance of developing novel interventions to mitigate age-related declines in spatial navigation. Digital memory augmentation (DMA) is a promising tool to mitigate episodic memory loss, using portable devices to capture day-to-day events for later review. However, no study to our knowledge has attempted to use DMA to directly improve spatial navigation of novel routes. In the present study, we aimed to investigate whether reviewing rich navigational cues of novel routes would improve spatial memory of those routes. Older adult participants learned novel routes on a real-world guided walking tour of the University of Toronto campus. After learning these routes, participants were randomly assigned to one of two experimental conditions: (1) a replayed condition, where participants reviewed video cues of their initial route learning, and (2) a non-replayed condition, where they did not. All participants were then asked to return two days after the guided walking tour for a series of follow-up memory assessments. We found that participants in the replayed condition had better temporal order memory and allocentric memory for locations encountered along the guided tour compared to participants in the non-replayed condition. A subsequent experiment using a within-subject design replicated this pattern of results. These findings suggest that reviewing rich video cues can improve learning of novel spatial routes in older adults.

Topic: LONG-TERM MEMORY: Episodic

A73 Power naps and episodic memory: Differential benefits of stage 2 sleep and slow wave sleep

Sara Y. Kim[1], Jessica D. Payne[1], [1]University of Notre Dame

Sleep is known to play a critical role in episodic memory consolidation. However, it is unclear whether 'power naps' (~20 minutes) confer the same memory benefits as naps that contain a full sleep cycle (~90 minutes). Some studies suggest that stage 2 sleep, which is characterized in the EEG by sleep spindles (12-15 Hz), is sufficient for memory consolidation. Others suggest that slow oscillations (SOs; 0.5-1 Hz) during slow wave sleep (SWS) are necessary as well. Here, we tested the hypotheses that episodic memory retention would be greater following an afternoon nap containing SWS, relative to both nap without SWS and wakefulness, and that spindles and SOs during SWS would predict memory retention. Participants (N=96) completed a word pair task, followed by a cued recall test to assess baseline memory performance. They were then assigned to a 90-min nap opportunity, 20-min nap opportunity, or 20-min active wakefulness, followed by another cued recall test to assess memory retention. Preliminary results indicate that the 90-min condition performed better than both the 20-min and wake conditions, although this difference was not statistically significant ($t(49.34)=1.89$, $p=0.065$; $t(62)=1.59$, $p=0.118$). Memory retention did not correlate with overall measures of spindle activity (total number, density, power) in either stage 2 or SWS. SO density, however, positively predicted memory retention in the 90-min condition ($b=1.79$, $p=0.011$). These findings provide initial evidence that the duration and composition of a daytime nap may affect memory consolidation. SWS and SOs, in particular, may be necessary to observe sleep-related memory benefits.

Topic: LONG-TERM MEMORY: Episodic

A74 Distributed representations of remembered vs. imagined events

Robert Molitor[1], Alexandra Tremblay-McGaw[1], Sarah DuBrow[1], Brice Kuhl[1], [1]University of Oregon

Episodic memory is important for remembering the past and imagining novel or future events. This duality of memory is evidenced by neuroimaging work which has shown that similar brain regions are engaged during retrieval and memory-based construction of imagined events. Despite this link between retrieval and imagination, it is unclear to what extent representations of imagined events resemble representations of retrieved events. Here, we used fMRI pattern similarity analyses to compare neural representations of retrieved and imagined events. Participants were scanned while watching videos, remembering previously viewed videos, and imagining novel events conceptually related to the content of watched and remembered videos. We first compared representations of retrieved events to representations of corresponding encoding events (i.e., watch trials). Critically, we contrasted this index of encoding-retrieval similarity to the similarity between conceptually-related retrieval and imagination trials. Preliminary analyses (n = 8) revealed encoding-retrieval similarity (reinstatement) within visual cortex, but no similarity between conceptually-related imagined and retrieved events. In contrast, in frontoparietal cortices and the hippocampus there was evidence for encoding-retrieval similarity (reinstatement) as well as similarity between conceptually-related imagined and retrieved events. Furthermore, encoding-retrieval similarity was comparable to imagination-retrieval similarity in these regions, indicating that imagined and retrieved events may share high-level, abstracted information. These results suggest that the connection between retrieval and imagination goes beyond the activation of similar brain regions within the memory network and extends to the similarity of how events are represented.

Topic: LONG-TERM MEMORY: Episodic

A75 Memory of Time: a novel paradigm to assessmnemonic discrimination for event duration

Nathan Muncy[1], Brock Kirwan[1], [1]BYU

Tasks designed to tax pattern separation processes in humans have largely focused on visual and spatial information, but few studies have investigated memory for time. Studies of memory for time have focused on order or antecedence. We developed a paradigm to test memory for temporal duration and used this paradigm to study the corresponding neural correlates in healthy young adults. We hypothesized that the medial temporal lobe would be differentially involved in correctly remembering duration in episodic memory. Thirty-five young, healthy participants (19 female, ages 18-31) completed a temporal discrimination task that consisted of a continuous-recognition paradigm in which visual objects were presented one at a time for either 1 or 1.5 seconds. Certain items repeated (Targets and Lures) where Targets were presented for the same duration while the duration of Lures was altered by ±0.5 seconds. Participants were asked to identify whether the stimulus duration changed. Whole-brain high-resolution fMRI data were acquired. Behavioral results indicate that participants were sensitive to both increases and decreases in duration. Further, fMRI analyses revealed that the left entorhinal and parahippocampal cortices were differentially involved in the encoding and retrieval of correct duration representations. Surprisingly,

neither the CA1 nor DG were identified in these analyses. These findings suggest that duration information is treated as contextual information in episodic memory and implicate the medial temporal lobe as being involved in the discrimination for temporal duration.

Topic: LONG-TERM MEMORY: Episodic

A76 The effect of targeted memory reactivation on generalisation in language learning

Chloe Newbury[1], Rebecca Crowley[1], Kathleen Rastle[1], Jakke Tamminen[1], [1]Royal Holloway University of London

Targeted memory reactivation (TMR) during sleep strengthens episodic memory. Its role beyond episodic memory is however less well understood. We tested impact of TMR on learning and generalisation of an artificial orthography. Adults (N = 24) learned to read fictitious words, each including one new letter that across the training set mapped onto two different vowel sounds (e.g., b#v pronounced /bev/, and n#d pronounced /nid/). Each word had a meaning in the form of an image of a familiar object. Half of the trained words (e.g., b#v but not n#d) were cued during subsequent non-REM sleep by playing the spoken words. The cued words were selected such that for each new letter only one of the two letter-to-vowel mappings was cued. Tests took place immediately and one week after sleep. We predicted that cueing would benefit episodic memory such that (1) cued words would be recalled and read more accurately than uncued words, and (2) that recognition memory for meanings of cued words would be better than uncued words. We predicted that if TMR promotes generalisation, cueing would benefit generalisation of the letter-to-vowel mappings, in that when reading untrained words participants would choose the cued letter-to-vowel mapping more often than the uncued one (read d#f as /def/ rather than /dif/). No cueing benefits were found in any task however. We suggest the impact of TMR is more limited than previously thought. Cueing one element of a memory (spoken form) may not cue associated elements (spelling or meaning).

Topic: LONG-TERM MEMORY: Episodic

A77 Does the mnemonic similarity task assess only memory, or is it sensitive to general cognitive function?

Sara Pishdadian[1], Nghi (Nick) Hoang[2], Stevenson Baker[1], Morris Moscovitch[1], R. Shayna Rosenbaum[1], [1]York University, [2]University of Toronto

Distinguishing between highly similar items in memory relies on the dentate gyrus (DG)/CA3 regions in the hippocampus. The Mnemonic Similarity Task (MST) Lure discrimination index (LDI) has been shown to be a sensitive behavioural measure of mnemonic discrimination. In this study, we aimed to test the sensitivity and specificity of the MST LDI score in community-dwelling older adults screened with the Montreal Cognitive Assessment (MoCA). The MoCA is a widely used screening measure for cognitive impairment, sensitive to several etiologies of cognitive dysfunction. Using regression analyses, we tested a sample of 88 participants (mean age = 70, n = 53 scoring 26 and above) to determine whether MoCA overall score, MoCA score without delayed recall subscale score, delayed recall subscale score, and overall cognitive status (overall score below or above a cut-off of 26) predicted MST lure discrimination performance above demographic factors (age, sex, education). Regression models showed all measures were significant predictors of MST LDI performance, over and above demographic variables. In contrast, the visuospatial/executive functioning subscale score was not significant in a regression model ($p = .07$). Our results suggest the MST LDI score is sensitive to both delayed memory scores and overall cognitive status. Compared to computational models of LDI score relying solely on hippocampal DG/CA3 region integrity, these results question the idea that the MST LDI is sensitive only to memory. Instead, our results suggest that LDI scores relate to more general cognitive status in healthy older adult community dwelling populations.

Topic: LONG-TERM MEMORY: Episodic

A78 The autobiographical significance of semantic knowledge in aging

Louis Renoult[1], Rachel Lambert[1], Michael Hornberger[1, 2], [1]University of East Anglia, [2]Norwich Medical School

In the present study, we studied autobiographical significance effects by which semantic concepts can become associated with personal memories. Fifty-one younger adults and forty older adults viewed faces or names of celebrities and performed a dead or alive semantic task, followed by an old-new recognition task. They then completed a questionnaire on all celebrities, evaluating related knowledge, familiarity, emotional salience, as well as whether they had any associated personal memories. An effect of modality was observed in the older adults, where famous faces were more likely to be associated with personal memories than famous names. Autobiographically significant concepts were associated with faster reaction times in the semantic task and higher accuracy in the recognition task in both groups. However, in older adults, these performance benefits were more prevalent for famous faces than for famous names. In both groups, most associated memories concerned unique events (63% of memories in younger and 62% in older adults), followed by memories of repeated events (32% and 33%, respectively), and a much smaller proportion of autobiographical factual knowledge (5% in both groups). In older adults, there was a greater proportion of memories for repeated events associated to famous names, as compared to famous faces. Interestingly, autobiographical significance effects did not vary with the time of the associated memories, and the same ratio of memory types was seen in the last 10 years and in the time period of the reminiscence bump in older adults.

Topic: LONG-TERM MEMORY: Episodic

A79 Targeted memory reactivation during sleep and memory suppression

Eitan Schechtman[1], Anna Lampe[1], Brianna J Wilson[1], Eunbi Kwon[1], Michael Anderson[2], Ken A Paller[1], [1]Northwestern University, [2]University of Cambridge

Sleep's role in memory consolidation is widely acknowledged, but its role in memory weakening is still debated. Like enhancement, memory deterioration is evolutionary beneficial and plays an integral part in cognition. In this study, we tested whether sleep can be harnessed to selectively enhance intentional memory suppression. To bias sleep-related memory processing, we used targeted memory reactivation (TMR), a paradigm involving the unobtrusive presentation of learning-related cues, thereby impacting consolidation. Participants learned pairs of associable words (e.g., PUMP - OIL) and were then exposed to the hint words and instructed to either recall ('Think') or suppress ('No-think') the target words. During a subsequent nap, one of two sounds conveying suppression instructions was presented, followed by the hint words. In non-cued pairs, memory for 'No-think' items was worse than for baseline items, which in turn were worse than 'Think' items. However, our results did not support the hypothesized suppressive effect of TMR on memory. Surprisingly, TMR enhanced memory for cued suppressed pairs relative to non-cued ones, but this effect was limited to pairs that were not correctly recalled before sleep. In contrast, there was no TMR effect for pairs that were correctly recalled before sleep. The lack of a suppressive TMR effect may be due to specific aspects of the design (e.g., parameters influencing interactions between the sound and words presented during sleep). Unexpectedly, however, our results provide additional evidence for the beneficial effects of TMR for memory, particularly for words that were not well-learned in the present design.

Topic: LONG-TERM MEMORY: Episodic

A80 Distinct neural substrates for scene perception and imagery

Adam Steel[1], Madeleine Billings[1], Caroline Robertson[1], [1]Dartmouth College

It is widely assumed that perception and mental imagery of high-level visual stimuli engage the same neural circuitry. Here, using fMRI, we report surprising evidence to the contrary. In Experiment 1, we had participants (n=16) perform mental imagery of personally familiar places vs. personally familiar people. At the individual participant level, this contrast revealed three regions of the human brain, one on each ventral, medial, and lateral surfaces, that were selectively activated during memory of familiar places, which we refer to as the 'place memory network'. These regions partially overlapped with, but were distinct from, the scene perception network, including the parahippocampal, occipital, and medial place areas (PPA, OPA, MPA). In Experiment 2, we explicitly compared brain activation in the place memory network vs. scene perception network during mental imagery vs. perception in these participants. Surprisingly, we found that the scene perception network showed no activation during mental imagery of familiar places, but the place memory network was strongly activated during mental imagery. However, during scene perception, this pattern was reversed - the place memory network showed little activity during scene perception, while the scene perception network was strongly activated. These results demonstrate that the place memory network, rather than the scene perception network, supports mental imagery of scenes. Given the preferential selectivity of place memory network for the memory - not perception - of visual scenes and adjacency to scene perception regions, we hypothesize that these regions may provide contextual representations to support navigation.

Topic: LONG-TERM MEMORY: Episodic

A81 Divergent thinking and constructing future events: Dissociating old from new ideas

Preston Thakral[1], Donna Rose Addis[2], Daniel Schacter[1], [1]Harvard University, [2]Rotman Research Institute

Divergent thinking (the ability to generate creative ideas by combining diverse types of information) plays an important role in imagining novel and specific future autobiographical events. In the current study, we examined whether divergent thinking is differentially associated with the ability to construct novel imagined future events and recast future events (i.e., actual past events recast as future events) as opposed to recalled past events. We also examined whether different types of creative ideas (i.e., 'old ideas' from memory or 'new ideas' from imagination) underlie the linkage between divergent thinking and various types of autobiographical events. The amount of episodic detail was quantified by the Autobiographical Interview. Divergent thinking ability was measured using the Alternate Uses Task (AUT). The amount of episodic details for both novel and recast future events was associated with divergent thinking (AUT scores), and this relationship was stronger with AUT scores for new creative ideas relative to old creative ideas. There was no significant relationship between divergent thinking and the amount of episodic detail for recalled past events. These results demonstrate that individual differences in divergent thinking are associated with the capacity to both imagine and recast future events, and that divergent thinking is an important ingredient for future episodic thought. The current findings have implications for studies examining the neural correlates of episodic and divergent thinking because they illuminate the specific cognitive processes that overlap between different forms of episodic and divergent thinking.

Topic: LONG-TERM MEMORY: Episodic

A82 Effects of Enhancement and Suppression Cueing on Long Term Memory

Janis Gaudreau[1], Harlan Fichtenholtz[1], [1]Keene State College

Previous research has found that more often participants are able to up-regulate their memory, or remember stimuli because of cueing, rather than down-regulate their memory, or forget the stimuli because of cueing. EEG results from past research show that frontal positivity is greater for items that were recognized with high confidence compared to those that were missed. The goal of the current study is to investigate whether cueing to remember or forget stimuli will affect visual long-term memory. Participants completed an encoding task in which the participant was cued to remember, forget, or view 300 pictures on an image by image basis. After a 2-minute rest period, participants were presented with a recognition memory test with 300 old and 300 new pictures responding if each was: (1) definitely an old picture, (2) maybe an old picture, (3) maybe a new picture, or (4) definitely a new picture. Behavioral results show that there is a significant impact of instructional cue on memory performance. Images receded by a 'remember' cue were recognized better than those preceded by either 'view' or 'forget' cues. Additionally, pictures preceded by a 'view' cue were recognized better than those following a 'forget' cue. During encoding, definite hits and definite misses show unique patterns of frontal positivity across suppression, enhancement, and passive viewing stimuli. Overall the outcome of this study is an addition to past research supporting the conclusion that people can enhance their own memory at will, but can also choose to suppress or forget information.

Topic: LONG-TERM MEMORY: Other

A83 Strategy Implementation and Feedback Processing in Healthy Young Adults

Victoria Tilton-Bolowsky[1], Lucia Hong[1], James C. Borders[2], Sofia Vallila Rohter[1], Yael Arbel[1], [1]MGH Institute of Health Professions, [2]Teachers College, Columbia University

Research has identified multiple systems that support human category learning, often termed implicit (gradual accrual of properties below conscious awareness) and explicit (conscious, intentional hypothesis testing). In the current study, thirty-eight healthy young adults completed a category learning task under two conditions, non-feedback and feedback, thought to differentially engage the learning systems. Category stimuli varied on ten features probabilistically. Behavioral and electrophysiological data were collected during training and testing phases. Behavioral analyses examined learner strategy during training and categorization accuracy during testing. Results indicated that regardless of condition, learners who employed an optimal strategy (multiple-feature) achieved significantly greater accuracy compared to those who employed suboptimal strategies (single-feature or random pattern). An event-related potential called the feedback-related negativity (FRN) was used to measure feedback processing during the feedback condition. Optimal strategy users showed typical FRNs in early training and enhanced FRNs following negative feedback in late training, suggesting effective utilization of trial-by-trial feedback. Suboptimal strategy users showed reduced FRNs in early training which further reduced during late training, suggesting reduced feedback processing and performance optimization. Certain participants with suboptimal strategy use in the feedback condition demonstrated higher accuracy and optimal strategy development in the non-feedback condition. These data suggest that there are important differences among individual learners and that the ability to develop optimal learning strategies may be related to one's ability to efficiently and effectively incorporate feedback during the learning process. Those who are unable to use feedback effectively may be better suited for non-feedback based learning.

Topic: LONG-TERM MEMORY: Other

A84 An Afternoon Nap Enhances Repetition Priming and Antipriming

Anna B Madden-Rusnak[1], Rebecca G Deason[1], Chad J Marsolek[2], Carmen Westerberg[1], [1]Texas State University, [2]University of Minnesota

Repetition priming occurs when object recognition is facilitated due to recent processing of that object. Because representations in visual cortex overlap, when one object is primed, processing deficits for similar but unprimed objects simultaneously occur, an effect known as antipriming. During sleep, some recent memories undergo consolidation, which can be manifested at synaptic and systems levels. Whereas declarative memories depend on systems consolidation during slow-wave sleep, priming and antipriming may be primarily influenced by synaptic consolidation during rapid-eye movement (REM) sleep, as REM during overnight sleep has been associated with enhanced priming. To determine how sleep during an afternoon nap influences priming and antipriming, participants identified common object images as quickly and accurately as possible to obtain baseline object recognition measures. Participants then viewed different object images and made liking judgements for those images. Next, during a 2-hour break, participants either took a 90-minute nap while electroencephalography was recorded (n=26) or remained awake (n=29). Afterwards, participants again identified object images as quickly and accurately as possible. Half were the same objects viewed just prior to the break (primed) and half were new (antiprimed). Priming (facilitation for primed versus baseline objects) and antipriming (decrement for antiprimed versus baseline objects) response times were larger for participants who slept compared with participants who remained awake, and this difference was not mediated by REM sleep. Sleep appears to enhance both priming and antipriming, and aspects of sleep that contribute to this enhancement during a nap may differ from those during overnight sleep.

Topic: LONG-TERM MEMORY: Priming

A85 Is neural conceptual space spherical? Intrinsic properties vs. artifacts in multidimensional scaling

Leyla Roksan Caglar[1], Dana Mastrovito[2], Stephen José Hanson[1], [1]Rutgers University Newark, [2]Stanford University

How does the brain organize and represent concepts and categories? We investigated the shape and structure of conceptual space, applying representational similarity analysis (RSA) and multidimensional scaling (MDS) to three large data sets (RSA; Chang et al., 2019; Kiani et al., 2007; Kriegeskorte et al., 2008). All derived representational manifolds were spherical in shape. However, since data with near equal dissimilarities will necessarily lead to spherical solutions in MDS, we proceeded to rule out the possibility that the spherical manifolds derived from the experimental data are an artifact of the analysis technique rather than an intrinsic property of conceptual space. In both real and simulated data, we investigated how the shape of the derived manifold is impacted by the distance metric used and its subsequent satisfaction of the metric axioms. In simulated data, we further characterized the effects of the underlying distributions of the data, number of data points, as well as its power spectrum on the resulting manifold. We show that both random and non-random data can produce spherical manifolds, but that meaningful spherical manifolds result only when the data exhibit categorical clustering, a frequency spectrum of pink noise (1/f), and when the distance metric satisfies the triangle inequality. Furthermore, we show in a series of simulations that spherical manifolds break-down as the spatial frequency characteristics of the data approach Brownian noise (1/f^2). Our results leave open the intriguing possibility that spherical manifolds are an intrinsic feature of neural representational space.

Topic: LONG-TERM MEMORY: Semantic

A86 The Role of the Left DLPFC in the Relationship between Metamemory Monitoring and Control

Casey Imperio[1], Elizabeth Chua[1, 2], [1]CUNY the Graduate Center, [2]Brooklyn College

Improving memory via strategic control is a crucial skill that is thought to rely on outputs from metamemory monitoring. Previous research showed that metamemory monitoring accuracy improved with high definition transcranial direct current stimulation (HD-tDCS) over the left dorsolateral prefrontal cortex (DLPFC). The current study tests the role of the left DLPFC in metamemory monitoring and control for a general knowledge task using HD-tDCS. Part 1 of the task included assessing previous knowledge, attempting recall and making 'feeling-of-knowing' judgments (i.e., a metamemory monitoring task). In Part 2, participants (n=36) chose a subset of non-recalled questions to re-answer with a hint (i.e., metamemory control task). Participants then re-answered their chosen questions, along with a subset chosen by the researcher, with a hint. Finally, participants took a recognition test. Active HD-tDCS over the left DLPFC was applied during Part 1, after Part 1, or sham was applied during Part 1. A stimulation x item interaction ($F(2, 62) = 9.393$, $p < .001$) showed that participant-chosen questions were associated with greater monitoring accuracy in the active stimulation conditions compared to sham (all p's < .05), whereas the researcher-chosen questions were associated greater monitoring accuracy for sham compared to 'DLPFC during' ($p < .05$). Additionally, participant-chosen questions had greater memory performance compared researcher-chosen questions, though this did not differ by stimulation. These results suggest that HD-tDCS over the left DLPFC may allow participants to better utilize the outputs of monitoring to strategically control and improve memory performance.

Topic: LONG-TERM MEMORY: Semantic

A87 Individual differences in learning rate are reflected in integration of feedback magnitude information

Berry Van den Berg[1], Timothy Sondej[1], Marty Woldorff[2], Monicque Lorist[1], [1]University of Groningen, [2]Duke University

The ability to use and integrate feedback information over multiple encounters is key to our ability to learn and make good decisions. Here, we sought to investigate the neural underpinnings of feedback processing using a reward-magnitude learning task by inspecting hallmark feedback-related ERP components. We asked participants to choose between two features, each of which could either yield net gains or net losses. Reward-magnitudes ranged from -8 to 8 points. Results showed that the feedback related negativity (FRN) and the late positive complex (LPC) played distinct roles. On the one hand, the FRN was especially sensitive to the detection of feedback, but there was no influence of the previous feedback on its amplitude, nor did the FRN vary as a function of how quickly individual participants learned. The LPC, on the other hand, played an integrative role; its amplitude was modulated by both the current feedback and the feedback on the previous trial. Finally, the influence of the previous feedback on the LPC was also modulated by the individual participant's learning rate. High learning rates were characterized by an LPC that was more strongly modulated by previous reward-magnitude information compared to lower learning rates. In sum, this study illuminates the relationship between brain processes, reward-magnitude information, and sequential learning by outlining how the relatively early FRN-ERP component reflects the detection of current feedback outcomes, but the later LPC reflects brain processes that serve an information-integration function.

Topic: LONG-TERM MEMORY: Skill Learning

A88 Investigating theta oscillations in intermodal selective attention

Audrey Murray[1], Dave Saint-Amour[1], Isabelle Soulieres[1], [1]Universite du Quebec a Montreal

Selective attention allows to selectively process potentially relevant information in order to complete a task. It has been recently proposed that theta band oscillations (~ 4-8 Hz) in the frontal regions are a key mechanism of endogenous selective attention. The current electroencephalography (EEG) study investigated the role of theta oscillations activity in the fronto-central regions in 20 participants (mean age = 26.6, 10 women) during an intermodal selective attention task in which a cue indicated on a trial-by-trial basis the sensory modality (visual or auditory) of a subsequent target discrimination (i.e., either a Gabor-patch orientation or frequency tone 2AFC discrimination). Importantly, cues were either congruent or incongruent with the target. Spectral analyses (Morlet and FFT) were used to quantify oscillatory power across time. As expected, reaction time was significantly slower ($F(2, 14) = 6.6$, $p < 0.01$) when cues were incongruent (M = 1029 ms, SD = 35.7) in comparison to congruent cues (M = 980 ms, SD = 33.7) or the absence of cue (M = 980 ms, SD = 144.1). However, EEG results did not show a greater power of theta oscillations in cued relative to non-cued trials. This study failed to replicate previous findings on the role of theta band in intermodal selective attention. The involvement of other frequency bands (e.g., alpha) or other mechanisms such as phase-amplitude coupling are more likely to occur.

Topic: METHODS: Electrophysiology

A89 DeepMedic for automated lesion segmentation in chronic stroke

Nadait Gebremedhen[1], Craig Fraser[1], Stephen Snow[1], Corrine Durisko[1], Liam Berti[1], Jing Shixiong[1], Steve Jacobs[1], Julius Fridriksson[2], Julie Fiez[1], [1]University of Pittsburgh, [2]University of South Carolina

Accurate segmentation of lesions is key to poststroke neuroimaging research aiming to understand disease-behavior relationships. Comparative evaluation of existing automated segmentation algorithms has recognized Lesion Identification with Neighborhood Data Analysis (LINDA) as a superior approach for unimodal T1-weighted (T1w) chronic stroke lesions (Ito, Kim, & Liew, 2019). LINDA is a program that employs a random forest (RF) algorithm to predict lesioned voxels (Pustina et al., 2016). Here, we compare DeepMedic ? a convolution neural network classifier, originally trained and tested on sub-acute ischemic stroke lesions ? to LINDA (Glocker et al., 2016). We implemented both lesion segmentation approaches on a dataset of chronic ischemic stroke (n = 31). Accuracy was assessed against manual tracing with Dice Score (DC), a performance evaluation metric which measures the degree of overlap between the ground truth and automated segmentation (Maier et al., 2017). Predicted lesion segmentations achieved a mean DC of 0.649?±?0.27 to LINDA's 0.667±0.26. We carried out the Mann-Whitney U test to determine whether there was a significant difference in the performance of the two approaches and found no statistically significant difference in the DC ($U = 452$, $p = 0.346$). Our results show that DeepMedic is a worthwhile alternative to LINDA; it has comparable accuracy, and because it was designed with a multimodal input strategy, it offers the added advantage of supplementing other MRI sequences when available. Moreover, the software can be trained with new datasets making it more adaptable to a range of settings and applications.

Topic: METHODS: Neuroimaging

A90 Oral Contraceptive Pills Reduce Cortical Thickness in Inferior Frontal Gyrus

Nicole Petersen[1], Nicholas Kearley[1], Dara Ghahremani[1], Jean-Baptiste Pochon[1], Megan Fry[1], Andrea Rapkin[1], Edythe London[1], [1]UCLA

Gonadal hormones influence neuronal organization and plasticity, yet the consequences of altering them with hormonal contraception are not known, and observational studies have indicated that oral contraceptive pill (OCP) use may be linked to changes in brain structure. To clarify this relationship and determine if it is causally linked, we performed a double-blind, placebo-controlled, randomized crossover study in 24 women. High-resolution structural brain images were obtained with MRI, and prefrontal cortical thickness was compared between the two intervention arms (OCPs vs. placebo). Mood and menstrual-related symptoms were self-reported each day that participants were enrolled in the study, and were increased by OCPs. Cortical thickness was reduced bilaterally in the pars triangularis, in the right pars opercularis, and right frontal pole during the OCP arm vs. placebo. Only the effect in the right pars triangularis survived multiple comparison correction. Right pars triangularis thickness was negatively correlated with severity of self-reported somatic symptoms. These findings suggest that one cycle of OCP use is sufficient to reduce cortical thickness in the right pars triangularis, but that change does not appear to be causally linked to OCPs' effects on mood. Rather, thicker pars triangularis is correlated with fewer somatic symptoms. Given that this region is not known to be associated with control or perception of interoceptive or visceral processes, it seems more likely that the symptoms and cortical thinning are independently related to the actions of steroid hormones in OCPs, with stronger responses to OCPs producing both more cortical thinning and more somatic symptoms.

Topic: METHODS: Neuroimaging

A91 Extracellular free water increases relate to altered cognitive function in systemic lupus erythematosus

Xing Qian[1], Beatrice Rui Yi Loo[1], Hui Li Koh[1], Kwun Kei Ng[1], Anselm Mak[2], Juan Helen Zhou[1], [1]Duke-National University of Singapore Medical School, [2]National University of Singapore

The brain white matter (WM) microstructural changes in systemic lupus erythematosus (SLE) have been well-documented by diffusion tensor imaging (DTI). However, conventional DTI technique cannot distinguish between the WM changes originating from brain tissue or extracellular free water abnormalities. The role of these WM changes in the etiology of SLE remains to be fully understood. This study aimed to discriminate between WM degeneration and neuroinflammation in SLE by applying a novel free-water (FW) imaging method on the DTI data acquired from a sample of patients with SLE and matched healthy controls (HC). We measured WM free water and FW-corrected DTI measures as well as the brain structural connectivity (SC) inferred from WM connections. We found that the participants with SLE showed an increase in the extracellular FW compared with HC, whereas no group differences were observed in the FW-corrected tissue compartments and the SC matrix. Moreover, the revealed FW increases were associated with poorer cognitive performance and higher cumulative prednisolone dose across SLE patients. Our findings suggest that excessive brain white matter extracellular water volume, reflecting neuroinflammation, is the predominant pathology of SLE underlying cognitive impairment.

Topic: METHODS: Neuroimaging

A92 Decoding the intensity and frequency of TMS: A concurrent TMS-fMRI study

Farshad Rafiei[1], Dobromir Rahnev[1], [1]Georgia Tech.

Transcranial magnetic stimulation (TMS) is a neuromodulatory technique that can be used to examine the causal role of specific brain regions in perceptual, motor, and cognitive processes. However, the mechanism of action by which TMS affects the neural dynamics is still unclear. One way to elucidate the changes of brain activity evoked by TMS is to measure the blood-oxygenation level-dependent (BOLD) signals using functional magnetic resonance imaging (fMRI). In two experiments, we acquired BOLD signals from healthy participants while applying TMS over dorsolateral prefrontal cortex (DLPFC) during rest. In Experiment 1, we delivered a series of pulses at high (100% of motor threshold) and low (50% of the motor threshold) intensity, whereas in Experiment 2, we always used high intensity pulses which were delivered at four different frequencies (5 Hz, 8.33 Hz, 12.5 and 20 Hz). To examine the effect of TMS, we defined spherical regions of interest (ROI) with four sizes (8 mm, 12 mm, 16 mm, 20 mm) immediately under the stimulation spot. Using conventional univariate analysis, we observed no consistent BOLD signal increase in these ROIs in either experiment for all ROI sizes. Nevertheless, we were able to decode both the TMS intensity (Experiment 1) and the TMS frequency of stimulation (Experiment 2) for all four ROI sizes. These results indicate that TMS might not produce univariate increase in BOLD but leads to differential effects on nearby voxels, which allows for decoding of both the intensity and frequency of stimulation.

Topic: METHODS: Neuroimaging

A93 Characterizing Social Interaction Via Dyadic Hyperscanning Techniques

Ruohan Xia[1], Runzhi Chen[1], Kayden Stockwell[1], Tanya Evans[1], [1]University of Virginia

Hyperscanning, the simultaneous recording of brain activity from multiple participants, is a crucial experimental model for studying social interactions in the field of cognitive neuroscience. By enabling researchers to investigate real-time interpersonal social encounters, hyperscanning paradigms have yielded results that would otherwise go unnoticed using non-interactive experiments. Dyadic interaction, anchored in mother-infant encounters, is the most fundamental social interaction unit. Derived from this innate inclination, studies focusing on dyadic interactions have identified subtle mechanisms (e.g., social eye gaze and conversational affect) that can contribute to the quality of social interactions. More recently, researchers have benefitted from the continuing efforts in advancing mobile neuroimaging (e.g., mobile EEG) technology, which provide ample opportunities to study the complex interactions in more naturalistic settings. What potential merit can dyadic hyperscanning paradigms bring to the scientific community? Here we provide a comprehensive account of research questions addressed using this methodology. A wide range of social interaction paradigms have been implemented - from basic processes such as social gaze, speech rhythm, and joint movements, to more sophisticated interactions involving empathy, complex cooperation (e.g., leader-follower interaction), as well as competition. Future work investigating social interactions will continue to benefit from dyadic hyperscanning techniques, particularly in the context of real-world settings.

Topic: METHODS: Neuroimaging

A94 Using Bayesian model comparison allows for effective model comparison: A study of the simple reaction time task

Darije Custovic[1], Adam Hampshire[1], Bojan Nikolic[2], Claudia Clopath[1], [1]Imperial College London, [2]Cavendish Laboratory, University of Cambridge

This study has two aims: to argue that cognitive neuroscience should adopt modern Bayesian model comparison techniques, and to demonstrate and discuss the idea that even simple cognitive tasks produce datasets evincing complex phenomena. The simple reaction time task (SRT), wherein subjects must respond as quickly as possible to a signal, is among the simplest of cognitive tasks. Despite its simplicity, the SRT is of interest as a test of fundamental processes of prediction and attention. Old SRT research, here reproduced and amplified, revealed complex phenomena in SRT performance. For example, there is a strong relationship between the length of the foreperiod (FPL) preceding, and mean response time to, a signal; this 'foreperiod effect' bears a statistical relationship to the distribution of FPLs. Furthermore, recent FPLs strongly modulate the foreperiod effect. Taken together, these results (and others) suggest that complicated cognitive mechanisms underpin SRT performance. Numerous models of SRT performance exist; noteworthy are multiple trace (MT) and drift-diffusion (DD) models. We used MultiNest, an advanced Bayesian inference algorithm, to distinguish these approaches, finding that MT models significantly outperform their DD counterparts. We thereby directly demonstrate the utility of modern Bayesian techniques. We conclude by discussing the implications of this research on a number of levels: its relevance to understanding the SRT specifically; its general ramifications for how data and modelling should be approached in cognitive science, especially in more difficult tasks; the benefits and drawbacks of its Bayesian methodology; and how its results could be translated into clinical settings.

Topic: METHODS: Other

A95 Focal Neurostimulation of Attention Networks

Benjamin Deck[1], Jared Zimmerman[2], Brian Erickson[1], Brooke Yeager[1], Apoorva Kelkar[1], John Medaglia[1], [1]Drexel University, [2]University of Pennsylvania

Transcranial magnetic stimulation (TMS) can elicit focal and reliable responses in the brain. However, the degree of specificity of TMS while targeting in the frontal lobe is not well understood. To test this, we applied TMS to several network hubs in the frontal lobe known to support different subfunctions of attention. We hypothesized that the proximity of the network hubs in each subject would drive the strength of TMS effects on these subfunctions. Network hubs related to attentional subfunctions were identified in each subject based on parcellations of previously collected resting-state functional connectivity data. In three sessions we applied continuous theta-burst stimulation (cTBS) inhibitory TMS, delivered to either the cingulo-opercular (CO), frontal-parietal control (FP-CN), or lateral dorsal attention networks (L-DAN). The attention network task (ANT) was administered to participants before and after stimulation. Euclidean distance between TMS targets for each subject was correlated with efficiency scores of each attentional subfunction (alerting, orienting, and executive control). We observed a significant negative correlation between the pre-post change in the ANT alerting efficiency measure and euclidean distance between CO and FPCN targets ($r(9)=-0.61$, $p=0.04$). The further the CO stimulation target was from the FPCN, the worse the attentional 'alerting' subfunction became. This suggests that the proximal effects of the TMS field may impact function in cortex near the target. Therefore, accounting for proximal effects in functionally-related cortex near the target may be important to understanding behavioral response variability.

Topic: METHODS: Other

A96 Multivoxel pattern analyses of brain structure to classify dyslexia

Ja Young Choi[1], Gabrielle Torre[2], Yaminah Carter[2], Terri Scott[2], Satrajit Ghosh[3], Tyler Perrachione[2], [1]Harvard University, [2]Boston University, [3]MIT

Developmental dyslexia is a common learning disability that specifically affects the development of fluent and accurate reading skills. Although dyslexia is thought to have a neurological origin, a reliable neuroanatomical signature of this disorder has remained elusive. In this study, we performed whole-brain analyses to identify differences in grey matter density between adults with dyslexia (n=52) versus typical reading abilities (n=56). First, in a classic voxel-based morphometry analysis, we found no significant group differences in grey matter density. Second, using multivoxel pattern analysis, we trained a support vector machine to classify the same grey matter density maps as belonging to either typical readers or those with dyslexia-asking whether there is information present in the pattern of grey matter density in the whole brain that is not detected by univariate, voxelwise analyses. We used recursive feature elimination to reduce the number of features from >840,000 voxels to the 176 most informative ones, which were spread throughout the brain. Using 5-fold cross validation, this classifier performed significantly better than chance - classifying brains as typical vs. dyslexic with > 60% accuracy. These results raise the possibility that multivariate analyses may provide new insight into the neuroanatomical bases of developmental dyslexia. This study represents a preliminary investigation of a sample of more than 1000 brains of children and adults with and without dyslexia. Our ongoing work is using this larger sample of brains to develop more accurate models based on grey matter density and other neuroanatomical features to predict reading development and impairment.

Topic: NEUROANATOMY

A97 The effect of drug of abuse and treatment status on the neurobiology of craving: a meta-analysis of neuroimaging studies

Francantonio Devoto[1], Giulia Spinelli[1], Giulia Scotti[1], Laura Zapparoli[1], Eraldo Paulesu[1], [1]University of Milano-Bicocca

Current narrative reviews have identified a number of factors that modulate the neural response to drug-associated cues in the cue-reactivity paradigm, which may lead to inconsistent findings across studies. We adopted a meta-analytical approach to assess the influence on the neurobiology of craving of: (i) the dependence induced by the substance, (ii) the treatment status of the participants and (iii) their interaction. We meta-analyzed 65 neuroimaging studies employing cue-reactivity paradigms in individuals addicted to cocaine, heroin, alcohol or nicotine-only. We employed the activation likelihood estimation method combined with hierarchical clustering and cluster composition analyses. Our results showed that individuals addicted to illegal substances (cocaine, heroin) exhibit stronger activity of the ventral tegmental area (VTA), the nucleus accumbens and the amygdala compared to individuals addicted to legal substances (alcohol, nicotine). Moreover, treatment-seeking (TS) individuals exhibit greater activity in the thalamus, whereas nontreatment seeking (NTS) individuals exhibit greater activity of the dorsal anterior cingulate cortex (dACC). Importantly, the caudate nucleus, the orbitofrontal cortex, and the inferior occipital gyrus showed a significant dependence-by-treatment status interaction, as they were more frequently engaged by TS compared to NTS individuals, but only in those addicted to legal substances.Overall, our results provide a quantitative assessment of the factors that modulate the neural drug cue-reactivity, suggesting both common and different neural substrates of craving across legal and illegal substances. Crucially, the treatment status and its interaction with the severity of the dependence give rise to specific brain activation patterns, which may explain the previously inconsistent findings.

Topic: OTHER

A98 Brief cognitive screening in youth at risk for psychosis

David Roalf[1], Kosha Ruparel[1], Tyler Moore[1], Monica Calkins[1], Ruben Gur[1], [1]University of Pennsylvania

Cognitive dysfunction is associated with psychosis. Individuals with, or developing, psychosis are not typically evaluated for cognitive dysfunction. Unfortunately, most current cognitive testing procedures are lengthy or have not been validated in youth with psychosis symptoms. Here, we measured cognitive performance using a cognitive screening inventory, the MMSE, and a comprehensive computerized neurocognitive battery, the Penn CNB. Cognitive performance was measured in 334 typically developing (TD; mean age = 17.23 +/- 3.58) youth and 208 youth at risk for developing psychosis (PS; mean age = 17.57 +/- 3.16). MMSE [F(1,534)=34.98, p< 5.9x10-9] and CNB [F(1,502)=28.78, p< 1.2x10-7] performance were lower in PS as compared to TD. Scores on the MMSE were positively correlated with CNB accuracy [r(505)=0.46, p

Topic: OTHER

A99 Mesoscopic functional interactions in human cortex during sleep and wake states

Annabelle Tao[1], Jiarui Wang[1], Gabriel Kreiman[1], [1]Harvard Medical School

We are regularly and naturally unconscious during non-dream sleep, but we know little about the neural mechanisms underlying sleep and wake. We analyzed functional interactions in continuous intracranial electroencephalography recordings from epilepsy patients. After correcting for artifacts and removing seizure events, we computed coherence in different frequency bands between electrode pairs as a metric for functional interactions. We annotated 1,363 hours in 14 subjects as sleep or wake based on patient video. We used a permutation test to isolate statistically significant functional interactions. For each electrode pair in each subject, we trained a support vector machine (SVM) to classify significant functional interactions as corresponding to sleep or wake states. The average 10-fold loss was 0.40 (SD 0.12) for 20,974 electrode pairs (chance = 0.5). For comparison, we trained an SVM for each individual electrode to decode sleep based on broadband power. The average 10-fold loss was 0.39 (SD 0.066) for 1,034 electrodes (chance = 0.5). We found correlations between individual electrode decoding accuracy and coherence decoding accuracy. Next, we used network analysis to investigate the network structure of pairwise interactions during sleep and wake states. We found that for significant functional interactions, there is significantly greater network organization during wake than sleep as assessed by properties such as efficiency, modularity, and clustering. We compared these results against similar recordings in macaque monkeys. These results provide a first look at functional interactions between neural circuits during sleep and wake states in large-scale human intracranial data.

Topic: OTHER

A100 Auditory Sensory Gating: Effects of Noise

Fan-Yin Cheng[1], Julia Campbell[1], Chang Liu[1], [1]University of Texas at Austin

Cortical neurons encode the transient amplitudes at the onsets of phonemes, a function important for speech perception. Central inhibition may aid this process by suppressing irrelevant auditory information (e.g., background noise), allowing the listener to focus on acoustical aspects of speech signals. Inhibition is measured through auditory gating using cortical auditory evoked

potentials (CAEPs) in response to paired stimuli. Data in our laboratory suggest that gating is related to variable speech perception-in-noise performance. However, few studies have directly examined the gating response in background noise, and none have compared the effects of energetic versus informational masking noise types. Therefore, the specific effects of noise on inhibition are unclear.The goal of the current study was to assess the effects of informational (four-talker babble) and energetic (temporally-modulated babble) masking on inhibition using an auditory gating paradigm with speech stimuli. Auditory gating was measured using high-density EEG in 15 normal-hearing adults (18-35 years). CAEPs were evoked by a 50 ms /i/ vowel pair at 80 dB SPL in three noise conditions (quite, four-talker babble, temporal modulated four-talker babble) at a signal-to-noise ratio (SNR) of 5 dB. CAEP amplitude gating difference and ratio indices of P50, N100, and P200 were calculated. No significant differences in gating indices were observed between conditions. However, there was a trend of decreased gating in both noise conditions compared to quiet, suggestive of reduced inhibition in noise. These preliminary results indicate that background noise, decreases inhibition, which may act as a mechanism for poorer speech perception performance in background noise.

Topic: PERCEPTION & ACTION: Audition

A101 This sounds good! Hurdling and tap-dancing re-afferences are processed differently in the brain

Nina Heins[1], Jennifer Pomp[1], Karen Zentgraf[2], Markus Raab[3], Ricarda Schubotz[1], [1]Department of Psychology, University of Muenster, Germany, [2]Department of Movement Science and Training in Sports, Inst, [3]Institute of Psychology, German Sport University Cologne

It is congruent with our everyday experience that most of our actions produce sounds. So far, it is unclear whether these action sounds are used as auditory feedback to evaluate the quality of action execution and are therefore important for motion control. For this study, we trained our participants in two sound-producing actions, one with intentional (tap dancing), one with incidental (hurdling) action sounds, and showed them point-light videos of their own actions in a functional Magnetic Resonance Imaging (fMRI) experiment. We examined the diverging influence of action sound omission on action evaluation (via action performance rating scores) and neuronal processing of these two action sound types, especially regarding the question whether auditory predictions are provided whenever the sound is removed. Findings suggest that the brain enhanced auditory predictions during tap dancing, and visually in hurdling. Auditory predictions manifested in the supplementary motor area (SMA), whose activity correlated both positively with rating scores and negatively with primary auditory cortex activity when sound was removed from tap dancing videos. In these videos, we suggest that a generative model of the expected sound was delivered by SMA, leading to attenuation in primary auditory areas. Our results contribute to a deeper insight into the importance of action sounds for understanding, evaluating and improving our action execution and action perception in sports and in everyday life.

Topic: PERCEPTION & ACTION: Audition

A102 Individual variability in functional organization of the human and monkey auditory cortex

Jianxun Ren[1], Hesheng Liu[2], Ting Xu[3], Franziska Schoeppe[2], Danhong Wang[2], Meiling Li[2], Yuanxiang Lin[4], Julian Ramirez[5], Jie Lu[6], Luming Li[1], Jyrki Ahveninen[2], [1]Tsinghua University, [2]Massachusetts General Hospital, [3]Child Mind Institute, [4]Fujian Medical University, China, [5]Oregon Health and Science University, [6]Xuanwu Hospital, China

Despite intensive research stretching over a century, the exact arrangement of the human auditory cortex (AC) remains elusive, largely due to the substantial inter-individual variability of anatomy and function in AC. Moreover, the possibility that AC variability could be linked to the individuality of our auditory and communication qualities has received little attention. Here, we examined the variability of ACs based on intrinsic functional connectivity patterns in humans and macaques. The variability in functional connectivity was estimated in human AC using a resting-state fMRI dataset consisting of 30 young healthy adults (15 females, age 24 ± 2.41 yrs) who underwent ten 10-minute scans. All results were replicated in an independent dataset including 10 young healthy adults (5 females, age 29.1 ± 3.3 yrs) who underwent ten 30-minute resting-state fMRI scans. The variability was also investigated in macaque AC across four macaque monkeys (one female, age 5.75 ± 0.95 yrs). Each monkey was scanned for eight 10-minute runs under anesthesia. Our results demonstrate that in humans, functional variability is 1) greater near the non-primary than primary ACs, 2) greater in ACs than comparable visual areas, and 3) greater in the left than right ACs. Remarkably similar modality differences and lateralization patterns of variability were observed in macaques. These connectivity-based findings are consistent with a confirmatory task-based fMRI analysis. The quantitative proof of the exceptional variability of ACs has implications for understanding the evolution of advanced auditory functions in humans.

Topic: PERCEPTION & ACTION: Audition

A103 Evaluating predispositions for music training: white matter in infancy relates to music aptitude abilities in preschool

Jennifer Zuk[1,2], Jolijn Vanderauwera[1,2], Ally Lee[1], Michelle Gonzalez[1], Jade Dunstan[1], Ted Turesky[1,2], Doroteja Rubez[1], Xi Yu[1,2], Ellen Grant[1,2], Nadine Gaab[1,2], [1]Boston Children's Hospital, [2]Harvard Medical School

The study of musical training as a framework for structural plasticity has evolved dramatically over the past decade. Characteristic structural alterations between musicians and nonmusicians have been identified, with emerging longitudinal evidence depicting training-induced plasticity. However, putative neural predispositions have also been proposed, as white matter organization in bilateral corticospinal and right superior longitudinal fasciculus prior to training onset among adults has been linked with faster auditory-motor learning. This raises an intriguing question of whether training effects may be influenced by variability in brain structure in early childhood. To address this unknown in the literature, the present study investigated whether white matter organization in infancy relates to subsequent music aptitude skills in preschool. This study draws from an ongoing longitudinal investigation tracking brain and language development. Initially, structural neuroimaging was successfully acquired with infants (ages 4-18 months) using a natural sleep technique. Automated Fiber Quantification was employed to estimate fractional anisotropy (FA) of key tracts previously implicated in the musical training literature. Infants were then longitudinally enrolled and re-invited for follow-up assessment in preschool. To date, 26 follow-ups (4.5?6 yrs) have completed music aptitude assessment. Longitudinal analyses establish significant relationships between FA in the (i) bilateral corticospinal tract in infancy and subsequent rhythm discrimination skills, and (ii) right corticospinal tract and tonal discrimination skills in preschool. This research provides developmental evidence in early childhood to support the notion that white matter organization prior to the onset of formal training may serve as a scaffold upon which ongoing experience can build.

Topic: PERCEPTION & ACTION: Audition

A104 Bouncing the Network: Modeling Auditory-Vestibular Interactions Underlying Infants' Perception of Musical Rhythm

Parker Tichko[1], Edward Large[2], [1]Northeastern University, [2]University Of Connecticut

From the time of antiquity, music and movement have been theorized to share an intimate linkage. Previous work suggests that, beginning in infancy, auditory-vestibular interactions influence the perception of music structure, such as the perception of accented beats in musical rhythm. In a seminal study, Phillips-Silver & Trainor (2005) found that periodic, maternal bouncing of 7-month-old infants to an unaccented rhythm subsequently influenced infants' listening preferences for accented rhythms that matched the rate of maternal bouncing. Here, we propose a neural-network model of auditory-vestibular interactions thought to underlie infants' listening preferences for accented rhythms. Using two oscillatory neural networks, one network representing the infant auditory system and another representing the infant vestibular-motor system, we simulated the effect of maternal bouncing (e.g., vestibular infants) on infants' listening preferences for duple- and triple-accented rhythms. In our model, the auditory and -vestibular-motor networks were connected with auditory-motor efferent connections, allowing oscillatory activity from the motor layer to propagate down to the auditory layer. After a period of unsupervised learning on either an unaccented musical rhythm, sinusoidal forcing at either a duple or triple rate to model maternal bouncing, or both, we found that the model which received simultaneous auditory-vestibular training, but not the models that received auditory-only or vestibular-only training, 'preferred' its frequency of bouncing, resonating more strongly at frequencies related to the combined auditory-vestibular stimulation. This finding is qualitatively similar to infants' preference for accented rhythms that matched the rate of maternal bouncing to unaccented rhythm (Phillips-Silver & Trainor, 2005).

Topic: PERCEPTION & ACTION: Development & aging

A105 Habituation of Involuntary Imagery as a Function of Stimulus Threat and Frequency

Dennis Lambert[1], Christina Wong[1], Ezequiel Morsella[1], [1]San Francisco State University

Involuntary mental imagery can be elicited in the Reflexive Imagery Task (RIT). In this task, subjects are presented with line drawings of everyday objects (e.g., CLOCK) and instructed to not think of the name of the objects. Involuntary subvocalizations occur on a substantive proportion of the trials. It has been hypothesized that this involuntary imagery is activated in a reflex-like manner. Accordingly, it has been observed that this imagery habituates (i.e., is less likely to arise) after repeated stimulation, as when each stimulus object is presented (4 s) for ten consecutive trials (Bhangal et al., 2016). With a sample of 65 subjects, we replicated Bhangal et al. (2016) and found the same habituation effect, $F (9, 576) = 66.48$, $p < .0001$. We also extended Bhangal et al. (2016) by investigating whether the nature of the habituation varies as a function of word frequency (High Frequency Words [e.g., 'DOOR'] versus Low Frequency Words [e.g., 'KITE']) of the stimulus and the degree to which the stimulus is associated with danger and threat (e.g., SPIDER [Threatening] versus CANDY [Non-Threatening]). For each of the four conditions, there were forty stimuli. Our project is amenable to neuroimaging technologies and provides further evidence that the involuntary cognitions arising in the RIT can be construed as being automatic and reflex-like. This extension of the RIT, with the involvement of threatening stimuli, also has implications for our understanding of cognitive control and psychopathological conditions involving intrusive, undesired cognitions.

Topic: PERCEPTION & ACTION: Motor control

A106 Rhythmic resynchronization ability predicts melodic intonation therapy performance and reading fluency

Yi Wei[1], Edward Large[1], [1]University of Connecticut

Melodic intonation therapy (MIT) has a long history of application for patients with non-fluent aphasia. The fundamental technique involves tapping to the onsets of syllables while speaking/singing. We refer to this as the MIT task. Research has also shown impairment of rhythmic ability in many clinical populations with language related deficits. In this study, we explored the relationship between rhythmic ability, performance on the MIT task, and reading fluency and comprehension in healthy English- and Mandarin-speaking adults. We used a resynchronization task to assess subjects' rhythmic ability by asking subjects to synchronize taps with a metronome that exhibited occasional tempo and phase perturbations. Subjects' resynchronization ability was assessed by phase variability immediately following the perturbation while they were trying to synchronizing taps to every tone in the rhythmic stimuli. We assessed ability to perform the MIT task by asking subjects to synchronize taps to the onset of each syllable they produced while reading sentences as naturally as possible. Performance on the MIT task was measured by the variability with which subjects synchronized taps to syllable onsets. Finally, language skills were measured using reading fluency and comprehension assessments for both native English and Mandarin speakers. We observed that participants' resynchronization ability correlated strongly with performance on the MIT task, and their resynchronization ability also correlated strongly with language fluency scores. Both findings generalized across English and Mandarin speakers. Implications for developing intervention and rehabilitation methods based on rhythmic synchronization training are discussed.

Topic: PERCEPTION & ACTION: Motor control

A107 Sensitivity to empty intervals in multimodal stimulation: A visuotactile study of time perception

Mercedes Villalonga[1], Rachel Sussman[1], Robert Sekuler[1], [1]Brandeis University

Previous work has shown that sequences of visual or auditory pulses can reliably communicate temporal information. To learn whether vibrotactile pulses can do the same, we examined visual (V) and vibrotactile (vT) temporal sensitivity. In the first experiment, human subjects received sequences of V pulses or vT pulses. Subjects judged whether pulse rate was slow (4 Hz) or fast (6 Hz). In one condition, pulses were isochronously spaced; in four non-isochronous conditions, pulse sequences with increasing amounts of temporal-domain noise were also tested. On vT trials, subjects were equally accurate with either 4- or 6-Hz pulses. On V trials, however, subjects performed substantially better with 6-Hz pulses. We hypothesized that this discrepancy arose from vision's comparatively poorer temporal acuity which may have promoted a partially-fused percept at 6 Hz. Reverse correlation revealed a primacy effect: the earliest intervals of each pulse sequence were most influential. Our second experiment directly measured temporal acuity using the same stimuli, as well as a bi-sensory condition. Subjects observed a pair of stimuli from the same modality: a single-pulse stimulus, and a double-pulse stimulus with an empty interval ranging 2-32ms. Subjects judged which of the two intervals contained the double-pulse stimulus. We found that subjects needed longer separation between successive V pulses than between vT or bi-sensory pulses to successfully discriminate single-pulse from double-pulse stimuli. Together, these results suggest that vibrotactile temporal sensitivity can surpass visual temporal sensitivity.

Topic: PERCEPTION & ACTION: Multisensory

A108 Effects of Repeated Tactile Brain-Computer Interface on the Behavioural Responses of Patients with Disorder of Conscious

Fan Cao[1], Nensi Murovec[2], Ren Xu[2], Yangyang Miao[3], Jing Jin[3], Katrin Mayr[1], Christoph Guger[2], [1]g.tec neurotechnology USA, Inc., [2]Guger Technologies OG, [3]East China University of Science and Technology

Persons diagnosed with disorders of consciousness (DOC) typically suffer from motor and cognitive disabilities, which makes accurate diagnosis a very challenging task. Recent research has shown that non-invasive brain-computer interface (BCI) technology could help assess these patients' cognitive functions and command following abilities. In this study, we repeated a vibro-tactile BCI paradigm on 10 DOC patients (5 MCS and 5 UWS) in a chronic stable condition, and attempted to investigate its influence on the level of consciousness measured with Coma Recovery Scale-Revised (CRS-R). Each patient was evaluated with CRS-R before and after the intervention, which consisted of 10 consecutive vibro-tactile BCI sessions within two weeks. Each session took about 1 hour, including 8 runs. EEG signals were recorded from eight channels (FCz, C3, Cz, C4, CP1, CPz, CP2, and Pz). The paradigm consists of 3 vibro-tactile stimulators that were placed on right wrist, left wrist and foot to provide target and non-target stimuli to the patients. The patients were asked to silently count and concentrate on the target vibrations while ignoring the non-target ones. A linear discriminant analysis was used to distinguish EEG features between target and non-target stimuli. A cross-validation resulted in a classification accuracy of 57±34% for the first run, and reached the maximum accuracy of 90±14% at the best run. More importantly, the CRS-R score improved in 7 out of the 10 patients. This study indicates a promising effect of a vibro-tactile BCI on the rehabilitation of DOC patients and it emphasises the importance of repeated measurements.

Topic: PERCEPTION & ACTION: Other

A109 Hierarchical statistical learning: Behavioral, neuroimaging, and neural network modeling investigations

Cybelle Smith[1], Sharon Thompson-Schill[1], Anna Schapiro[1], [1]University of Pennsylvania

How does the brain encode contextual information at different temporal scales? When processing familiar sensory and semantic input, cortex is sensitive to input further into the past along a posterior to anterior gradient (Hasson et al. 2015). To investigate how we learn new hierarchical temporal structure, we designed a novel paradigm employing statistical learning that can be used to map neural contributions to contextual representation at different time scales. Over four behavioral experiments (N=72), we demonstrate that humans are sensitive to transition points among both low- and high-level sequential units during exposure to sequences of abstract images (fractals). However, results may be attributable to low-level learning of image trigrams. Thus, we altered the paradigm to more effectively disentangle learning of nested order information at slow and fast temporal scales. One of eight context cue images is presented multiple times, and embedded in this stream are paired associate images. Critically, pairwise contingencies depend on both the identity of the context cue (fast temporal scale) as well as the time since the previous context shift (slow temporal scale). We have found that multi-layer recurrent neural networks trained to predict the upcoming image in this paradigm encode order information at shorter time scales at lower levels (closer to perceptual input). Planned neuroimaging work will test the idea that brain regions similarly spatially segregate these timescales. In particular, we anticipate that the hippocampus will represent these hierarchical timescales on an anterior-posterior gradient and that prefrontal cortical regions will be engaged along a lateral-medial gradient.

Topic: PERCEPTION & ACTION: Other

A110 Identifying networks with common changes in representational similarity over time using jackknife resampling

Essang Akpan[1], Marc N. Coutanche[1], [1]University of Princeton

The magnitude of similarity between patterns of activity reflects underlying neural information. Representational similarity analysis (RSA) can be used to examine the representational dissimilarity matrix (RDM) of a single region, or to compare RDMs of different regions through a second-order correlation. This regional comparison typically collapses each region's timeseries in order to compare (global) representational dissimilarity spaces, removing any information that might be contained in similarity fluctuations over time. We present a method for identifying regions with common across-trial fluctuations in their representational similarity. We analyze an open functional magnetic resonance imaging (fMRI) dataset collected as participants viewed clips of animals from different animal taxonomies performing different behaviors. We use a jackknife resampling procedure to quantify the influence of removing each trial on the global RDM in the activity patterns of ventral temporal cortex. A searchlight was used to identify regions that show similar changes to their jackknifed timeseries over time, which was then compared to the set of regions that can be associated through a second-order (global) RSA, and through functional connectivity. Jackknife resampling reveals that a subset of regions within the ventral stream showing a correlated global RDM or significant functional connectivity have common RDM fluctuations across time. These regions also overlapped with the second-order RSA and functional connectivity analysis.

Topic: PERCEPTION & ACTION: Vision

A111 Psychometric and electrophysiological characterization of visual processing in 22q11.2 Deletion Syndrome

Catherine Halpern[1], Ana Francisco[1], Chloe Ifrah[1], Mariana Santos Lucas[1], John Foxe[2], Sophie Molholm[1], [1]Albert Einstein College of Medicine, [2]University of Rochester

22q11.2 Deletion Syndrome (22q11.2DS, also known as velocardiofacial or DiGeorge syndrome), the most common chromosomal microdeletion disorder, is characterized by variable developmental delays and cognitive deficits. Though there have been numerous studies on the deletion's neuroanatomical signatures, its impact on brain activity is less well understood. Our aim is to characterize the cognitive phenotype of 22q11.2DS and ally this information with high-density recordings of electrical brain activity (EEG). Here, we quantified visual processing differences in 13 children and adolescents with 22q11.2DS using the Sensory Profile Caregiver Questionnaire (SPCQ) and brain responses from an EEG visual paradigm evoking the early visual components N1 and P2, as compared to neurotypical age-matched controls.. The SPCQ visual sub-scale differed between those with the deletion and those without, with children and adolescents with 22q11.2DS scoring significantly lower when compared to their neurotypical peers. Preliminary EEG analyses of occipital recording sites further indicate larger amplitude N1 in 22q11.2DS, while P2 amplitude was undifferentiated from controls. These data suggest a relationship between the cortical processing of visual sensory information and atypical reactivity to the visual sensory environment in 22q11.2DS. Additional analyses will be directed at testing this relationship while considering moderating variables such as IQ.

Topic: PERCEPTION & ACTION: Vision

A112 Dissociable cortical networks for dynamic and static face processing emerge early in childhood

Frederik Kamps[1], Daniel Dilks[2], [1]MIT, [2]Emory University

By adulthood, face processing depends on a network of cortical regions that respond selectively to faces. A fundamental division of labor in this network has been drawn between regions representing dynamic or changeable aspects of faces, including the posterior superior temporal sulcus (pSTS), and regions representing static or invariant aspects of faces, including the fusiform face area (FFA). How does this division of labor develop? Do dissociable dynamic and static systems emerge slowly, only after many years of

experience? Or are they established relatively early, within the first few years of life? Addressing this question, here we measured responses across the cortical face network in 5 (N=16) and 8 year old (N=16) children. Child participants were scanned using fMRI while viewing dynamic movies and static images of faces, objects, and scenes. Consistent with previous work, both FFA and pSTS responded selectively to faces (relative to objects and scenes) by 5 years old, with similar face selectivity found in 8 year olds. Critically, by age 5 (and continuing at age 8), FFA and pSTS already represented face information differently, with pSTS-but not FFA-responding significantly more to dynamic than static faces. Importantly, pSTS only responded to motion information on faces, not on objects or scenes, indicating pSTS responses are not driven by domain-general motion processing, even in childhood. Taken together, these findings suggest that the division of labor between dynamic and static face processing systems is established early, sometime within the first few years of life.

Topic: PERCEPTION & ACTION: Vision

A113 White matter connectivity in fusiform gyrus is associated with face perceptual deficits in developmental prosopagnosia

Maruti Mishra[1, 2], Emma Brown[2,3], Alice Lee[3], Xian Li[1, 2], Regan Fry[1,2], Joseph Degutis[1,2], [1]Harvard Medical School, [2]VA Boston healthcare, [3]Boston University

Developmental prosopagnosia (DP) is characterized by an impairment in face recognition, which involves an extended network of brain regions. It is unclear whether DPs' impairment is related to local or more global white matter (WM) structural differences. Previous studies with small samples of DPs have reported that impaired face recognition in DPs is associated with low WM integrity in either the fibers local to right fusiform region, or the long-range ventral occipital-temporal tracts. In this study, we collected imaging data in 23 DPs and 23 age-matched controls, along with a comprehensive battery of face perception and face memory tests. Based on DSM-5 criteria, DPs were categorized as having mild/major perceptual deficits,

Topic: PERCEPTION & ACTION: Vision

A114 We Prefer Less Input: Attraction, Goodness-of-Fit, and the Partial Information Effect

Javid Sadr[1], [1]University of Lethbridge

How do perception, memory, and affective response co-operate to produce our apprehension and evaluation of incoming stimuli? One might reasonably expect fundamental aspects of recognition to rest on some internally generated measure of goodness-of-fit, relating incoming stimulation to prior experiences or even innate templates; critically, however, this should not be confused with solely externalized metrics of objective stimulus quality or clarity. Elabourating and specifying a processing-fluency perspective, we not only examine the interaction (or duality) between this perceptual-mnemonic goodness-of-fit and the hedonic experience of subjective preference but also demonstrate an exciting and counter-intuitive effect: greatly diminishing stimulus information profoundly and systematically enhances subjective attraction. Here, in a series of experiments featuring entirely different image-level stimulus manipulations, each progressively diminishing visual input/information, subjects performed the simple, natural task of rank-ordering novel faces by attractiveness. Across all experiments -- parametric contrast reduction, gaussian blur, and partial occlusion -- we find a powerful and very consistent effect of reduced visual input increasing perceived attractiveness. There are no male/female differences in this 'partial information effect' of enhanced subjective attraction to diminished objective stimulation, nor any differences in response in repeated blocks of trials when the stimuli are re-encountered and thus no longer novel. In this crucial clarification of processing fluency and its affective and behavioural correlates, we see that as objective image quality and stimulus information is reduced, a positive hedonic experience seems to arise as a subjective phenomenological index of enhanced perceptual goodness-of-fit for underspecified stimuli.

Topic: PERCEPTION & ACTION: Vision

A115 Typical facial expression recognition without motor simulation

Gilles vannuscorps, Michael Andres[1], Alfonso Caramazza[2], [2]Harvard, [1]Université catholique de Louvain

Perceiving others' movements activates imitative motor plans in the observer. This led to the idea that efficient interpretation of others' movements, such as their facial expressions, requires covert imitation of these movements, a 'motor simulation'. If so, then, individuals born with congenital bilateral facial paralysis, who never developed motor representations that could be mobilized to covertly imitate facial movements, should interpret facial movements less efficiently than typically developed participants. We report the results of five experiments assessing different aspects of facial expression recognition in eleven individuals born with bilateral congenital facial paralysis. Their patterns of performance were indistinguishable from that of typically developed individuals. Thus, efficient action interpretation does not require motor simulation.

Topic: PERCEPTION & ACTION: Vision

A116 Rapid motor responses based on perceived brightness, not on local contrast

Cary Wang[1], Marjan Persuh[1,2], [1]BMCC, [2]CUNY

The perception of brightness is fundamental for human vision. Previous work suggests that rapid motor responses, as opposed to visual perception, are driven by local contrast and not by perceived brightness. We explored this suggestion with White's illusion, in which local contrast and perceived brightness move in opposite directions. Participants made speeded responses to a pair of rectangular target stimuli on a neutral background, which differed in luminance. To determine whether motor responses to targets were influenced by local contrast or perceived brightness, we briefly presented a pair of primes, which preceded and flanked the targets. Primes were gray bars located within an array of alternating black and white bars (White's illusion). When presented on black bars and surrounded by white bars, the gray bars appeared brighter than identical bars presented on white bars, although local contrast pointed in the opposite direction. Our results showed that motor responses to targets were systematically influenced by the perceived brightness of primes and not by the local contrast. We then manipulated the luminance of primes to increase the local contrast. Despite having a stronger contrast in the opposite direction, primes affected responses to targets based on perceived brightness. Our results demonstrate that even during the fast motor responses, which some have suggested depend on unconscious processing, our visual systems rapidly extract perceptual qualities.

Topic: PERCEPTION & ACTION: Vision

A117 WITHDRAWN

A118 Multivariate fMRI evidence of opposite laterality and contra-hemifield bias for words and faces

Zhiheng Zhou[1, 2], Lars Strother[2], [1]University of California Davis, [2]University of Nevada Reno

The degree to which neural mechanisms in ventral occipitotemporal cortex (VOTC) operate differently during the visual processing of highly homogeneous stimulus classes like words and faces is not known. We varied the location of words and faces to examine hemifield-hemisphere effects for each. Univariate fMRI analyses yielded opposite lateralization for centrally-viewed words and faces (left- and right-lateralization, respectively). In contrast, multivariate category-level fMRI decoding was observed in bilateral VOTC and was not limited to category-selective regions for either stimulus type. However, multivariate exemplar-level decoding results revealed a visual word form area (VWFA) and more posterior fusiform area (pFus) in the left hemisphere showed decoding of words; and a fusiform face area (FFA) and the pFus in the right hemisphere showed decoding of faces. Results for words and faces viewed in the periphery were similar to those for centrally viewed stimuli, but only when stimuli were viewed contralateral to the VWFA and FFA, respectively. This is consistent with the involvement of these regions of VOTC in contralateral visual field advantages for words and faces. Interestingly, when word and faces were viewed ipsilateral to the VWFA and FFA, bilateral pFus showed successful decoding of word and face exemplars. We conclude that contralateral bias and opposite lateralization for words and faces in VOTC underlie opposite contralateral hemifield advantages for words and faces, and that object recognition mechanisms in VOTC flexibly engage in visual processing of different stimulus classes depending on their locations in the visual field.

Topic: PERCEPTION & ACTION: Vision

A119 DRD2 polymorphism and sensitivity to losses during value-based decision-making

Cristina Banuelos[1], Kasey Creswell[1], Stephen Manuck[2], Peter Gianaros[2], Timothy Verstynen[1], [1]Carnegie Mellon University, [2]University of Pittsburgh

Different dopamine receptor subtypes respond to phasic dopamine signals differently: D1 receptors increase synaptic efficacy of direct pathways in the basal ganglia to positive feedback errors (i.e., gains) while D2 receptors increase synaptic efficacy of indirect pathways to negative feedback errors (i.e., losses). This means that individual differences in the relative density of D1 or D2 receptors should interact with the magnitude of dopamine signals to determine the efficacy of value-based decision-making. An insertion/deletion variant in the human dopamine receptor D2 (DRD2) gene associates with lower levels of D2 receptor density. Thus DRD2 carriers may be less sensitive to losses during feedback learning. Here we tested if the ventral striatal reactivity to rewards interacted with the presence of the DRD2 (-141C Ins/Del) polymorphism to impact sensitivity to gains and losses. In a sample of neurologically healthy adults (N = 438), ventral striatal (VS) responses to rewards were measured using fMRI, genetic measures of the DRD2 polymorphism were run on all individuals, and cognitive performance was measured through the Iowa Gambling Task (IGT). DRD2 polymorphism carriers had generally lower performance in IGT than non-carriers ($t = 3.230$, $p = 0.001$). There was also an overall positive association between VS reactivity and effective use of rewards in the IGT, however, there was no difference in this effect between DRD2 carriers and controls ($p = 0.295$). This provides inconclusive evidence for the role of D2 pathways in using feedback effectively during value-based decision-making.

Topic: THINKING: Decision making

A120 Neural correlates underlying spatial and social navigational distance processing.

Ya-Ting Chang[1], Yi-Chuang Lin[1], Charlotte Maschke[2], Joshua Oon Soo Goh[1], [1]National Taiwan University, [2]Technical University Dresden

This study evaluated neural processing of spatial and social distances between physical landmarks and social agents in the same environment. 18 young adults (24.3±2.95 yrs old, 8 female) underwent a spatial navigation functional magnetic resonance imaging (fMRI) experiment, in which participants first navigated a virtual maze to learn locations of 12 landmarks. Participants then were placed at various test locations and judged distances and navigated to target landmarks. Participants also performed a similar social experiment except they learned, retrieved social association distances, and interacted with a network of 12 agents within the same maze. Agents interacted only if participants previously interacted with associated agents. Errors and time spent increased with distance for both judgement types. During both judgments, neural responses increased with target distance in precuneus and retro-splenial cortex, with no interactions. Spatial responses were higher than social in visual, postcentral, and precentral areas, but higher for social than spatial in angular, precuneus, anterior temporal, medial prefrontal, and left superior frontal areas. During navigation, responses increased with both distance types across visual, precuneus, inferior parietal, superior temporal, insula, superior frontal, supplementary motor areas, and thalamus. Spatial responses were higher than social in right superior parietal and inferior frontal areas, but higher for social than spatial across precuneus, bilateral angular, anterior temporal, anterior medial frontal, and left orbitofrontal areas. Differential responses to increasing spatial and social distances were seen in dorsomedial prefrontal and insula areas. Our findings delineate how cognitive operations about spatial and social associations might overlap in the brain.

Topic: THINKING: Decision making

A121 Electrophysiological indices of lowering standards

Neil M. Dundon[1], Viktoriya Babenko[1], Alex Stuber[1], Tom Bullock[1], Mary MacLean[1], Javier Garcia[2], Scott T. Grafton[1], [1]University of California, Santa Barbara, [2]US Combat Capabilities Development Command

Survival requires altering behavior to suit changes in the environment. Value based decision-making is accordingly governed by dynamic processes that integrate the reward and cost of choices through normalization filters that account for additional external influences including recent decisions. We recorded continuous electroencephalography (EEG) while 33 subjects performed an approach-avoid task, where varying degrees of monetary reward were paired with varying degrees of electric shock in a take-it-or-leave-it offer format. Trialwise, visual cues of reward and shock were tagged with separate flicker frequencies, allowing us to separately index their relative influence on each trial. Behavioral analyses clearly indicated that choices were influenced by prior subjective value in a manner consistent with microstate contextual updating, i.e., a low value offer increased acceptance on the subsequent trial, and vice versa. Time-frequency EEG analyses suggest that this decision bias is characterized by a specific facilitation of steady state visually evoked potentials coupled with reward following a prior trial with a low value offer. No such facilitation was observed in steady state signals coupled with cost. In addition, no facilitation was observed in endogenous processes indexed by alpha activity over occipital sites, nor beta activity over motor sites. We accordingly reveal that evaluation of current reward offer is conditioned by prior subjective value, mediated by possibly implicit orientation processes.

Topic: THINKING: Decision making

A122 The Nuances of Norepinephrine: Salivary Alpha-Amylase's Role as a Biomarker in tDCS-Directed Judgment & Decision Making

Lauren M. Kim[1], Michael J. Lundie[1], Matthew J. Kmiecik[1], Harshith Dasara[1], Daniel C. Krawczyk[1], [1]The University of Texas at Dallas

The locus coeruleus-norepinephrine system (LC-NE) ? a primary distribution point of norepinephrine in the brain ? modulates allocation of attention used in executive functioning and reasoning through connection tracts to the prefrontal cortex (PFC); however, the changes of norepinephrine related to decision-making when affected by transcranial direct current stimulation (tDCS) are not fully understood. This obstacle is largely due to traditionally used between-subjects experimental designs that are limited in their ability to study the changes in norepinephrine across both individuals and time. For this reason, samples of salivary alpha-amylase (sAA) ? a correlated biomarker of norepinephrine production ? were collected within-subjects, therefore controlling for individual circadian variations of sAA. Samples consisted of one baseline measure (Collection 1) followed by three post-tDCS stimulation collections (Collection 2, 3, & 4) using equivalent time intervals. Participants' sAA collections were repeated across three weekly visits of varying tDCS stimulation conditions: left dorsolateral prefrontal cortex (DLPFC), right DLPFC, and sham. Following each stimulation condition, participants completed a series of cognitive tasks measuring decision-making and judgement-related behavior. Stimulation condition interacted with time of salivary collection such that tDCS stimulation to the left DLPFC and sham conditions led to significant increases in sAA levels across collections. Both the sham and left DLPFC stimulation conditions demonstrated a significant sAA increase in Collection 1 to 4. Conversely, sAA levels did not increase following stimulation of the right DLPFC. Together, stimulating lateral PFC sites may differentially modulate norepinephrine release across time when controlling for individual subject variability.

Topic: THINKING: Decision making

A123 ERP measures of conflict monitoring and inhibition during a Go/NoGo task are related to response speed

David Shucard[1,2], Xuedi Wang[1,2,3],Thomas Covey[1,2,3], Matthew Evans[1,2,3], Janet Shucard[1,2,3], [1]University at Buffalo, [2]Jacobs Sch Med & Biomed Scic, [3]SUNY

Cognitive control refers to brain processes that monitor conflicting response options, inhibit inappropriate responses, and select correct responses. The ability to inhibit responses that interfere with performance is essential for efficient cognitive functioning. In the present investigation, we examine the relationship between Go/NoGo task performance (Reaction Time, RT and Standard Deviation of RT, SDRT) and event-related brain potentials (ERPs) derived from dense electroencephalographic recording obtained during the task. Participants were required to make a motor response to the target or 'Go' stimuli and withhold their response to 'NoGo' stimuli. N2 and P3 ERP components from midline electrode clusters were examined to determine the relationship between Go RT/SDRT and ERP amplitude and latency measures for Go and NoGo. For the Go Condition, significant negative correlations were present between central- parietal P3 amplitudes and RT and SDRT, indicating that greater Go P3 amplitude at these sites was related to faster RT and less RT variability. Findings for Go N2 amplitude and latency were not significant. For the NoGo Condition, frontal-central P3 amplitudes were negatively correlated with Go RT, and N2 latency was positively correlated with Go RT. Thus, at frontal-central sites, greater NoGo P3 amplitude was related to faster RTs, and delayed NoGo N2 latency was related to slower RTs. Source analysis contrasting P3 Go and NoGo conditions yielded a significant difference between the two conditions at the anterior cingulate gurus. These findings support a relationship between biological markers of cognitive control and speed of responding correctly during response selection.

Topic: THINKING: Decision making

A124 Creative idea generation is promoted by an optimal level of thought constraint

Anna Smith[1], Nick Brosowsky[1], Paul Seli[1], [1]Duke University

Despite the fact that some of the world's most innovative thinkers have attributed their creative insights to undirected thinking, there has been a relative dearth of research examining a possible link between such thinking and creative problem-solving. Here, we examined the possibility that one mental process that may support spontaneous creative insights is the recently proposed Freely-Moving Thought (FMT) dimension of mind-wandering, which characterizes thoughts that are unconstrained by executive control. We probed participants on the task-relatedness of their thoughts, the intentionality of their mind-wandering, and the extent to which their thoughts moved freely during a 2-back task. We found that participants who reported higher levels of FMT tended to score higher on a subsequent test of divergent thinking ($r = .24$, $p < .05$), the Alternate Uses Task (AUT). However, in addition to observing a significant linear relationship, we found that the data are best described by a quadratic function, such that participants who engaged in an 'optimal' amount of FMT tended to produce more creative AUT responses ($r2 = 0.084$, $p < 0.05$). This finding is consistent with the current understanding among creativity researchers that insight arises from a give-and-take between unconstrained thought and more directed focus.

Topic: THINKING: Other

A125 Reduced certainty preference after solving problems with insight than solving with analysis

Yuhua Yu[1], Carola Salvi[2], Mark Beeman[1], [1]Northwestern University, [2]University of Texas at Austin

An 'Aha' experience when finding an insightful solution is often associated with a feeling of suddenness, pleasure and certainty. How does such an experience affect subsequent decision making and, in particular, risk preference? This is a rarely explored but important question because, in real life, solving a problem is often followed by courses of actions (such as implementing or advocating the solution), which involve risk/reward evaluation. In this study, online participants recruited from Amazon Mechanic Turk were asked to solve verbal Compound Remote Associate puzzles, report whether they solved with insight or analysis, and then make a risk choice: accept a fixed bonus (on average, $0.25) or a bonus drawn randomly from a low and a high amount (e.g., $0.05 vs $0.55) with equal odds. The bonus amounts were individualized to each participant's choice point, through a trial run of baseline choices prior to the problem solving task. As predicted, participants were more likely to make a risky choice (reduced certainty preference) after they solved problems with insight than after solving with analysis. Therefore, the manner in which people solve problems fosters a shift of risk preference from baseline. Further, this shift appears to be mediated by personality traits. Lastly, the current study validates the self-report of solution process with online subjects, with behavioral results consistent with those from lab settings.

Topic: THINKING: Problem solving

A126 A large scale internet-based study on the reasoning abilities of the general population

Maria Balaet[1], Adam Hampshire[1], [1]Imperial College London

Reasoning is a fundamental human cognitive ability required in most day-to-day activities. It is the capacity to consciously make inferences based on available information. We conducted a large-scale internet-based study, advertised via British public television, to acquire a normative dataset that would inform us of the reasoning abilities of the general population. Participants completed a battery of eight tasks which took no longer than 30 minutes to complete. The tasks tapped into different aspects of reasoning, such as planning (Tower of London, Slider), spatial visualisation (Blocks), spatial rotation (2D manipulations), verbal abilities (Verbal Analogies and Verbal Reasoning) and pattern recognition (Feature Matching and Odd One Out). The battery was completed by 3661 people (2554 females) aged between 16 and 90 (41,27 ± 14.97,mean ± SD). Having such a large dataset allows us to reliably sample the general population and look at age and gender effects on task performance in a way that has not been done before. We found no age or gender effects on any of the tasks, with one exception. On the Tower of London task, a planning task, there was both an age effect, with scores decreasing with age, and a gender effect, favouring males. Overall, these results suggest that reasoning ability is evenly spread throughout the population.

Topic: THINKING: Reasoning

A127 An fMRI investigation of functional network connectivity during abstract reasoning

Thomas Morin[1], Kylie Moore[1], Chantal Stern[1], [1]Boston University

The goal of this study was to investigate the functional connectivity of cortical brain networks that support abstract reasoning behavior. We developed a simplified, one-dimensional version of the Raven's Progressive Matrices task which required participants to complete sequences composed of either discrete symbols or a continuous visual pattern (N = 27). Earlier work from our lab has demonstrated that this task elicits activity in the dorsal attention and frontoparietal control networks. Following fMRI preprocessing (FMRIPREP; Esteban et al., 2018), beta series correlation analysis methods (Rissman et al., 2004) were implemented using NiBetaSeries (Kent & Herholz, 2019) and were used to compare task-evoked functional connectivity between cortical networks during discrete and continuous sequence completion. Seed-regions were defined from the Schaefer-400 parcellation, which divides cortex into 400 regions and assigns each region to one of the Yeo-7 resting state cortical networks (Schaefer, 2018). Our results identified changes in functional connectivity associated with reasoning about discrete and continuous sequences. Changes in connectivity were most prevalent in cortical parcels assigned to the Yeo-7 visual, dorsal attention, cognitive control, and default networks. Preliminary analyses suggest that connectivity in these networks was highest for the discrete sequence condition, consistent with the idea that abstract reasoning is dependent on integration of information across multiple cortical networks.

Topic: THINKING: Reasoning

A128 Subdivisions of the Anterior Cingulate Cortex related to the Intuitive Psychology and Intuitive Physics Dichotomy

Ana Navarro-Cebrian[1], Jason Fischer[1], [1]Johns Hopkins University

Previous findings suggest that intuitive physics (understanding and predicting the physical dynamics of our everyday environments) and intuitive psychology (understanding and predicting others' thoughts and behaviors) are in a push-pull relationship in the brain – intuitive physics tasks deactivate brain regions involved in intuitive psychology and vice-versa. What brain structures mediate the interaction between intuitive physics and intuitive psychology? Here, we investigated the Anterior Cingulate Cortex (ACC) as a possible locus of these mutually inhibitory interactions. The ACC plays a critical role in regulating motivation, and previous work has identified a ventral "emotional" subdivision associated with social processes and a dorsal "cognitive" subdivision implicated in attentional control and response selection. We hypothesized that these two subdivisions of the ACC are differentially connected to the cortical regions recruited for intuitive psychology and intuitive physics, respectively, and the ACC may act as a "switch" between these cognitive domains. Our analysis of resting-state functional connectivity data from 29 individuals confirmed these predictions: while resting-state activity in the dorsal ACC was significantly more correlated with activity in premotor cortex (intuitive physics) than with the posterior cingulate cortex (PCC; intuitive psychology; $p<0.0001$), activity in the ventral ACC showed the reverse pattern of significantly stronger correlations with the PCC than premotor cortex ($p<0.0001$). These results indicate that different subdivisions of the ACC are preferentially connected to the brain networks recruited for intuitive physics and intuitive psychology and suggest that a push-pull relationship between these cognitive domains could be driven by motivational factors regulated in the ACC.

Topic Area: need topic

Session B

Sunday, March 15, 8:00–10:00 am, Exhibit Hall C

B1 Auditory Cortex Tracks Masked Acoustic Onsets in Background Speech: A Potential Stream Segregation Mechanism

Christian Brodbeck[1], Alex Jiao[1], L. Elliot Hong[1], Jonathan Z. Simon[1], [1]University of Maryland, College Park

Humans are remarkably skilled at listening to one speaker out of an acoustic mixture of multiple speech sources, even in the absence of binaural cues. Previous research on the neural representations underlying this ability suggests that the auditory cortex primarily represents the acoustic mixture in early responses, and selectively processes features of the attended speech at longer latencies (from ~85 ms). It is not known, however, exactly how the attended source signal is segregated from the mixture, including whether ignored sources are also segregated from the mixture. We show, in human magnetoencephalographic responses to a two-talker mixture, a neural representation of acoustic onsets in the ignored speech source, over and above onsets of the mixture and the attended source. This suggest that the auditory cortex initially reconstructs acoustic onsets that might belong to any speech source, critically, even when those onsets are acoustically masked by another source. Responses from auditory cortex tracked onsets in the unseparated acoustic mixture with a lower latency (~70 ms) than masked onsets in the sources (~90 ms), suggesting a neural processing cost to the recovery of the masked onsets. Because acoustic onsets precede sustained source-specific information in the acoustic spectrogram, these representations of onsets likely serve as cues for subsequent processing stages, at which features of the attended source are analyzed more selectively. Furthermore, these findings suggest that even bottom-up saliency of objects in the auditory background may rely on active cortical processing, and could explain many of the behavioral effects of background speech.

Topic Area: ATTENTION: Auditory

B2 Decoding attention control and selection in young and older adults

Xiangfei Hong[1], Jiaqi Wang[2], Jianan Wang[2], Junfeng Sun[2], Jijun Wang[1], Chunbo Li[1], Mingzhou Ding[3], Shanbao Tong[2], [1]Shanghai Mental Health Center, [2]Shanghai Jiao Tong University, [3]University of Florida

Here we examined how normal aging impacted attention control and selection by decoding EEG from healthy young and older adults during two cued visual spatial attention tasks (instructional-cueing: 30 young vs. 20 older; probabilistic-cueing: 26 young vs. 31 older). Following cue onset, the decoding accuracy began to rise above chance level later ($p < 0.001$) and remained marginally lower ($p = 0.091$) in older adults than in young adults for instructional-cueing. For probabilistic-cueing, the decoding accuracy began to rise above chance level earlier ($p < 0.001$) while remained at similar levels in older adults than in young adults. Across the two experiments, the cue-related decoding accuracy predicted the magnitude of attentional modulation of target-evoked N1 amplitude for young adults, but not for older adults. Following target onset, the decoding accuracy began to rise above chance level later ($p < 0.001$) and remained at similar levels in older adults than in young adults for instructional-cueing. For probabilistic-cueing, the decoding accuracy began to rise above chance level earlier ($p < 0.001$) and remained at similar levels in older adults than in young adults. The target-related decoding accuracy was positively associated with behavioral performance in both groups. These results suggest that normal aging impacts the neural processes underlying both attention control and selection. In particular, young adults were faster in the formation of attention set and target selection under more definitive task instructions (instructional-cueing), while older adults might have chosen to focus attention more unilaterally and efficiently under less definitive task instructions (probabilistic-cueing).

Topic Area: ATTENTION: Development & aging

B3 Crossmodal modulation of the intracortical depth profile of BOLD signals in auditory cortex

Kaisu Lankinen[1, 2], Seppo P. Ahlfors[1,2], Fahimeh Mamashli[1,2], Anna Blazejewska[1, 2], Tommi Raij[3,4], Jyrki Ahveninen[1,2], [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Shirley Ryan AbilityLab, [4]Northwestern University

Previous electrophysiological studies in non-human primates have shown different laminar activation profiles to auditory vs. crossmodal visual stimuli in auditory cortices and adjacent association areas. Using 1-mm isotropic resolution 3D echo-planar imaging at 7T, we studied the intracortical depth profiles of fMRI blood-oxygen level dependent (BOLD) signals to unimodal or multisensory stimuli in 11 healthy subjects. Subjects were presented with 5-stimulus trains of 300-ms auditory noise bursts (A), visual static checkerboard patterns (V), and audiovisual (AV) combinations of these two. In a simple oddball task, subjects were asked to detect occasional target stimuli (pure tone and/or diamond shape). The fMRI data were resampled into a family of 11 equally spaced surfaces within the gray matter. Intracortical depth-profiles of percentage-signal-changes of the BOLD signal were determined in five anatomically defined regions of interest (ROIs) in auditory (Heschl's gyrus, HG; Heschl's sulcus, HS; planum temporale, PT; superior temporal gyrus, STG) and polymodal (superior temporal sulcus, STS) cortices. The biases caused by the draining vein effect, increasing the BOLD sensitivity towards the superficial layers, were accounted for by using a variety of normalization techniques. Our linear mixed-effect model of the contrast AV-A suggested that combining auditory stimuli with visual inputs increased the BOLD signal more in the superficial than deeper 'layers' in PT and STS ($p < 0.05$). The cortical depth profile of the BOLD signal may be modulated differentially for unisensory and multisensory stimuli in posterior non-primary auditory cortices and adjacent polymodal areas. Supported by: R01DC017991, R01DC016765, R01DC016915, R01MH111419.

Topic Area: ATTENTION: Multisensory

B4 Testing a cellular metabolism account of attention and capacity limits in perception

Merit Bruckmaier[1], Ilias Tachtsidis[1], Phong Phan[1], Nilli Lavie[1], [1]University College London

We present work testing a neurobiological account attributing perceptual capacity limits directly to limits on cerebral cellular metabolism. Following widely cited work (Clarke and Sokoloff, 1999), we hypothesised that mental task demand does not affect the overall levels of cerebral energy supply and therefore total levels of neural metabolism. Thus, an attention mechanism is required to flexibly regulate cellular metabolism levels according to the demands on neural computation: When perceptual load in a task is increased, this should be met with increased metabolism underlying attended processing, which, importantly, needs to be balanced by reduced metabolism related to unattended processing. We tested this prediction using broadband near-infrared spectroscopy to measure the oxidation state of the mitochondrial enzyme cytochrome c oxidase (oxCCO), an intracellular marker of oxidative metabolism levels. oxCCO levels were recorded from visual cortex while participants performed a rapid sequential visual search task under either low perceptual load (feature pop-out search) or high perceptual load (complex feature-conjunction search). A peripheral, flickering checkerboard which participants were instructed to ignore was presented on a random half of trials. Visual cortex regions responsive to the attended stimuli showed increased oxCCO levels in high compared to low perceptual load, while oxCCO levels related to unattended processing were reduced. Moreover, a negative temporal correlation of attended and unattended load effects provided additional support for the metabolism trade-off account. These results establish that attentional regulation of cellular metabolism levels in line with task demands is an important factor to consider when explaining capacity limits in perception.

Topic Area: ATTENTION: Nonspatial

B5 Failing to Integrate Feature Representations During Visual Search

Junha Chang[1], Kyle Cave[1], Lisa Sanders[1], [1]University of Massachusetts Amherst

In difficult visual searches, a mental representation of the target guides attention. Observers can flexibly modify this target representation to meet task demands, and search performance can improve with more precise target information. We investigated whether observers create a single integrated target representation when searching for the conjunction of two separately presented target features. In the split-cue condition, participants searched for a color-orientation conjunction target after seeing a simultaneous color cue and an orientation cue. In the integrated-cue condition, color and orientation were shown together as features of the same cue. Conditions were blocked, with order balanced across participants. If participants formed a single integrated target representation from the separately presented features, search performance would improve. To test for evidence of feature integration, we measured Contralateral Delay Activity (CDA) during the interval between presentation of the cue and presentation of the search array. CDA, defined as the difference in amplitude over parietal-occipital regions contralateral compared to ipsilateral to the cue display, reflects the number of items in Visual Working Memory. The split-cue condition resulted in slower response times and larger CDA amplitude compared to the integrated-cue condition.

Participants did not integrate the features and instead held two separate representations. These results have implications for how untrained observers typically search, as well as for training that could improve search under real-world conditions.

Topic Area: ATTENTION: Other

B6 Difference of attention to the physical attractiveness of the opposite and same sex

Kohei Fuseda[1], Jun'ichi Katayama[1], [1]Kwansei Gakuin University

Previous studies reported that physical attractiveness captures the observer's attention when photographs of the opposite sex were presented as task-irrelevant information. However, it is unclear whether physical attractiveness of the same sex elicit the same effect. The present study investigated this point with an oddball paradigm, using an event-related brain potential (ERP) as index of attentional capture. Heterosexual 32 persons (16 males) participated. In the opposite sex condition, photographs of attractive and unattractive individuals of the opposite sex were presented as a nontarget with the same frequency (44% each). In the same sex condition, the same procedure was carried out with stimuli of the same sex. In both conditions, photographs of house were presented at low (12%) frequency as a target to which the participants were asked to press a button. P3 amplitude in response to attractive individuals was larger than that to unattractive ones after 200 -400 ms from stimulus onset only in the opposite sex condition. This result indicates that the physical attractiveness of the opposite sex captures attention even if it is unrelated to the current task. In addition, LPP amplitude in response to attractive individuals was larger than that to unattractive ones after 400 - 600 ms from stimulus onset only regardless of opposite and same condition. This result indicates that sustained attention is occur to the attractive person.

Topic Area: ATTENTION: Other

B7 Task-induced attention gates unconscious semantic interference, via load

Shao-Min Hung[1], Daw-An Wu[1], Shinsuke Shimojo[1], [1]California Institute of Technology

In general, a stimulus that summons more attention is better processed, leading to better behavioral performance and stronger brain activity. However, whether such attentional modulation extends to unconscious stimuli remains largely unknown, especially when it comes to high-level unconscious information. To address this issue, we developed a double Stroop paradigm. In each trial, a prime colored word was interocularly suppressed. Subsequently, a target colored word was presented, and participants were instructed to name the word or its color. Prime invisibility was confirmed both by immediate subjective report and retrospective objective chance localization. In the word-naming experiment, both prime-target color and word incongruency between the invisible prime and visible target slowed down target responses. In the color-naming experiment, the incongruency effects disappeared. To examine whether this was due to the task load induced by color-naming (Stroop effect), we split the data into early and late trials. The prime-target word incongruency was found to slow down target responses only in the late trials when participants exhibited a practice effect. The asymmetry of unconscious interference suggested that the incongruency effects were gated by task load and only emerged when the load was low (word-naming) or decreased (color-naming, after practice). These results were later replicated with colorless words (word-only), colored symbols (color-only), and orthographically dissimilar words (semantics only). Our findings show that task load plays a key role in gating high-level unconscious semantic information, indicating the capacity to extract unconscious information can be modulated by a concurrent task.

Topic Area: ATTENTION: Other

B8 The influence of baseline attentional differences on tDCS-mediated learning

Benjamin Gibson[1], Teagan Mullins[1], Jacob Spinks[1], Denica Aragon[1], Leslie Bauchman[1], Melissa Heinrich[1], Vince Clark[1], [1]University of New Mexico

Transcranial direct current stimulation (tDCS) over the right ventrolateral prefrontal cortex (rVLPFC) has been used to influence a number of cognitive functions, including attention. Across tDCS studies, a number of factors have been shown to moderate the effect of tDCS, and research is still trying to parse how these factors interact with stimulation to sometimes produce contrasting results across subjects. The goal of the current study was to explore the interaction between baseline individual differences, as measured by tasks associated with the rVLPFC, and the application of anodal and cathodal tDCS. Using discovery learning, participants were trained to classify pictures of European streets into two categories while receiving 30 minutes of 2.0 mA anodal, cathodal, or sham tDCS over the rVLPFC. The pictures were classifiable according to two separate and arbitrary rules. Subjects were grouped according to the rule they used to classify the pictures, with all subjects only learning 1 of the 2 rules. A multinomial logistic regression was fit to predict rule learning using baseline measures. The overall model showed a classification accuracy of 75.9% in predicting rule learning. Of the baseline measures, tests of visual orienting, convergent creativity, and state anxiety were significant predictors of rule learning. These results indicate that individual differences at baseline can influence attention and subsequently affect tDCS mediated learning.

Topic Area: ATTENTION: Spatial

B9 Spontaneous eye-movements reduce resting-state-network modularity by increasing visual-sensorimotor connectivity

Uri Hasson[1], Cemal Koba[2], Giuseppe Notaro[1], [1]University of Trento, [2]IMT School for Advanced Studies Lucca

It has been shown that functional MRI signal from the eye-orbit area relates to eye movement (Beauchamp, 2003). Here we determined whether these time series contain information that can associate spontaneous eye movements with resting state activity and connectivity. We extracted the EPI Eye-Movement (EEM) time series from the eye orbits. An initial evaluation against simultaneously acquired eye-tracking data showed significant correlations between EEM and both blinks and gaze-velocity. We created whole-brain correlation maps using EEM as a seed time series. We found correlations in a visual/sensorimotor system including pre- and post-central gyri bilaterally, parts of the superior temporal gyrus and visual cortex, as well as in the thalamus and left inferior parietal lobule. This was found when the EEM time series was convolved with an HRF basis function, and to a lesser extent also without convolution. To determine the impact of spontaneous eye movements on network-level configuration, we quantified the difference between resting-state functional connectivity networks derived using a typical preprocessing workflow and those derived using a workflow where EEM data were regressed from the data (500-region networks; Schaefer et al. 2018). EEM-removal decreased connectivity in the aforementioned visual/sensorimotor regions. EM-removal also strongly increased network modularity while concomitantly reducing clustering coefficient, efficiency, mean node degree and other related network metrics. The findings show that spontaneous eye movements captured by EEM time series strongly determine features of 'resting' activity.

Topic Area: ATTENTION: Spatial

B10 Inter-subject correlation of eye movements predicts test scores in online video education

Jens Madsen[1], Sara U. Júlio[1], Pawel J. Gucik[1], Richard Steinberg[1], Lucas C. Parra[1], [1]City College of New York

Online educational materials are largely disseminated through videos, and yet little is known about how effective the video material is at captivating the audience and in the end disseminating the material. Even less is known about how to measure how attentive students are while watching educational videos and in the end how much they learn from the video. We hypothesize that attentive students follow educational videos similarly with their eyes. We find that inter-subject correlation of eye movements is substantially higher when students watch videos attentively compared to when they are distracted.Given the link between attention and memory we also predict that similarity of eye movements with a group of students is predictive of subsequent performance in a test regarding the educational material.We show that inter-subject correlation of eye movements is predictive of individual test scores for recall and comprehension questions alike. These findings replicate using videos produced for online education in a variety of styles and learning contexts. These results suggest that eye movements can be used as a marker of attentional mechanisms necessary to retain information. In the future, eye movements may be used as a tool to design and assess online educational content as well as track student attention in real time.

Topic Area: ATTENTION: Spatial

B11 Age-related deficits in alpha-band modulation during probabilistic cueing of visual spatial attention

Jiaqi Wang[1], Jianan Wang[1], Junfeng Sun[1], Shanbao Tong[1], Xiangfei Hong[2], [1]Shanghai Jiao Tong University, [2]Shanghai Mental Health Center

Although the modulation of alpha-band (8-13 Hz) activity has been established as a canonical marker of visual spatial attention, it still remains elusive to what extent such alpha-band modulation is impacted during normal aging. In the current study, we recorded scalp EEG from healthy young (N = 24) and older (N = 30) adults while performing a classical Posner spatial attention task with probabilistic cueing (~74% valid). Both young and older adults showed significant attentional cueing effects, suggesting successful orienting of visual attention. However, the classical cue-related alpha modulation, especially the alpha lateralization that was robustly observed in young adults, declined significantly in older adults. Specifically, after a transient alpha power decrease within 400 ms following cue onset in both age groups, only young adults showed sustained suppression of alpha power over posterior cortices contralateral to the attended hemifield, leading to significant alpha lateralization. By contrast, in the same time interval, older adults showed a rapid increase of alpha power over both ipsilateral and contralateral posterior cortices, resulting in the absence of alpha lateralization. Furthermore, compared with young adults, the attentional modulation of target-evoked N1 amplitudes was significantly reduced for older adults. Taken together, our results suggest the age-related deficits in both suppressing alpha power over visual cortices during anticipatory attention and enhancing the sensory processing during target selection. However, the comparable behavioral performance between young and older adults indicates that such age-related deficits might be compensated by other neural substrates of visual spatial attention in older adults.

Topic Area: ATTENTION: Spatial

B12 The neurodevelopmental basis of humor appreciation: a functional near infrared spectroscopy study with young children

Naama Mayseless[1], Allan Reiss[1], [1]Stanford University School of Medicine

Humor is crucial for social development. Humorous encounters encourage playfulness, and are important for development of joint attention and understanding of other's emotional attitudes and expectations. The main aim of the current study was to characterize the neural basis of humor in young children. While there are many studies conducted among adults, there are only a few with children. In the current study, 35 healthy children (6-8 years old) watched funny and neutral video clips while undergoing functional near infrared spectroscopy (fNIRS) imaging. We examined activation patterns in response to humorous content as well as functional connectivity. We observed activation increases in left temporo-occipito-parietal junction (TOPJ), inferior-parietal lobe (IPL), dorsolateral-prefrontal cortex (DLPFC) and right inferior frontal gyrus (IFG) and superior parietal lobe (SPL) regions. Activation in left TOPJ was positively correlated with age while activation in right IFG and SPL was negatively correlated with IQ levels. In addition to activation patterns, we conducted a coherence analysis to examine functional connectivity related to humor appreciation. We found that coherence in bilateral frontal-parietal network increased in humor viewing compared to neutral content. This effect was different for boys and girls in the right frontal-parietal network. While boys exhibited stronger coherence between frontal and parietal regions for the humor condition, girls did not show a difference between conditions. These results expand our understanding of the neurodevelopment of humor by highlighting the effect of age on the neural basis of humor appreciation as well as emphasizing different developmental trajectories of boys and girls.

Topic: EMOTION & SOCIAL: Development & aging

B13 Receptive Music Intervention in Older Adults: A Multimodal Longitudinal Study

Psyche Loui[1], Grace Wilson[2], Valerie Goutama[1], Maiya Geddes[3], Suzanne Hanser[4], Manoj Bhasin[5], [1]Northeastern University, [2]Simmons College, [3]Harvard Medical School, [4]Berkeley College of Music, [5]Emory University

Music therapy research has established the significant influence of music-based interventions on mood and management of stress. Several randomized controlled trials have shown benefits of listening to familiar music on cognition, mood, perceived stress, and quality of life in people with mild cognitive impairment (MCI) and Alzheimer's disease (AD), but this evidence is not yet well established, due to small sample sizes and large inter-subject variability. This underscores the need for a unified mechanistic understanding of music-based interventions. We hypothesize that listening to familiar, self-selected music may increase activity in the reward system. Here we report effects of a music listening intervention. Older adults with and without MCI participated in a similar 8-week music intervention, facilitated by a board-certified music therapist. The intervention consisted of focused, daily listening to playlists of preferred music for relaxation and enjoyment for one hour each day, accompanied by weekly processing over the phone with the therapist. We collected neuropsychological measures and fMRI before and after the eight weeks. Preliminary neuropsychological results showed decreased stress and loneliness, increased pleasure, and increased musical sophistication after the intervention. When listening to self-selected music, compared to unselected music, fMRI responses showed activity in the auditory-motor network (STG, STS, SMA) and a reward region (VMPFC). After the 8-week listening intervention, the same contrast showed increased VMPFC and decreased SMA activity (p

Topic Area: EMOTION & SOCIAL: Development & aging

B14 Disruption to the Uncinate Fasciculus among young children with ADHD: The role of co-morbid Callous-Unemotional Traits

Paulo Graziano[1], Dea Garic[1], Megan Hare[1], Anthony Dick[1], [1]Florida International University

Callous-unemotional traits (CU), which refer to low levels of guilt, empathy, and caring for others, are critical markers of a subgroup of children with the most pervasive, severe, and aggressive patterns of conduct problems (CP).? Adolescent and adult neuroimaging studies suggest that disruption in the amygdala and prefrontal regions and their connections are key to the development of CP (Blair, 2007).??One major fiber tract implicated in the development of CP is the uncinate fasciculus (UF) which connects amygdala to orbitofrontal cortex (OFC). Waller et al., 2017 found evidence for disrupted white matter microstructure in the UF across different populations with high levels of CP (e.g., incarcerated adults). Within an adolescent population, Breeden et al., 2015 found that the link between CP and reduced integrity in UF was?driven by CU traits. The current study examined the white matter microstructure in the UF within?198?young?children (69% male, Mage??=?5.7 yrs) with (n?= 102) and without (n?= 96)?a diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD).??Results indicated that ADHD symptoms, CP, and CU traits all independently related to reduced integrity in UF (p?

Topic Area: LONG-TERM MEMORY: Episodic

B15 The neural outcomes of emotional regulation following Mindfulness Based Stress Reduction training

Hsuan Chi Liu[1], Jin Mei Hu[2], Chuan Yueh Hsu[2], Zenas C. Chao[3], Joshua Oon Soo Goh[1], Chien Te Wu[1], [1]National Taiwan University, [2]Chinese MBSR Service, [3]The University of Tokyo

Mindfulness and cognitive reappraisal are two common but rather different strategies to downregulate emotional and stress-related responses. While cognitive reappraisal help downregulate emotion through reinterpreting the context, mindfulness does so through focusing on the awareness and acceptance of emotions. In the present study, we evaluated how a mindfulness training program might differently change the neural processes associated with these two different emotion regulation strategies. We recorded EEGs of fifteen novice participants aged from 28 to 55 (13 females and 2 males) while they were performing an emotional regulation task on positive/negative emotional pictures from the International Affective Picture System (IAPS) before and after an 8-week Mindfulness-Based Stress Reduction (MBSR) training program. During the task, participants were instructed to experience the emotional pictures using either a mindfulness or cognitive reappraisal strategy. Passive viewing of emotional pictures and scramble-pixelated pictures were included as control conditions. Analysis of event-related potentials (ERP) revealed that the late positive potential (LPP) (0.5~1s) averaged at CP1, CPZ, CP2 showed significant interaction between Strategy and Time (i.e., pre- vs. post-training) (F=14.02, p

Topic Area: EMOTION & SOCIAL: Emotional responding

B16 Assessing the relationship between alpha power and hemodynamic activation during emotional mental imagery

Maeve Boylan[1], W. Matthew Friedl[1], Harold Rocha[1], Andreas Keil[1], [1]University of Florida

Mental imagery is a critical factor in the etiology and maintenance of many psychiatric disorders, as well as a component in gold-standard treatment options. The neural underpinnings of mental imagery are however poorly understood. At the level of hemodynamics, research has demonstrated that mental imagery activates emotion networks of the brain. Scalp-recorded EEG has also shown an increase in endogenous activity in the alpha band during mental imagery tasks. To define the neurophysiology of mental imagery, we combined the information from blood oxygen level-dependent (BOLD) signals with concurrently recorded EEG alpha-band power during a visual script-driven mental imagery task in a sample of 20 healthy participants. Ongoing analyses demonstrate that established BOLD activation patterns during mental imagery were replicated with the addition of EEG recordings: BOLD was selectively enhanced during emotional, compared to neutral imagery, in medial prefrontal cortex, precuneus, and cerebellum. These changes were associated with alpha-power changes, assessed on a trial-by-trial basis, as well as related to the level of alpha-power change across trials. Together, findings suggest that alpha-power changes in the scalp-recorded EEG may represent a sensitive index of emotional imagery.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B17 Action-Value Derived Evidence for Greedy Affect Control: an fMRI Study

Keith Bush[1], G. Andrew James[1], Clint Kilts[1], [1]University of Arkansas for Medical Sciences

We explored whether value-based (specifically action-value or Q-value) cognitive control obtains empirical support from functional magnetic resonance imaging (fMRI) data recorded for (n=40) healthy subjects performing an affect control task. Task trials (n=30 per subject) were comprised of International Affective Picture Set (IAPS) image stimuli (2 s) succeeded by control steps (8 s) in which subjects volitionally re-experienced the perceived affect of the stimuli while observing a fixation symbol. Affect (valence) measurements were predicted by previously reported fMRI-derived machine learning models fit separately to each subject using unique IAPS stimuli. States were defined as mean neural activations within a set of five BrainMap-derived emotion/interoception-involved independent components. Actions were defined as predicted valence differences between successive fMRI volumes discretized into (n=5) bins. Reward was defined as absolute difference between the control valence and stimulus valence in the succeeding volume. For each subject, for each of a set of discount factors (gamma) sampled on the range of [0,1] at 0.1 increments, the Q-function was modeled via random forest implementation of the fitted Q-iteration algorithm. For each discount factor and each subject, we computed: 1) on-policy out-of-sample group median Q-values; 2) random-policy out-of-sample group median Q-values; and, 3) error between on-policy actions and out-of-sample group median optimal actions. We found that on-policy Q-values were significantly greater than random policy Q-values across all discount factors supporting value-based affect control. We also found that error between on-policy actions and optimal actions was lowest for small [0.0-0.1] discount factors supporting a greedy affect control strategy.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B18 Brain Network Activation during Emotional Response Inhibition Impacted by Perceived Stress in Adolescents

Eleanor Schuttenberg[1,2], Julia Cohen-Gilbert[1,2], Jennifer Sneider[1,2], Emily Oot[1,2], Anna Seraikas[1,2], Sion Harris[2,3], Lisa Nickerson[1,2], Marisa Silveri[1,2], [1]McLean Hospital, [2]Harvard Medical School, [3]Boston Children's Hospital

Adolescence is a distinct period of development marked by substantial brain remodeling, particularly in networks subserving inhibitory control that are susceptible to stress. This study evaluated network activation during performance of an emotional Go-NoGo task and associations between network activation and stress. Functional magnetic resonance imaging data were acquired at 3Tesla from 45 (25 female) adolescents (13-14yrs). NIH Emotion Toolbox was used to measure perceived stress and rejection (PS,

PR), and pediatric Maltreatment and Abuse Chronology of Exposure (MACE) assessed peer emotional abuse (PEA). Network template spatial activation maps derived from HCP data were projected onto brain activation for negative>neutral inhibitory (NoGo) trials to generate a subject-series of activation strengths for each network/participant. Activated networks for this contrast included central executive, salience, dorsal attention, and default mode networks (DMN). Higher perceived stress was associated with increased impulsive errors (p=.003). Perceived stress, rejection and peer emotional abuse were negatively associated with activation of a ventromedial PFC network (PS p=.01, PR p=.008), and two sub-networks of the DMN: medial temporal DMN (PS p=.01, PR p=.02, PEA p=.009) associated with autobiographical recall, and prefrontal DMN, associated with theory of mind (PS p=.005, PEA p=.03). These findings suggest internalized stress may alter engagement of networks related to emotion regulation and social cognition during response inhibition during negative relative to neutral emotional distraction. Findings could reflect increased impulsivity and self-reflective processing elicited by both negative and neutral stimuli that could serve as an early marker for later mental health problems (increasing depressive/anxiety symptoms).

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B19 Social Context Inhibits What Has Been Semantically Primed: An Event-Related Potential Study

Sujata Sinha[1], Maud Haffar[1], Hugo Pantecouteau[2], Amanda Tardif[1], Sheila Bouten[1], Ashley Chau-Morris[1], J.Bruno Debruille[1], [1]McGill University, [2]École Normale Supérieure

Previous studies found effects of the presence of a confederate on the event-related potentials (ERPs) elicited by meaningful stimuli: the small amplitude of the N400 ERP evoked by semantically primed words was enhanced when participants knew the confederate did not receive the priming information.

We tested whether or not this enhancement indexes an inhibition of that priming, inhibition that would be performed to fit the social context of the uninformed confederate. We examined whether both N300s and N400s would be smaller when what should be inhibited cannot be determined. This indeterminacy was created by using an unknown social context, i.e., by placing a stranger next to participants and by using a task that did not require much inhibition: an image memorization task.Amplitudes of N400s and N300s were largely smaller than those of participants who were alone. In contrast, relative to these alone participants, these amplitudes were modestly increased by the presence of a friend, and thus when the social context was better known to participants and when what had to be inhibited to fit this context could be determined. We also found that this modest increase was significantly bigger for the participants who 'Felt Together' in the presence of their friend (FTs, n =46) than for those who 'Felt Alone' despite that presence (FAs, n =41). The timing and scalp distribution of these modest differences were similar to those of the large differences found between participants who were alone and participants who were with a stranger.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B20 Neural Correlates of Aesthetic Engagement with Literature

Yuchao Wang[1,2], Franziska Hartung[2], Marloes Mak[3], Roel Willems[3], Anjan Chatterjee[2], [1]Haverford College, [2]Penn Center for Neuroaesthetics, [3]Radboud University Nijmengen

Literary stories contain artistic value in what is said and how it is said. Reading literature typically affects readers emotionally: they may experience empathy, suspense, and even physical sensations like chills because of the wording used. To better understand what brain networks are co-opted when laypeople engage with literature, we modeled functional magnetic resonance imaging (fMRI) data while people listened to literary stories. We tested the hypotheses that emotional and literary experiences of narratives are neurally dissociable. While emotional arousal during story engagement is correlated with activity in sensory and social-processing areas, comprehending literary language is correlated with language and attention areas. We collected ratings of emotional arousal (N=27) and literariness (N=27) of two stories from two independent groups of raters to create two regressors (emotional arousal and literariness). These regressors were used to parametrically model blood-oxygen-level-dependent signal changes of 52 participants listening to the same two narratives. The fMRI results show that emotion and literariness of narratives are processed by independent brain networks. Highly emotional content leads to increased activation in bilateral superior frontal gyri, right medial superior temporal sulcus, and left tempo-parietal junction, an area predominantly involved in social cognition. Literary language in the narrative activates left perisylvian areas, including the angular gyrus and inferior frontal gyrus, both of which process and integrate semantic information during language comprehension. Overall, our results support our hypotheses and shed light on the function of and interaction between attention, social understanding, and semantic networks during literary engagement.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B21 Proposal for a working model for bi-directional neural-aesthetic translational application of neuroaesthetics

Kelly Adams[1], Jonsara Ruth[2], Annabelle Adams-Beyea[2], Able Bloodgood[3], Castle Bloodgood[4], Martin Goldstein[5], [1]Paul Bloodgood Center for the Study of Neuroaesthetics, [2]Parsons School of Design, The New School for Social Research, [3]Bard High School for Early College, [4]Hunter's Point Community MS, [5]Icahn School of Medicine

"Background: Neuroaesthetics, developed over just two decades, aspires bridging art with neuroscience. Initial efforts aimed toward neuroscientifically-understanding fundamental stimulus features defining aesthetic value (i.e., identifying a common 'aesthetic neural signature') ? a Gazzaniga/Miller-style mission integrating the brain into a field theretofore the sole province of philosophy, thereby creating a novel nexus of aesthetics and neuroscience. As has occurred in other neurosciences, neuroaesthetics is undergoing maturation. Cross-disciplinary initiatives and innovative investigational paradigms mark the excitement of neuroaesthetics' current 'adolescence'. Profound translational applications are emerging, including improving identification/measurement of creativity; neuroscientifically-informing art education; enhancing artist health; and developing objectively-definable criteria for art valuation. Consequently, there appears need for augmenting the conceptual framework of neuroaesthetics to facilitate continued growth, and optimize realization of translational potential. Methods: Metanalysis performed via searching National Library of Medicine with 'neuroaesthetics'. We limited search to visual arts. Using this data, we construct a 'knowledge map' of neuroaesthetics to inform proposal of a working neuroaesthetics model . Results: 104 citations initially identified. Restriction to visual modality-only yielded subset of 68 publications. Current literature ranges across theoretical and empiric studies. Metanalysis reveals need for, and data to inform, advancing neuroaesthetics' framework.Discussion: As neuroaesthetics evolves, there is corresponding need to renovate its conceptual framework. We propose a dynamic model capturing neuroaesthetics' theoretical basis; empiric enterprises; bi-directionality of the art-brain interface; and critical translational applications, thereby providing a framework for nurturing understanding of the genesis, experience, and valuing of aesthetic work product, with consequent benefit to human creative development and health."

Topic Area: EMOTION & SOCIAL: Other

B22 Neural correlates of socio-cognitive processes in deception: Meta-Analysis of Functional Neuroimaging Studies of Lying

En-Syuan Huang[1], Ying-Chen Liu[2], Chih-Mao Huang[2], [1]Institute of Neuroscience, National Yang-Ming University, TW, [2]NCTU, TW

Deception refers to the behavior to falsify others by conveying the wrong information or concealing the truth and is a commonly observed in the real world. Previous functional neuroimaging studies suggest that information processing involved in deception relies on neural substrates of socio-cognitive systems for executive function, decision-making, theory of mind, and social cognition. In the present study, we investigate the common and distinct neural correlates of deception and honest actions by performing a quantitative meta-analysis of functional magnetic resonance (fMRI) studies using activation likelihood estimation (ALE) approach. The meta-analytic results showed greater activation in insula for honest actions whereas greater activation in premotor cortex, dorsolateral prefrontal cortex (DLPFC), inferior PFC, and inferior parietal lobule for processing deception, probably reflecting cognitive efforts for reading intentions of others, conflict monitoring and resolution, and language comprehension. Moreover, when deception studies were divided in social and non-social conditions, increased activation in precuneus and posterior cingulate cortex was found to be greater in social than non-social deception, suggesting the integrative nature of socio-cognitive information processing in the social interactive setting. Our findings are congruent with the notion that the process of deception is supported by distributed fronto-parietal networks for integrating socio-cognitive information processing and influenced by social interaction.

Topic Area: EXECUTIVE PROCESSES: Other

B23 A Functional Neuroimaging Investigation of Moral Foundations Theory

Maria Khoudary[1], Eleanor Hanna Valassis[1], Vijeth Iyengar[1], Scott Clifford[2], Felipe De Brigard[1], Walter Sinnott-Armstrong[1], Roberto Cabeza[1], [1]Duke University, [2]University of Houston

Moral Foundations Theory (MFT), an influential conceptual framework in the social sciences, posits that humans make judgments about the rightness and wrongness of particular acts based on a set of discrete moral foundations. A number of behavioral dissociations suggest that these foundations can be grouped into superordinate categories of binding (purity, authority, and loyalty) and individualizing (harm and fairness) that reflect the social level at which an act is performed. Despite robust behavioral evidence of this hierarchical organization, there has yet to be an investigation into the neural processes that generate these patterns of responses. Here, we use spatiotemporal partial least squares (PLS) analyses on fMRI data from 32 participants to investigate whether brain activity during MFT judgments exhibits a response profile similar to behavior. A mean-centered PLS analysis returned two significant latent variables (LVs). LV1 (p

Topic Area: EMOTION & SOCIAL: Other

B24 Perception of dance movements modulates sensorimotor activity: mu suppression as an index for embodied emotions

Claudia Corradi[1], Jorge Almansa[1], Eirin Sabel[1], Jonathan Silas[2], Alexander Jones[2], Beatriz Calvo-Merino[1], [1]City, University of London, [2]Middlesex University

Research has shown that we understand others by internally simulating their actions into our body via our own sensorimotor system. Mu desynchronization has been taken as an index of motor engagement during action perception. Recognizing the emotion expressed in actions is a crucial feature in social interactions. This study aims to investigate if sensorimotor activity is modulated by the emotion observed in whole-body actions. We recorded EEG activity in 32 participants while they observed videos of dance movements expressing happiness or sadness. In two blocked tasks, participants rated the emotion of the movements and a control visual feature (i.e. direction of the movement). We analyzed mu band (8-13 Hz) activity over the sensorimotor cortex. Results showed reduced mu band oscillations when performing the emotion recognition task compared to the control task, indicating stronger recruitment of sensorimotor activity when focusing on the emotions of the movement. These results support the idea that we understand others' emotional states by internally simulating them in our own body. This data is consistent with theories of embodied cognition and embodied emotions.

Topic Area: EMOTION & SOCIAL: Person perception

B25 Pupil size during authenticity recognition in laughter and crying

Gonçalo Cosme[1], Vânia Tavares[1], Mónica Costa[2], César Lima[3], Thomas Wilcockson[4], Trevor Crawford[5], Diana Prata[1], [1]Instituto de Biofísica e Engenharia Biomédica, [2]ISPA, [3]ISCTe-IUL, [4]Loughborough University, [5]Lancaster University

Emotions play an important role in social interactions however some neurological pathologies manifest themselves with dysfunctional emotional recognition and/or expression, strongly motivating research on these emotional processes. Nonverbal emotional vocalizations are expressions of emotions without semantic context, can be characterized according to their category (e.g. amusement, sadness and fear), valence (positive or negative), arousal and authenticity (whether spontaneous or voluntary). The ability to correctly recognize authenticity is an advantageous social skill that enhances group cohesion, affiliation and cooperation. Recent studies suggest that spontaneous emotions elicit different brain activation patterns compared to voluntary emotions mostly because perceivers require less mentalization (i.e. cognitive effort) to recognize spontaneous emotions; and that spontaneous vocalizations were more arousing than voluntary. In this work, pupil size, a well-known measure of cognitive load and arousal, was measured during displays of nonverbal emotional vocalizations of amusement (laughter) and sadness (crying) modulated for their authenticity (spontaneous or voluntary). After sound display, 28 participants rated the sounds on their perceived authenticity in a Likert scale (1-7). Group analysis demonstrated a statistically significant main effect of valence on max and mean pupil size and an interaction effect of authenticity and emotion such that voluntary laughters elicited more pupil dilation than spontaneous laughter, with no difference in cries. These results suggest that the autonomous nervous system is involved in authenticity processing; and consolidates pupil size as a neurophysiological measurement which is sufficiently sensitive to complex social processes as is authenticity rating in nonverbal emotional vocalizations.

Topic Area: EMOTION & SOCIAL: Person perception

B26 Attentional Prioritization of Negative Appearance-Behavior Cues in Impression Formation

Isabelle Moore[1, 2], Eric Fields[1, 3], Jennifer Crawford[1, 4], Laura Paige[1], Angela Gutchess[1], Brittany Cassidy[5], [1]Brandeis University, [2]University of Virginia, [3]Boston College, [4]Washington University in St. Louis, [5]University of North Carolina at Greensboro

Previous research has identified a number of factors that affect the strength of social impression information. These factors include the positive or negative valence of social cues, as well as the congruity of the appearance with behavioral cue (e.g., a trustworthy face paired with an untrustworthy behavior). Building off of this work, we employed event-related potentials (ERPs) to investigate the effects of valence and appearance-behavior congruity on

attention by studying the processes involved in the integration of cues about appearance (trustworthy or untrustworthy faces) and behaviors, with these pairings varying in their congruity (congruent or incongruent). Participants were presented with a sentence describing a behavior and then viewed the face of the person who had performed said action. Behavioral judgment tasks served as manipulation checks to assess whether the strength of congruency or incongruency was perceived as intended. In Experiment 1, participants evaluated congruency between face-behavior pairs. In Experiment 2, participants rated their likelihood of approaching each person. Congruent negative appearance-behavior pairs (negative behaviors paired with untrustworthy faces) evoked a larger late positive potential (LPP) response than any other pair, suggesting an attentional prioritization of negative social cues. In addition, participants had the greatest adjustment in their behavioral evaluation of each person when a negative face followed a positive behavioral cue across experiments. These findings converge to reveal neural and behavioral evidence speaking to the strength of negative social cues when integrating appearance and behavioral cues together to form impressions.

Topic Area: EMOTION & SOCIAL: Person perception

B27 Judging books by their covers: A candidate neurocognitive mechanism underpinning bias towards facial anomalies

Clifford Workman[1], Geoffrey Aguirre[1], Anjan Chatterjee[1], [1]University of Pennsylvania

Mounting evidence suggests an 'anomalous-is-bad' stereotype facilitates negative attitudes towards people with facial differences (e.g., scars). A neural biomarker sensitive to anomalous faces has been hypothesized to underpin this stereotype, resulting in dehumanization. This effect may occur because facial anomalies incorrectly signal poor health, thereby triggering disgust. Alternatively, anomalous faces may be perceived as morally deficient (i.e., untrustworthy). In this study, 27 participants completed a 1-back test ? learning 90 average-looking faces ? before completing an oddball task during fMRI scanning. During scanning, both novel and learned faces were presented while participants kept a tally of faces new to them (30 novel-anomalous, 30 novel-average-looking, 30 novel-good-looking). After scanning, participants completed an Implicit Association Tests (IAT), associating faces with and without anomalies with good and bad words. Participants were also assessed for sensitivity to pathogen-related and moral disgust. When comparing anomalous faces against average- and good-looking faces, greater activation was found in fusiform and middle occipital gyri, amygdala, inferior frontal gyrus, and inferior parietal lobule (all bilateral). Including IAT scores as a regressor revealed positive relations between implicit biases and activation throughout a similar occipito-temporal network. Comparing average- and good-looking faces to anomalous faces did not replicate the neural biomarker reported previously. Blunted ventral striatal activation to anomalous compared to average- and good-looking faces, however, correlated with greater sensitivity to moral but not pathogen-related disgust. These findings contrast with the pathogen-avoidance account and suggest a candidate neurocognitive mechanism for moral disgust that may underpin the anomalous-is-bad stereotype.

Topic Area: EMOTION & SOCIAL: Person perception

B28 Developmental Changes in Neural Substrates of Inhibitory Control from Childhood to Adolescence among Youths with and wit

Cheng-Yu Hsieh[1], Susan Shur-Fen Gau[2], Tai-Li Chou[1], [1]Department of Psychology, National Taiwan University, [2]Department of Psychiatry, National Taiwan University Hospital

Introduction: Children with Attention-Deficit/Hyperactivity Disorder (ADHD) have impaired inhibitory control. However, there have been inconsistent in the findings of over- or under-activation in brain regions for inhibitory control across different age-groups. One of the reasons is that cross-sectional rather than longitudinal fMRI studies only address age-related differences rather than longitudinal changes. Thus, the present study aimed to answer this question by conducting a longitudinal neuroimaging study with increased statistical power. Method: We conducted an fMRI study on 38 ADHD and 38 typically developing (TD) children (mean age: 11-year-old at time 1). Participants received two scans in a 4-year interval while fulfilling a counting Stroop task. We examined the contrast of inhibitory control by conducting a 2 (group: ADHD, TD) x 2 (age: time 1, time 2) factorial design at a whole-brain analysis using uncorrected $p < .01$ threshold. Result: The interaction effect was significant in the right inferior frontal gyrus (rIFG) and dorsal anterior cingulate cortex (dACC). The post-hoc analyses further indicated that both the rIFG and dACC were hyperactivated at time 1 but tended to normalize at time 2 in the ADHD group relative to the TD group.Discussion: Children with ADHD may engage in compensatory strategies to perform inhibitory control tasks. However, when they enter adolescence, their efficiency in recruiting regions supporting inhibitory control may increase but not fully normalize to the level of age-matched TD peers. The result might support a maturational delay hypothesis for ADHD since adolescents with ADHD tend not to adopt such a compensatory mechanism.

Topic Area: EXECUTIVE PROCESSES: Development &aging

B29 Individual differences in neuroanatomy predict neurostimulation related multitasking gains in older adults

Kevin Jones[1], Theodore Zanto[1], Avery Ostrand[1], Wan-Yu Hsu[1], Adam Gazzaley[1], [1]University of California, San Francisco

We have previously demonstrated that multitasking is associated with theta (4-7 Hz) oscillations in prefrontal cortex. Furthermore, we have shown that theta (6 Hz) transcranial alternating current stimulation (tACS) to the prefrontal cortex (PFC) enhances multitasking ability in young adults. However, it is unclear whether such benefits may extend to a population with deficits in multitasking ability, such as healthy older adults. To test this, theta tACS was applied to the PFC in older adults aged 60 ? 80 years. On three consecutive days, participants engaged in a multitasking paradigm while receiving tACS (25 minutes per day). Participants were randomly assigned to receive either 6 Hz (theta) tACS or 1 Hz tACS as a frequency control. Electroencephalogram data was recorded. Behavioral results demonstrated high variability between participants with no group effects of tACS. To assess the source of this variability, magnetic resonance imaging (MRI) data was acquired and used to form individualized models of the tACS-induced electric field (EF) changes in the cortex. Results showed that in the theta tACS group, the modeled EF magnitude in PFC predicted multitasking improvement, which was not observed in the 1 Hz control group. Furthermore, a median split of the groups based on the modeled EF in PFC showed that participants with the highest modeled theta tACS EF exhibited greater multitasking performance than those with the highest modeled control tACS EF. Together, these results highlight the importance of anatomical variability, which alters current flow to the brain and affects the efficacy of tACS.

Topic Area: EXECUTIVE PROCESSES: Development &aging

B30 Theta-Band Power in Context-Dependent Task-Switching

Dillan Cellier[1], Marco Pipoly[1], Kai Hwang[1], [1]University of Iowa

The ability to adjust one's actions according to changing contexts is essential to goal-directed behaviors. For example, while an individual might answer their ringing cell phone while alone in their home, they are unlikely to do so while in the middle of an important business meeting. This flexibility in using context-dependent information to guide action is thought to be supported by the rostral-

caudal organization of the prefrontal cortex (Badre and Nee, 2018). However, the neural oscillations involved in context-dependent task-switching remain a subject of open inquiry. We recorded electroencephalography (EEG) while subjects performed a task which required them attend to a context cue and either to switch between two contextually-defined task-sets (Extra-Set Switch condition), switch between two task-rules within a context (Within-Set Switch condition), or remain on the same task rule (Stay condition) from trial-to-trial. Critically, we held the working memory load constant across conditions. We found that ESS trials elicited the longest reaction times and increased theta-band power (4-8 Hz) 220 milliseconds after the onset of the context cue, relative to WSS and Stay trials. Taken together, these results suggest that task switching between contexts (ESS condition) is more cognitively taxing than switching between rules within the same context, or not switching task rules at all. Additionally, theta band oscillatory activity might index cognitive control processes related to switching between task-sets under different contextual conditions. These findings further suggest that phase- and amplitude-specific patterns of theta-band activity could be one mechanism that support cognitive flexibility.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

B31 Contributions of fatigue and automatic processing to cognitive flexibility

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

Task switching paradigms are commonly used to measure cognitive flexibility. However, little work has examined the effect of task length, including practice effects and fatigue, on task switching performance. The current work examines two samples of participants that performed 390 trials of either an explicit task switching paradigm (n = 116), on which participants are told which task to perform, or a voluntary task switching paradigm (n = 114), on which participants could choose which task to perform. Drift diffusion models were fit to assess the effects of practice and fatigue on latent decision-making variables. In both versions of the task, reaction times decreased over time. In the explicit version, this decrease was larger for repeat trials. In the voluntary version, switch rates declined over time. Together, the results suggest a fatigue-related increase in bottom-up, automatic processing during task performance. Models fit to both versions revealed an increase in drift rate and a decrease in response boundary over time. Subject-level decreases in response boundary were significantly correlated with subject-level decreases in switch rate, suggesting this parameter might quantify fatigue effects on bottom-up bias. Improvements in drift rate over time might track improvements due to practice, although this was not tested. The current work suggests that, over time, participants both improve in task performance and rely more on bottom-up automatic processing, possibly due to fatigue. Future work should attempt to dissociate practice effects from fatigue as well as assess how other bottom-up biases change with fatigue.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

B32 Hierarchical organization of the prefrontal cortex independent of sensory modality

Taehyun Yoo[1], Minho Shin[1], Hyeon-Ae Jeon[1], [1]DGIST, Daegu, Republic of Korea

The prefrontal cortex (PFC) plays an important role in cognitive control. It has been known that the functional organization of the PFC reflects the hierarchy of cognitive control along the posterior-to-anterior axis of the dorsolateral PFC. So far, researchers have used only visual stimuli to investigate the hierarchical processing of cognitive control. However, in everyday life, multisensory information always gets involved during this process, and thus we should consider multisensory information to unveil the functional specificity of the PFC involved in the processing of hierarchical structures in cognitive control. We invented a study design where two different sensory modalities-auditory cues and visual targets-were used to establish different levels of hierarchy in cognitive control. The experiment consisted of four subordinate-experiments, having four levels of hierarchy-Response (the lowest level), Feature, Dimension, and Context (the highest level)-with varying levels of complexity defined as the number of alternatives (one to four). Participants were asked to press appropriate buttons to a given cue from the set of cue-relevant mappings. In result, the posterior-to-anterior pattern of activations over the dorsal premotor area, pre-dorsal premotor area, inferior frontal sulcus and frontal polar cortex was observed as the level of hierarchy increased. Therefore, we suggest that the functional organization of the PFC is manifested along the posterior-to-anterior axis of the prefrontal cortex independent of sensory modality of information.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

B33 The effect of feedback validity on learning and its relation to self-efficacy in children: an ERP study

Xinyi He[1], Yael Arbel[1], [1]MGH Institute of Health Professions

The study evaluated the effect of consistent and inconsistent performance feedback on learning in children. Children (n = 110) between the ages of 7 and 10 years performed a probabilistic task while their electrophysiological data were recorded. Participants were tasked with sorting items into two bins based on the category to which they belonged (total of 8 categories). Participants were presented with performance feedback after each of their responses. Under the consistent feedback condition, performance feedback was consistent with the participants' responses. Under the inconsistent feedback condition, feedback was consistent on 80% of the trials, while on 20% of the trials, participants received the wrong feedback. Two event related potentials associated with feedback processing were evaluated, the feedback related negativity (FRN) and a fronto-central positivity (FCP). Each participant completed the Students' Perception of Control Questionnaire (SPOCQ), a measure of self-efficacy. Analysis of the behavioral data indicated that participants performed better under the consistent feedback condition. Self-efficacy scores related to control beliefs were found higher among the older children in the study (10-year-olds) when compared with the younger children. Linear regression analysis indicated that greater difference in FRN to positive feedback between the consistent and inconsistent conditions was associated with greater difference in accuracy between the two conditions. Higher self-efficacy scores were found associated with greater differences in FRN to negative feedback between consistent and inconsistent condition in 9-year-olds. Higher self-efficacy was associated with smaller differences in FCP amplitude to negative feedback between consistent and inconsistent condition in 10-year-olds.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

B35 BMI Correlates with Brain Activity during the Stroop Task in Individuals with Overweight and Obesity

Geneva Litz[1], Jamie Peven[1], John Jakici[1], Renee Rogers[1], Chelsea Stillman[1], Jennifer Watt[1], Kirk Erickson[1], [1]University of Pittsburgh

Higher body mass index (BMI) has been associated with slower response times (RT) on inhibitory control (IC) paradigms, e.g., Stroop task. There is limited research examining associations between BMI and brain activity in regions supporting IC. This study examined whether BMI is related to Stroop task performance and brain activity in individuals with overweight or obesity. We hypothesized higher BMI would be associated with worse Stroop task performance and lower activity in brain areas supporting IC. We analyzed baseline data from 124 adults with overweight and obesity (average age=44

years, average BMI=32.46kg/m2) enrolled in a weight loss intervention. Participants underwent event-related fMRI while completing a color-word Stroop task. Using a whole-brain analytical approach, we identified activation patterns related to BMI and further examined these regions with respect to RT. All analyses controlled for sex. BMI was not significantly related to RT during any task condition (all p-values>0.52). However, higher BMI was associated with less of a difference in activation between the incongruent and congruent conditions in the right frontal pole, precuneus, and middle temporal gyrus (p

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

B36 The neural correlates involved in metaphor comprehension with varying levels of familiarity and context

Hee Dong Yoon[1], Youngjoo Kim[2], Ki-Chun Nam[3], Sun-Young Lee Cyber[4], Hyeon_Ae Jeon[1], [1]Daegu Gyeongbuk Institute of Science and Technology (DGIST), [2]Kyung Hee University, [3]Korea University, [4]Hankuk University of Foreign Studies

Altering the familiarity of the metaphor and manipulating the context is known to impose additional processing demands on executive functions, specifically, interference control. Therefore, we investigated the neural correlates involved in metaphor comprehension influenced by the familiarity and the context in relation to individuals' executive functions. Participants read 124 two-sentence pairs (i.e., one sentence with contextual information and the other sentence containing a metaphorical expression) and responded whether the second sentence made sense after reading the first sentence. We manipulated familiarity of the metaphor (familiar vs. novel metaphors) and the preceding context (supporting vs. opposing contexts). We also measured participants' executive functions using various neuropsychological tests. In result, significant main effects of both familiarity and context were observed in response times (RTs) and accuracy. Notably, only the semantic fluency test, which represents the capability of individuals' interference control, was correlated with participants' RTs, suggesting a critical role of the interference control during metaphor comprehension. In an fMRI study, we identified the areas associated with familiarity and context. The left inferior frontal gyrus, the posterior medial frontal gyrus, and the left middle temporal gyrus were more activated for novel metaphor condition than familiar metaphor condition. Opposing context condition yielded significantly higher activations in the right middle frontal gyrus, supramarginal gyrus, and the right angular gyrus compared to supporting context condition. We suggest a differential involvement of the brain regions: familiarity-related areas mainly in the frontal and temporal regions and context-related areas in the frontal and parietal regions.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

B37 Executive functioning predicts unique relationships between PTSD symptoms and resting-state connectivity

Audreyana Jagger-Rickels[1], Anna Stumps[2], David Rothlein[1], Travis Evans[3], Francesca Fortenbaugh[4], William Millberg[4], Brian Marx[5], Regina McGlinchey[4], Jenn Fonda[6], Cate Fortier[7], Joe Degutis[2], Mike Esterman[5], [1]Neuroimaging Research for Veterans (NeRVe) Center, VA Boston, [2]Translational Research Center for TBI and Stress Disorders, [3]VA Boston Healthcare System, [4]Translational Research Center for TBI and Stress Disorders, [5]National Center for PTSD, VA Boston, [6]Boston University, [7]Harvard Medical School

PTSD is a heterogeneous disorder, both clinically and neurobiologically. Recently, researchers have attempted to use neuroimaging and cognitive performance to account for this heterogeneity and define latent neurocognitive subtypes. Using a similar approach, we considered whether cognitive functioning (in attention, memory, and executive functioning (EF)) moderated the relationship between PTSD symptoms and functional connectivity and whether subtypes of PTSD could be defined by specific neurocognitive profiles. Our study included 287 post-9/11 Veterans (mean age = 31, 90% males) that participated in resting-state fMRI and cognitive testing. The sample was divided into three groups based on each cognitive composite score using DSM-5 criteria: mild neurocognitive impairment, average, and above-average ability. Using a 7-network parcellation, functional connectivity (FC) was computed for 28-network within- and between-network pairs. We examined whether FC for each network pair was predicted by PTSD symptom severity and cognition, as well as their interaction. We also included age, head motion, IQ, mild TBI, and depression severity as covariates. PTSD severity significantly predicted the FC between the limbic and executive network. Further, the interaction between PTSD and EF performance significantly predicted limbic and executive FC. Specifically, those with impaired EF had a stronger relationship between PTSD and limbic executive FC ($r = 0.50$, $p = 0.002$) whereas those with above-average EF had no relationship between PTSD severity and limbic executive connectivity ($r = -0.18$, $p = 0.24$), indicating that executive function modulates the FC signature of PTSD severity. This provides preliminary evidence for an executive dysfunction subtype of PTSD.

Topic Area: EXECUTIVE PROCESSES: Other

B38 Noradrenergic contributions to reinforcement learning in Parkinson's disease -- ultra-high field imaging and atomoxetine

Claire O'Callaghan[1], Naresh Subramaniam[2], Frank Hezemans[3], Catarina Rua[2], Rong Ye[2], Luca Passamonti[2], Trevor Robbins[2], James Rowe[2], [1]Brain and Mind Centre, University of Sydney, [2]University of Cambridge, UK, [3]Medical Research Council Cognition and Brain Sciences Unit

Noradrenaline plays a key role in modulating an organism's learning and engagement with its environment. In Parkinson's disease (PD), there is neuronal loss in the noradrenergic locus coeruleus (LC) and dysregulation of forebrain noradrenaline projections, which is thought to contribute to cognitive and neuropsychiatric symptoms. Using ultra-high field neuromelanin imaging of the LC, and an atomoxetine manipulation, we characterised this brain system and revealed the benefits of boosting noradrenaline on a reinforcement learning task. Twenty-five individuals with PD and 26 controls were scanned at 7T using a 3D magnetisation transfer sequence. Nineteen patients also underwent a double-blind randomised placebo-controlled crossover design, receiving 40 mg oral atomoxetine/placebo. Participants also underwent a reinforcement learning task in combination with pupillometry. We used hierarchical Bayesian models to establish learning rate, exploration-exploitation, and lapse rate parameters. In the patients we showed signal loss in the LC. Confirming a role for noradrenergic function in reward-related processing, under atomoxetine we found a significant improvement in learning. Of the computational parameters, the effect of atomoxetine was most prominent in the exploration-exploitation parameter, consistent with increased levels of prefrontal noradrenaline facilitating a more exploitative strategy. Furthermore, preserved integrity of the LC was associated with a better behavioural response under atomoxetine. Our findings reveal noradrenergic contributions to reinforcement learning in PD -- suggesting a potential neurocognitive mechanism that might underpin the noradrenergic role in depression and apathy in the disease. Our findings also have relevance for normative models of noradrenergic function centred on exploration-exploitation behaviour.

Topic Area: EXECUTIVE PROCESSES: Other

B39 Dual-Task Conditions Reveal Long-Term Postural Stability Deficits Associated With History of Concussion

Nicholas Reilly[1], Jessica Prebor[1], Jacquelyn Moxey[1], Eric Schussler[1], [1]Old Dominion University

Concussion is a type of mild traumatic brain injury that can manifest in a wide variety of cognitive symptoms including problems with focusing attention. Dual-task protocols in which a cognitive task is performed concurrently with a balance assessment have been implemented in screenings for acute concussion symptoms. However, few studies have examined the deficits in postural stability under divided attention is resolved once medical clearance has been determined. In the present study, dual-task postural stability was assessed in healthy adults including those reporting at least one prior diagnosed concussion (n=26) and those reporting no prior diagnoses (n=25). Participants were instructed to stand on a force plate for thirty seconds while performing a serial subtraction task to create a dual-task condition. Despite averaging over seven years since the most recent injury, individuals with a prior history of concussion demonstrated decreased postural stability under dual-task conditions in the forms of greater center-of-pressure displacement and decreased regularity of postural sway when assuming both a bipedal and unipedal stance. Additionally, individuals with a prior concussion history responded with significantly more errors on the cognitive task when assuming a unipedal stance. In summary, individuals that have a history of concussion demonstrate greater impairments for attention capacity. These results indicate that concussion is associated with impairments of motor control under conditions when attention is divided and that these impairments persist beyond the resolution of the initial injury.

Topic Area: EXECUTIVE PROCESSES: Other

B40 Increased Midfrontal Theta-Band Power During an N-Back Task Following Working Memory Training

Madeline Gregory[1], Thomas Covey[1], Janet Shucard[1], David Shucard[1], [1]State University of New York at Buffalo

The goal of this analysis was to determine whether working memory (WM) training results in changes in theta-band power. It has been suggested that increases in theta power during a WM task serve as a gating mechanism, playing a role in the activation of neural structures underlying WM. We hypothesized that after WM training, participants would show increased theta activity as compared to pre-training. Prior to training, participants completed a verbal 3-back during which EEG activity was recorded from a 256-channel sensor net. Training was completed using an online platform and consisted of 20 sessions of adaptive n-back training to be completed over approximately 5 weeks. Each session consisted of 10 blocks, with 45+n trials per block and took 25-30 minutes to complete. Participants later returned to the lab for post-training tests. EEG data from the verbal 3-back task at pre- and post-test were pre-processed using epochs of -1000 to 1400ms (time-locked to stimulus onset). For each subject (n=16), activity from the Fz electrode cluster underwent complex Morlet wavelet convolution, implemented using the fast Fourier transform. Data was extracted from the theta-band (3-7 Hz) at 0-200ms and 200-400ms time windows (selected to correspond to stimulus duration of 400ms). A paired samples t-test revealed that theta-band power was significantly increased at post-test during the 200-400ms time window (p

Topic Area: EXECUTIVE PROCESSES: Working memory

B41 Independent effects of socioeconomic status and genetics on adolescent brain development and working memory

Nicholas Judd[1], Bruno Sauce[1], John Wiedenhoeft[2], Jeshua Tromp[3], Hugh Garavan[4], Torkel Klingberg[1], [1]Karolinska Institutet, [2]Univeristy Goettingen, [3]University of Leiden , [4]University of Vermont

Genetic factors and socioeconomic (SES) inequalities play a large role in educational attainment, and both have been associated with variations in brain structure and cognition. However, genetics and SES are correlated, and no prior study has assessed their neural effects independently. Here we used polygenic score for educational attainment (EduYears-PGS) as well as SES, in a longitudinal study of 551 adolescents, to tease apart genetic and environmental effects on brain development and cognition. Subjects received a structural MRI scan at ages 14 and 19. At both time-points, they performed three working memory (WM) tasks. SES and EduYears-PGS were correlated ($r = 0.27$) and had both common and independent effects on brain structure and cognition. Specifically, lower SES was related to less total cortical surface area and lower WM. EduYears-PGS was also related to total cortical surface area, but in addition had a regional effect on surface area in the right parietal lobe, a region related to non-verbal cognitive functions, including mathematics, problem solving and WM. SES, but not EduYears-PGS, affected the change in total cortical surface area from age 14 to 19. This is the first study demonstrating the regional effects of EduYears-PGS and the independent role of SES on cognitive function and brain development. It suggests that the SES effects are substantial, affect global aspects of cortical development, and exert a persistent influence on brain development during adolescence.

Topic Area: EXECUTIVE PROCESSES: Working memory

B42 The Use of Eye-tracking and Neuroimaging to Examine Cognitive Load During Multimedia Learning

Stephanie Juth[1], Stephanie Juth[1], David Feldon[1], Carla Orellana[1], Ron Gillam[1], [1]Utah State University

Due to technological advancements, particularly in neuroimaging and eye-tracking (ET), many researchers now argue for a convergent approach to cognitive load (CL, Cook, 2009). The purpose of this study was to examine the role of working memory (WM) on multimedia processing and the convergent validity of functional near-infrared spectroscopy (fNIRS) and ET while manipulating CL. Eye movements of 49 undergraduate students (ages 19-36) were recorded by an eye-tracker while they examined biology text and diagrams. Using a pseudorandomized, counterbalanced block design, we compared contiguous (text within diagram) and non-contiguous conditions (text opposite unlabeled diagram). For a subset of 19 of these participants, fNIRS data were concurrently collected with ET. Four regions of interest (ROIs) were analyzed utilizing the area of the hemodynamic response curve (AUC). We analyzed both fNIRS (AUC) and ET measures (saccade count, fixation time) with linear mixed effects modeling. The best fit model for saccade count included a significant two-way interaction between CL and WM. For fixation count, a similar pattern was noted, with a significant two-way interaction between CL and WM. Similarly, the best fit model for the AUC of the fNIRS data, included two significant two-way interactions, ROI x WM and CL x WM. Particularly, in the dorsal lateral prefrontal cortex and inferior parietal lobule, oxygenation increased as WM capacity increased. Furthermore, in the high-load condition, individuals with higher WM capacity also demonstrated increased oxygenation levels as measured by AUC. Results suggest the validity of convergent ET and fNIRS measurement of cognitive load.

Topic Area: EXECUTIVE PROCESSES: Working memory

B43 Mobile based EEG assessment of fatigue in clinical practitioners

Suriya Prakash Muthukrishnan[1], Sunaina Soni[1], Ratna Sharma[1], [1]All India Institute of Medical Sciences, New Delhi

Human brain has the high likelihood for committing errors when confronted by a day-to-day situation that demands to process more than four integrated items in working memory, for example driving a car to a new destination in high traffic. However, neural mechanisms underlying the response outcome in working memory is still unclear. High temporal resolution and improved spatial resolution of dense array electroencephalogram (EEG) make it an ideal tool to investigate the dynamics of brain networks. In the present study, the brain activity of twenty healthy male volunteers was investigated during correct and error trials of visuospatial working memory task using dense array EEG. Independent brain components identified using independent component analysis (ICA). Event related spectral perturbations (ERSP) were computed for each independent components using Morlet wavelet transform for the frequency range of 3-70 Hz. ERSP of independent component clusters identified using K-means algorithm were statistically compared between correct and error trials. Theta power increased in the component cluster located at cingulate gyrus prior to the error response of visuospatial working memory task. The current study findings suggest that cingulate generated theta activity might reflect the quality of memory representation and the intensity of target uncertainty during the visuospatial search.

Topic Area: EXECUTIVE PROCESSES: Working memory

B44 Reward Influences the Shift of Attention Among Items in Working Memory

Jorja Shires[1], Mohsen Rakhshan[1], Alireza Soltani[1], Marian Berryhill[2], [1]Dartmouth College, [2]University of Nevada, Reno

Many of us have watched a locked door close just as we realize our keys, and not other unimportant objects, remain inside. This example reflects our ability to shift attention among items held in working memory based on their utility or value. Here, we examined interactions between working memory, attention and reward value using a change detection retro-cue paradigm. On each trial, four visual stimuli briefly flashed and only after the maintenance period did a valid or neutral retrospective cue appear. A recognition memory probe followed a second brief delay and reward feedback was provided at the end of each trial. Reward associated with a correct response (trial value) was manipulated on a block-by-block or trial-by-trial fashion whereas stimuli could have similar (colored target) or different (American coins) reward associations. As expected, across experiments there was a retro-cue benefit such that performance was superior on valid compared to neutral trials. Trial value has no effect on retro-cue benefit but when assigned on a trial-by-trial basis caused slower RT when the value was higher. Examining the effect of stimuli with previously learned reward values, we found performance to be superior for the lowest and highest value coins and significantly worse for the middle two items. These results indicate attentional bias for the best and worst stimuli and resemble overweighting of the best and worst outcomes in evaluating mixed gambles. Overall, our results provide evidence for non-trivial effects of reward values on shifts of attention among items in working memory.

Topic Area: EXECUTIVE PROCESSES: Working memory

B45 Using an Inverted Encoding Model to Measure Memory Intrusions in a Think/NoThink Task

Kelsey Sundby[1], Sirawaj Itthipuripat[2], Henri Skinner[1], Adam Aron[1], [1]University of California San Diego, [2]Vanderbilt University

Maintaining control over our thoughts is a fundamental part of cognitive control. In a world rich with distraction, cues in our environment may trigger the retrieval of unwanted memories. The Think/NoThink (TNT) task is designed to test whether individuals are able to exert control over cued retrieval and prevent unwanted memories from intruding. In TNT subjects see a memory cue and are instructed to not think of a previously learned associate. Recent versions also ask subjects to indicate after each trial whether or not they were successful in blocking the associate. While the ratings are useful, retroactive self-reports may be susceptible to demand characteristics, nor do they provide information about when the intrusions occur. We aimed to develop a tool to objectively measure memory intrusions. In a modified TNT task, subjects learned associations between objects and spatial locations as we recorded scalp EEG. Subjects were then given a memory cue (an object) and instructed to not think of the associated location. Using an inverted encoding model trained on trials in which subjects retrieved the associated locations, we tested whether spatial information was eroded for NoThink trials. Preliminary data (n=15 of 20) show a degradation of spatial information on NoThink trials compared to Think trials when subjects retrieve the spatial memory (p=.008). In the full sample we plan to also compare trials with a reported intrusion versus those without. Developing a tool to objectively measure intrusions will allow us to ask more targeted questions about executive control over memory retrieval.

Topic Area: EXECUTIVE PROCESSES: Working memory

B46 Atypical white matter mechanisms underlying reading development in adolescents with fetal alcohol spectrum disorders

Jade Dunstan[1], Xi Yu[1, 2], Nadine Lindinger[3], Ernesta Meintjes[3], Sandra Jacobson[4], Joseph Jacobson[4], Nadine Gaab[1], [1]Boston Children's Hospital, [2]Beijing Normal University, [3]University of Capetown, [4]Wayne State University

Prenatal alcohol exposure (PAE) affects brain development in utero, leading to deficits in a broad range of domains of cognitive function, including reading. However, the neurobiological mechanisms underlying alcohol-related reading impairments are still unknown. DTI data were acquired from 93 Cape Coloured (mixed ancestry) adolescents (26 fetal alcohol syndrome (FAS) or partial FAS (PFAS), 28 heavily exposed (HE) nonsyndromal, 39 controls) from our prospective Cape Town Longitudinal Cohort. Reading skill was assessed using the Gray Oral Reading Test (GORT). Utilizing the automated fiber quantification software, fractional anisotropy (FA) of three reading-related tracts-arcuate fasciculus (AF), superior longitudinal fasciculus (SLF), inferior longitudinal fasciculus (ILF) were estimated for both hemispheres, and lateralization indices (LI) for each tract were computed. ANOVAs revealed significant group effects for the LI of the ILF, driven by higher FA values in the right ILF for the FAS/PFAS compared to the nonsyndromal HE subjects ($t54=2.6$, $p=0.013$). Moreover, regression analyses incorporating group, reading skill and their interaction term revealed a significant interaction in the left SLF, driven by a positive correlation between GORT scores and FA of the left SLF in the control group ($r = 0.34$, $p = 0.041$) but a negative correlation in the HE group ($r=-0.36$, $p=0.059$) and no relation in the FAS/PFAS group ($r=-0.15$, $p=0.47$). Our results suggest atypical white matter tract development associated with PAE, which may underlie reading impairments in individuals with FASD, as well as a fetal alcohol-related absence of lateralization in a white matter circuit important for reading.

Topic Area: LANGUAGE: Development & aging

B47 Structural neural correlates of reading development in children with early language delay

Carolyn King[1, 2], Jolijn Vanderauwera[3], Jennifer Zuk[1, 2], Theodore Turesky[1, 2], Nora Jamoulle[4], Nora Raschle[5], Nadine Gaab[6], [2]Boston Children's Hospital, [2]Harvard Medical School, [3]Universite Catholique de Louvain, [4]University of Groningen, [5]University of Zurich, [6]Associate Professor of Pediatrics

Previous research has shown that kindergartners with a parental retrospective report of language delay in toddlerhood (early language delay; ELD) exhibit greater gray matter volume (GMV) in frontal regions and less GMV in middle temporal regions compared to children without ELD. However, these effects were observed in pre-reading children and it remains unclear whether and how these GMV differences change as children learn to read. To address this, children with (n = 17) and without (n = 18) ELD underwent structural MRI scanning prior to (i.e., kindergarten) and one year after the start of formal reading instruction. Nonword reading (i.e., decoding) skills were characterized at the second time point, the beginning reading stage. GMV was estimated using CAT12 and ROI analyses focused on the frontal and middle temporal regions previously identified. Repeated measures analyses showed that the main effect of ELD on GMV remained stable over time in both ROIs. Overall, the frontal ROI showed a developmental increase over time, whereas no significant change was observed in the middle temporal ROI. An exploratory analysis within the group of children with ELD revealed a significant time point by decoding skills interaction in the middle temporal ROI. In other words, a developmental increase over time within the middle temporal ROI was associated with better decoding outcomes at the beginning reading stage. These findings point toward neuroanatomical underpinnings of the trajectory of reading development among children with early language delay.

Topic Area: LANGUAGE: Development & aging

B48 Developmental changes in the processing of statistical information in speech: an EEG study

Yi-Lun Weng[1], Julie M. Schneider[1], Zhenghan Qi[1], [1]University of Delaware

The frequency of exemplars in the speech input is a critical cue for early language development (Maye, Werker, & Gerken, 2002; Kuhl, 2004). However, it is unclear whether and how the neural sensitivity to frequency of distributional cues in speech changes from childhood to adulthood. To address this question, we recorded electroencephalography (EEG) from 30 healthy adults and 13 typically developing children (Mean age = 8.5 years, SD = 1.3 years) in an auditory oddball paradigm, while they watched a silent cartoon movie. We manipulated the domain of deviant stimuli (syllable or voice) and how frequently each type of deviant occurred (rare vs. frequent). We found adults showed an overall greater mismatching negativity (22-180 ms) compared to children ($p = 0.004$), indexing an overall greater oddball effect. However, compared to adults, children showed larger negativity elicited by the rare deviants than the frequent deviants (significant group by frequency interaction, $p = 0.008$) in the late time window (324-500 ms). Our results provided novel evidence for the sensitive period theory of language development. Even though statistical learning behavior has not been found to decline with age, our findings suggest that the neural sensitivity to fine-grained frequency information of speech exemplars seems to decline across the lifespan.

Topic Area: LANGUAGE: Development & aging

B49 Interplay between task demands and language mode in bilingual word recognition: Evidence from ERPs

Liv Hoversten[1], Clara Martin[1], [1]Basque Center on Cognition, Brain and Language (BCBL)

Previous studies suggest that bilinguals can quickly identify the language to which a word belongs and use this information to suppress a task-irrelevant language at the global level. Research also suggests that language activations depend on the language mode of the current setting, such as the amount of each language present in the input. The current study therefore aimed to assess whether increasing the proportion of the task-relevant (target) language enhances suppression of the task-irrelevant (nontarget) language. Additionally, we aimed to establish the locus of language suppression at lexical and/or semantic levels of abstraction. 32 Spanish-Basque bilinguals made simultaeous language membership and semantic classification decisions on Spanish and Basque words during electrophysiological (EEG) recording. Frequency and concreteness were orthogonally manipulated within each category of words (Spanish/Basque, Living/Non-living), and the proportion of words belonging to each language was manipulated across blocks. Results show that task demands and language proportion differentially influenced frequency and concreteness effects in the event-related potential (ERP) signal for words belonging to the target and nontarget languages. These results provide evidence that the nontarget language is suppressed relative to the target language and that the the language membership of prior bottom-up input in a particular setting influences the degree of suppression of the nontarget language. The findings enhance our understanding of the neurocognitive mechanisms of bilingual language control during comprehension and call for revisions to current models of bilingual visual word recognition.

Topic Area: LANGUAGE: Lexicon

B50 Do Mandarin-French bilinguals hear Chinese when reading French? ERP evidence of proficiency level

Yaru WU[1], Jeremy Yeaton[2], Frédéric Isel[3], [1]MoDyCo, UMR 7114, CNRS/Paris Nanterre;LPP, CNRS (UMR 7018), [2]Laboratoire de Psychologie Cognitive UMR 7290, France, [3]CNRS Modyco/Paris Nanterre University

Humans regularly derive pleasure from visual experiences, even when not associated with primary rewards. Such 'aesthetic' experiences with artworks, performances or natural settings unfold in time, yet most of what is known about the psychological and neural basis of such experiences comes from studies with static images (paintings, photography, landscape). Previous imaging studies with artworks suggest that aesthetically pleasing experiences modulate activity not only in subcortical reward regions (ventral striatum), but also in portions of the ventral visual pathway and the default-mode network (DMN). We investigated behavioral and neural responses to temporally extended, aesthetically engaging stimuli (videos), using fMRI in combination with continuous behavioral ratings. Participants (n=26) were scanned as they viewed 40 video clips of landscapes (30 s) and indicated their moment-to-moment liking, as well as a final summary rating at the end of each clip. Category-selective visual regions in ventral occipitotemporal cortex (e.g. Parahippocampal Place Area, Fusiform Face Area) were identified using a functional localizer scan, and core regions of the DMN were identified using a 'rest' scan, in each individual. A parametric regression analysis of the fMRI data using overall ratings as regressors revealed sensitivity to aesthetic appreciation in several scene selective regions (Parahippocampal Place Area, Retrosplenial Cortex and Occipital Place Area) as well as ventral striatum and inferior frontal sulcus, but not in the DMN. These results suggest that aesthetically pleasing landscape videos may modulate a wider network of

higher-level visual regions than their static counterparts and rely less on top-down information for their aesthetic appeal.

Topic Area: LANGUAGE: Lexicon

B51 Neural Indices of speech processing of consonant cluster word onsets in English, Korean, and Spanish listeners

Minsoo Ko[1], Alahna Cogburn[1], Teresa Ribas[2], Valerie Shafer[1], [1]City University of New York, Graduate Center, [2]University of Barcelona

The aim of this study is to examine how first language experience modulates neural processing of American English consonant clusters (blow) versus unstressed onsets (e.g., below). Korean does not include stop-liquid consonant clusters in syllable onsets; in contrast, Spanish allows such clusters, but does not have unstressed vowels (e.g., schwa in below). Neural measures to nonsense words (bli, beli with a 30-ms vowel and be:li with a 60-ms vowel) were recorded in an oddball paradigm in which attention was directed to a muted movie. Preliminary results with seven Korean, three Spanish, and five native English speakers revealed that Korean and Spanish listeners were poor at categorizing whether a stimulus was 'bli' or 'beli' in an AXB task, whereas English listeners clearly categorized the endpoints (bli versus be:li-60 ms). All groups showed neural discrimination (Mismatch Negativity, MMN) for be:li-60 ms compared to bli. The groups showed different patterns dependent on which stimulus was the standard. For example, English and Korean listeners showed a larger MMN when bli was the frequent stimulus (standard), whereas Spanish listeners showed a larger MMN when beli-60 ms was the standard. In addition, none of the groups showed MMN to beli-30 ms versus be:li-60 ms. These results suggest that both acoustic-phonetic and phonological factors modulate discrimination of speech patterns and contribute to the observed asymmetries in relation to stimulus probability.

Topic Area: LANGUAGE: Other

B52 Acoustic and visual parameters underlying word-shape sound symbolism

Simon Lacey[1], Yaseen Jamal[2], Sara List[2], Kelly McCormick[2], K. Sathian[1], Lynne C. Nygaard[2], [1]Penn State College of Medicine, [2]Emory University

Sound symbolism refers to a non-arbitrary mapping between the sound of a word and its meaning. The most commonly studied mapping is that of sound to shape in which people assign auditory pseudowords like 'maluma' and 'takete' to rounded and pointed visual shapes, respectively. However, it is unclear which properties of the pseudowords contribute to their perception as rounded or pointed, generally considered visual attributes. Here, we compared perceptual ratings of the roundedness/pointedness of large sets of pseudowords and shapes to their acoustic and visual properties using a novel application of representational similarity analysis (RSA). Representational dissimilarity matrices (RDMs) of the auditory and visual ratings of roundedness/pointedness were crossmodally correlated. The auditory perceptual RDM was correlated with RDMs of the spectral tilt, the power spectrum of temporal frequency and the speech envelope. Conventional correlational analyses showed that ratings of pseudowords transitioned from rounded to pointed as many measures of vocal variability or roughness (harmonics-to-noise ratio, pulse number, fraction of unvoiced frames, mean autocorrelation and jitter; but not shimmer or pitch standard deviation) increased. The visual perceptual RDM was correlated with RDMs of global indices of visual shape (the simple matching coefficient, silhouette, image outline and Jaccard distance) but not the power spectrum of spatial frequency. Crossmodally, the auditory spectral parameters were related to the global indices of visual shape. Our work establishes the utility of RSA for analysis of large stimulus sets comprising multiple measures per stimulus and offers novel insights into the stimulus parameters underlying sound symbolism.

Topic Area: LANGUAGE: Other

B53 Code-switching during composition: MEG evidence from Korean-English bilinguals

Sarah Phillips[1], Liina Pylkkänen[1], [1]New York University

Bilinguals' fluid ability to code-switch has inspired much research on the brain basis of language switching, but most of that work has not addressed their ability to compose structure from mixed-language input. Instead, most research has focused on single word production in picture-naming tasks. How do bilinguals combine words from different languages into complex, coherent representations? Using magnetoencephalography, we tested whether a relatively well-established effect of composition in the left anterior temporal lobe (LATL) at 200-250ms would be elicited when bilinguals combine two words from different languages. We also tested whether such language switches would engage executive control regions (dlPFC, ACC), as has been reported for picture naming. 20 Korean-English bilinguals were presented with compositional two-word sentences and non-compositional two-word lists that varied in whether the two words came from the same language, Korean or English, or whether one word came from Korean and the other from English. All stimuli were pre-normed for well-formedness. We also varied whether the Korean words were displayed in Hangul (the preferred orthographic script) or in the Roman Alphabet (a prevalent alternative script). Our results revealed composition effects in the LATL for both single-language and code-switched expressions. Executive control regions did not engage for language-switching trials. These results show that the LATL can engage in composition even when the input items come from different languages. Together with the absence of switching effects in the executive control network, our findings point towards a unified cross-language combinatory process at 200-250ms in the left anterior temporal cortex.

Topic Area: LANGUAGE: Other

B54 Heschl's gyrus encoding of abstract context-invariant speech cues in natural speech perception

Kyle Rupp[1], Fernando Llanos[1], Madison Remick[1], Bharath Chandrasekaran[1], Taylor Abel[1], [1]University of Pittsburgh

Transforming continuous and highly variable acoustic signals into discrete and perceptually constant phonemic representations is critical to speech perception. For example, vowels are perceptually distinguishable by their two major vocal tract resonance frequencies, or formants. In connected speech, however, vowel formants are highly variable and dependent on their neighboring sounds due to coarticulation. While the human brain can normalize this context-dependent acoustic variability into a single percept for each vowel, the neural computations underlying this normalization, as well as their anatomical location and timing, remain an open question. We performed direct intracerebral recordings of bilateral superior temporal plane, including Heschl's gyrus (HG), in six patients while they listened to natural narrative speech annotated for vowels, onsets, and offsets. Using broadband power as an index of cortical activity, electrodes in HG exhibited rapid activation within 20-30 ms of vowel onset, with maximal differences between vowels occurring between 85-110 ms. To explore these differences further, we built encoding models to predict broadband power and estimated the best subset of interpretable acoustic predictors. While raw formant frequencies (F1, F2) were often selected as explanatory features, models preferentially selected formant values normalized by contextual pitch (F0). These normalized features are posited to be critical to the process of contextual normalization. Our results demonstrate that abstract, context-invariant representations for vowel categories can be discerned within the bilateral auditory cortex.

Topic Area: LANGUAGE: Other

B55 An EEG Study of Aphasia Recovery in Bilinguals

Jennifer Segawa[1], Meredith Adams[1], Alexis Medeiros[1], [1]Stonehill College

Past research has shown that healthy bilinguals have increased cerebral connectivity, particularly between the left and right hemispheres, due to the increased executive function of language required to speak multiple languages. These regions and their connectivity appear to play an important role in recovery of language processes lost due to stroke-induced aphasia. However, the exact nature of the relationship between functional and structural brain differences from bilingualism and their effect on aphasia recovery is not fully understood. This study uses electroencephalography (EEG) to 1) evaluate the brain's connectivity in order to better understand how the brain recovers from chronic post-stroke aphasia, and 2) evaluate the role of bilingualism in that recovery. We examined EEG measures ? oscillatory power and network connectivity (e.g., centrality) ? during both resting state and listening tasks. Consistent with past research, we found that people with aphasia (PWAs) had equal gamma power between left and right pairs of frontal and temporal electrodes, particularly those corresponding to Broca's area; in contrast, healthy controls had significantly lateralized power. Furthermore, this effect in early or simultaneous bilingual PWAs was correlated with greater language recovery. We also found enhanced connectivity between these regions in bilinguals compared to monolinguals. We believe this further solidifies the theory that bilingual PWAs can more readily compensate for damage from their stroke using previously existing, less-centralized language networks.

Topic Area: LANGUAGE: Other

B56 Automatic Activation and Processing of Color-Emotion Metaphors in Chinese-English Bilinguals: Evidence from ERPs

Junqing Chen[1], Natalie Kacinik[1,2], [1]City University of New York, [2]Brooklyn College

Conceptual Metaphor Theory (Lakoff & Johnson, 1980, 1999) claims that people use more concrete knowledge to represent abstract concepts through metaphorical mappings. We have been investigating how English and Chinese monolingual and bilingual speakers conceptualize emotions by metaphorical connections with colors (Chen, et al., in prep.) Results from a series of automatic experimental tasks showed that color-emotion metaphors specific to each culture (e.g., Sadness Is Blue in English, Happiness Is Red in Chinese) are also mentally represented in speakers of the corresponding language. In addition, Chinese-English bilinguals were found to automatically activate metaphors learned from their native L1 Chinese (Happiness Is Red) in either language context. The current study involves measuring ERPs to investigate the underlying neural activity, specific timecourse and degree to which late Chinese-English bilinguals activate the metaphorical systems in each language. Participants were asked to judge if target words conveyed the emotions of Happiness or Sadness. The data collected so far (N=12) indicates a significant font color (red versus blue) by emotion (happiness versus sadness) interaction with the N400 in the Chinese context. Happy words presented in blue evoke a greater N400 effect compared to red; while Sadness words show the opposite pattern. However, this color by emotion N400 interaction is not significant in the English context. This demonstrates that metaphorical representations can at least be automatically activated in the L1 context regardless of whether they come from L1 or L2 experiences.

Topic Area: LANGUAGE: Semantic

B57 Psychophysiological correlates of novel meaning processing in bilingualism

Katarzyna Jankowiak[1], Marcin Naranowicz[1], [1]Adam Mickiewicz University, Poznan

Thus far, little attention has been devoted to novel metaphor comprehension in the context of bilingualism, and therefore specific mechanisms engaged when processing semantically complex meanings in the native (L1) and non-native language (L2) remain under-investigated. Since models of monolingual novel metaphor comprehension postulate that comparison mechanisms are engaged in mapping between source and target domain of a novel metaphoric utterance (Bowdle & Gentner, 2005), the present study aims to test whether and to what extent the processing of such semantically complex meanings is modulated by language nativeness. To this end, highly proficient Polish (L1) - English (L2) bilingual speakers (N = 20) performed a semantic decision task to novel similes, novel nominal metaphors, literal utterances, and anomalous sentences in their L1 and L2, while the EEG signal was recorded. ERP analyses revealed that within the N400 time window (350-450 ms), a main effect of sentence type was observed ($p = .001$), showing that in both languages, anomalous sentences elicited the most robust N400 response, followed by novel nominal metaphors, novel similes and, finally, literal sentences. Such results suggest that comparison mechanisms initiated when processing similes facilitate novel metaphor processing in both L1 and L2, which is consequently indicative of similar processes engaged in novel meaning conceptual mapping in both languages when participants are at high level of proficiency in their non-native language.

Topic Area: LANGUAGE: Semantic

B58 Predicting Semantic Category Typicality from Brain Activation Patterns in Healthy Adults and Individuals with Aphasia

Ran Li[1], Tyler Perrachione[1], Jason Tourville[1], Swathi Kiran[1], [1]Boston University

The typicality effect, which means typical examples in a semantic category are accessed faster and more accurately than less typical examples, has been widely replicated in behavioral psycholinguistics studies. However, the neural representations of category typicality are not well understood. Here, we examined how brain regions represent typical versus atypical exemplars in both healthy adults and individuals with chronic aphasia (PWA). Healthy adults (n=18) and PWA (n=19) participated in an fMRI study, in which they were asked to verify semantic features of picture stimuli that were either typical (e.g., sparrow) or atypical (e.g., penguin) exemplars from five different semantic categories (e.g., bird). We classified the typicality of stimuli using whole-brain searchlight multi-voxel pattern analysis (MVPA) of fMRI data within each subject. In healthy adults, significant above-chance classification accuracy (cluster-level FWE-corrected $p < .05$) between typical and atypical items was found in two clusters: left middle occipital gyrus (extending into the left lingual gyrus), and right calcarine cortex (extending into right superior occipital gyrus). The same searchlight analysis in PWA did not reveal any significant clusters after correcting for multiple comparisons. Classification accuracy in the above regions did not correlate with mean response accuracy during the fMRI task in PWA. These results indicate that category typicality is represented in the visual cortex in healthy adults. However, this region did not appear to represent typicality in PWA, which may imply a role for the intact language system in the visual representation of category typicality.

Topic Area: LANGUAGE: Semantic

B59 Traveling back in time: how do temporal terms shape our expectations for the unfolding linguistic input

Yanina Prystauka[1], Stephanie Chinwo[1], Gerry Altmann[1], [1]University of Connecticut

The theory of Intersecting Object Histories (Altmann, & Ekves, 2019) postulates that the processing of a previously encountered object entails activation of its previous states, and these compete for selection. Hindy et al. (2012) used language as a test case and found that such competition manifests in increased activation in Stroop-sensitive voxels in Left Inferior Frontal Gyrus (LIFG). Previous research suggests that comprehending events described out of chronological order comes at increased processing cost (Mandler, 1986; Nieuwland, 2015). Here, we tested whether reversing the order of events (via language) affects the interplay between alternative object states. EEG was acquired while participants read sentences presented one word at a time. We manipulated the degree of change that the object underwent (The chef will chop/weigh the onion) and the order of events (and then/but first, she will smell the onion). A time-frequency analysis of EEG, time-locked to the sentence-final determiner phrase, revealed a stronger suppression of alpha/beta power in sentences describing substantial change (chop) in a chronological order (and then) compared to all other sentences. This effect was observed at the determiner before the onset of the noun. Such pre-target alpha/beta decreases have been associated with preparation for the input (Rommers et al., 2017). We conclude that the interplay between the order in which the events are presented and the degree of change that the events entail manifests in the anticipatory region as increased prediction for the substantial change & chronological order condition.

Topic Area: LANGUAGE: Semantic

B60 Analogy questions can be solved with addition and subtraction of fMRI pattern

Meng-Huan Wu[1], Andrew Anderson[1], Robert Jacobs[1], Rajeev Raizada[1], [1]University of Rochester

Analogical reasoning, evidenced when solving analogy questions (e.g., teacher is to chalk as mechanic is to wrench), plays a fundamental role in human cognition. However, how functional neuroimaging (fMRI) patterns of individual words are combined to solve such questions remains unclear. Recent advances in computational linguistics have showcased how analogical problems can be solved by simple addition and subtraction of word embeddings (e.g., wrench = mechanic + chalk ? teacher). Critically, this property emerges in domain-general language processing models which are not explicitly trained to perform analogical reasoning. Here, we tested whether this property holds when fMRI activation patterns were elicited from thirteen participants who viewed isolated words but did not perform analogical reasoning tasks. Analogy questions were constructed by selecting words that were categorically or thematically related, and we tested whether the predicted pattern calculated with simple arithmetic was more correlated with the pattern of the target word than other words. We observed that not only target word identity, but also word category and theme could be predicted significantly above chance from whole-brain fMRI patterns of other words in an analogy question (one-sided t-test, $p = 0.01$, 0.001 and 0.05 respectively). In summary, this study demonstrated that analogy questions can be solved with addition and subtraction of fMRI patterns, and that, similar to word embeddings, this property holds for domain-general patterns elicited when participants were not explicitly told to perform analogical reasoning.

Topic Area: LANGUAGE: Semantic

B61 We 'might could' revisit syntactic processing: Studying dialectal variation with event-related potentials

Holly A. Zaharchuk[1], Adrianna Shevlin[1], Janet G. van Hell[1], [1]The Pennsylvania State University

While dialectal (regional, social, or ethnocultural) variation is inherent to language, theories of language processing have primarily drawn upon evidence from standard language varieties. For syntactic processing in particular, research has focused mostly on written stimuli with grammatical violations or ambiguities. As a result, language processing theories are limited in their explanatory power of everyday speech. The present study used event-related potential (ERP) analysis of electroencephalographic (EEG) data to investigate online auditory comprehension of dialectal variation in English syntax. The syntactic variant under investigation was the double modal, which comprises two consecutive auxiliary (helping) verbs, such as 'might' and 'could' in the sentence 'She said we might could go on Tuesday.' This construction is found across subregional dialects of Southern United States English (SUSE) and typically expresses indirectness or uncertainty. We compared processing of double modal and standard single modal sentences in two groups of young adult participants: Mainstream American English (MAE) listeners who are unfamiliar with double modals and Southern United States English (SUSE) listeners who use these constructions. MAE listeners engaged both rapid detection of non-standard language (early anterior negativity) and sentence-level reanalysis (P600) for double modals, which aligned with their performance on offline language tasks. SUSE listeners showed a trend toward these effects in their ERP data, but not in their behavioral data. We interpret these findings in relation to theories of dialect contact, which clarify the dynamics among prestige, salience, and dominance in processing linguistic variation.

Topic Area: LANGUAGE: Syntax

B62 Evidence for adult-like hippocampal pattern similarity across shared contexts in early childhood

Elizabeth Eberts[1], Susan Benear[1], Chi Ngo[2], Emily Cowan[1], Cat Camacho[3], Susan Perlman[3], Vishnu Murty[1], [1]Temple University, [2]Max Planck Institute for Human Development, [3]Washington University in St. Louis

Discriminating between similar features of events is an important function of the hippocampus. The protracted development of the hippocampus may underlie a developmental emphasis on extracting generalized knowledge rather than specificity of events during childhood (Keresztes et al., 2018). Pattern similarity offers a tool to explore how the hippocampus represents related experiences and to characterize these changes across childhood. To assess this question, 25 children (age range: 4-10; M = 7.36 years) and 19 adults (age range: 20-32; M = 25.74 years) viewed movie clips while undergoing fMRI. Pairs of clips were pulled from the same movie (16 total clips, 8 pairs), allowing us to use multivariate pattern analysis to investigate neural pattern similarity within and across movies. There was greater pattern similarity in the left hippocampus within clips from the same movie compared to different movies for both the children ($p = .0048$) and adults ($p = .0389$); pattern similarity did not significantly differ between the two age groups ($p = .5243$). We further investigated representational patterns in the parahippocampal cortex (PHC), given its known role in processing contextual information. In left PHC, pattern similarity was significantly greater for shared contexts compared to across contexts only for adults ($p = .0426$); pattern similarity did not differ for children ($p = .1213$). However, there was no significant difference across groups ($p = .6976$). This data suggests that some hippocampal mechanisms (e.g., bridging episodes that share contextual information) may reach adult-like levels in childhood.

Topic Area: LONG-TERM MEMORY: Development & aging

B63 Relationships Between Sleep Quality and Neural Reinstatement of Associative Memory in Young and Older Adults

Emily Hokett[1], Soroush Mirjalili[1], Audrey Duarte[1], [1]Georgia Institute of Technology

Compared to young adults, older adults tend to have worse sleep quality and episodic memory. Older adults experience habitually disrupted sleep patterns and have difficulty binding and retrieving detailed associative memories. Sleep fragmentation may interfere with both encoding and retrieval. Individual differences in the degree of reinstatement of neural activity present during encoding and retrieval supports episodic memory accuracy. However, the association between individual differences in objectively-measured sleep quality and episodic memory at the neural level is largely unexplored, especially in older adults and diverse racial groups. Considering that racial/ethnic minorities report worse sleep quality than non-minorities, the degree of neural reinstatement in racial/ethnic minorities at encoding and subsequent retrieval could be associated with the degree of sleep fragmentation. Thus, the current study primarily aimed to answer whether sleep quality was differentially associated with behavioral memory performance and underlying neural reinstatement of associative memory by age group and racial group. To explore this, we recruited a diverse sample of young and older adults; measured one week of their sleep quality using accelerometry; and recorded participants' EEG during an associative memory task. Older adults demonstrated worse associative memory than young adults, and Black adults experienced poorer sleep than White adults. Across age and racial groups, neural reactivation for confidently-remembered word pairs between encoding and retrieval was positively related to memory accuracy. Furthermore, sleep fragmentation was associated with reduced pattern similarity and reduced memory performance. Thus, poorer sleep quality corresponded with poorer associative memory accuracy and reduced memory-related neural reactivation.

Topic Area: LONG-TERM MEMORY: Development & aging

B64 Utilizing socioemotional processing to alter older adults' memory: implications for individual differences in cognition

Rachel Van Boxtel[1], Jaclyn Ford[1], Elizabeth Kensinger[1],[1]Boston College

Healthy aging is associated with a characteristic decline in working memory and ability to learn new information. This could be due to age-related degradation of the prefrontal cortex (PFC)(Raz et al., 1997), and that engagement of the lateral PFC- which is typically associated with successful memory and recall in younger adults- becomes less efficacious with age (Grady, 2008). Recently, it has been argued that the degraded lateral regions may be bypassed by engaging the mPFC in older adults (MacPherson, Phillips, & Della Sala, 2002). Prior work indicates that the mPFC can be strategically activated to better encode and retrieve memories of socioemotional relevance (Gutchess & Kensinger, 2018), and may be involved in an association between memory and music (Janata, 2009). Based on this evidence, an online memory study (n=750, with 525 participants age 55+) was conducted which incorporated a behavioral manipulation, either prior to encoding or retrieval, to test the effects of priming the mPFC using a self-reference, autobiographical memory, or music task. A secondary analysis examined the interaction of the behavioral manipulation with cognitive ability of older adults, assessed using the N-back test. We found unexpectedly high memory performance in older adults compared to young adults in this sample, leading to questionable generalizability of the findings. This memory enhancement appears specific to the memory task, as 2-back performance was predictably reduced with age. Unexpectedly, memory performance was not reliably influenced by involvement in any behavioral manipulation conditions, even when controlling for age or individual differences in 2-back performance.

Topic Area: LONG-TERM MEMORY: Development & aging

B65 March Madness: Behavioral, physiological, and neural effects of continuously updated surprise

James Antony[1], Sam McDougle[2], Thomas Hartshorne[1], Ken Pomeroy[3], Todd Gureckis[4], Uri Hasson[1], Ken Norman, [1]Princeton University, [2]University of California, Berkeley, [3]www.kenpom.com, [4]New York University

In domains where humans observe events unfold over time, such as listening to narratives or watching sports games, probabilistic beliefs in particular outcomes are continuously updated. In these domains, surprise occurs when there is a large discrepancy between previous and current beliefs. Additionally, surprising events seem to segment the ongoing flow of continuous experience and are better remembered. Here, we set out to characterize behavioral, physiological, and neural correlates of surprise in an event cognition framework. We used fMRI and eye tracking while human subjects viewed and freely recalled the final five minutes of high-stakes NCAA basketball games. We operationalized momentary beliefs (i.e., which team would win) using a 'win probability' metric derived from an expert basketball analyst, which were updated every time the possession of the ball changed. We approximated surprise using the derivative of the belief time course, which changed after a team scored or turned the ball over to the opposing team. Behaviorally, we found that surprise across possession boundaries predicted free recall for those possessions. Surprise also increased linearly with pupil area increases across the boundary and midbrain responses related to dopamine processing. Finally, Hidden Markov Model analyses, which allow for characterizing neural activity into stable states and jumps between those states, show that the ventromedial prefrontal cortex transitions between states infrequently, but does so most often after surprising boundaries, suggesting this area represents changes in higher level beliefs. We hope this research will enhance knowledge of the neural mechanisms underlying event segmentation and memory.

Topic Area: LONG-TERM MEMORY: Episodic

B66 An ERP investigation of the effects of acute stress on memory formation and judgments of learning

Felicia Chaisson[1], Lauryn Burleigh[1], Steven Greening[1], Heather Lucas[1], [1]Louisiana State University

Acute stress can facilitate memory for threat-relevant information. However, little is known about how stress influences memory for threat-neutral information, and even less about its impact on metamemory processes such as judgments of learning (JOLs). To investigate these issues, we asked participants to view and attempt to recall two sets of neutral words, one of which was encoded in a stressful context using the threat-of-shock paradigm (threat blocks), and one of which was encoded without threat (safe blocks). In addition, trial-by-trial JOLs were collected in both blocks to examine the effects of the threat manipulation on metamemory. Self-report and analysis of skin conductance data confirmed that participants experienced more anxiety during threat than safe blocks. Overall, participants remembered significantly fewer words that were encoded during threat blocks. By contrast, JOL magnitude and accuracy did not differ between blocks. To examine how threat impacts the neural correlates of memory encoding, we conducted a follow-up study in which continuous EEG was recorded during both encoding contexts. Relative to safe blocks, words encountered during threat blocks evoked larger (more negative) amplitudes of the N400 component associated with semantic processing, as well as a subsequent frontal negativity. Overall, these data

suggest that acute stress may harm memory, but not metamemory, by interfering with semantic processing of to-be-remembered information.

Topic Area: LONG-TERM MEMORY: Episodic

B67 The spatial reconstruction task is a sensitive measure of declarative memory in adults with traumatic brain injury

Natalie Covington[1], Neal Cohen[2], Melissa Duff[1], [1]Vanderbilt University Medical Center, [2]University of Illinois at Urbana Champaign

Hippocampal damage is common following traumatic brain injury (TBI), with even mild TBI resulting in changes to hippocampal structure and function. Subjective memory impairment is among the most common complaints in individuals in the chronic stage of recovery post-TBI, but often formal neuropsychological testing does not corroborate these subjective complaints. Here, we provide preliminary evidence that the spatial reconstruction (SR) task is a valid and reliable measure of declarative memory impairment post-TBI. Twenty-five patients with moderate-severe TBI and twenty-five demographically-matched healthy comparison participants completed the SR task and traditional neuropsychological tests of declarative memory. In the SR task, participants are asked to remember the locations of novel objects during a study phase, and then to reconstruct the studied scene by dragging objects back to their original studied locations. Patients with TBI were significantly impaired at placing items in their original studied locations relative to healthy participants. In contrast, patients did not significantly differ from healthy participants on a standardized measure of declarative memory, and all but two patients scored within a standard deviation of the normative mean. Test-retest reliability was assessed in a subset of the healthy participants (n = 16), who returned and completed an alternate form of the SR task, and ranged between 0.63 and 0.80 for the four memory measures assessed. Taken together, the SR task shows promise as a valid, reliable measure of declarative memory that may be more sensitive to subtle (but meaningful) memory impairments that are not captured by existing neuropsychological measures.

Topic Area: LONG-TERM MEMORY: Episodic

B68 The Effects of Time of Day and Brief Recovery Sleep on Emotional Perception Abilities following Total Sleep Deprivation

Tony Cunningham[1, 2], Ryan Bottary[3], Elizabeth Kensinger[3], Robert Stickgold[1], [1]Beth Israel Deaconess Medical Center, [2]Harvard Medical School, [3]Boston College

Brief periods of recovery sleep following acute sleep loss can restore normal performance abilities on basic cognitive tasks (e.g. vigilance, working memory, spatial abilities). Emotion perception, a complex cognitive process that is both socially and psychopathologically relevant, is also negatively impacted by total sleep deprivation (TSD), yet virtually no studies have explored if a nap post-TSD can restore this ability. In the present study, participants categorized and rated the intensity of a range of emotional faces (Happy, Sad, Angry, Neutral) at baseline (2100), at 0900 following a night of TSD, and at 1400 following either a 90-minute nap opportunity (nap group) or continued wakefulness (wake group). Vigilance testing revealed that all participants committed more omission errors at 0900 following TSD [t(37)=2.8, p=0.008], but both groups returned to baseline levels of vigilance by 1400. Emotional categorization was impaired in all participants after TSD [t(39)=5.5, p

Topic Area: LONG-TERM MEMORY: Episodic

B69 Slow oscillation-spindle coupling during slow-wave sleep impairs emotional memory consolidation following stress

Dan Denis[1], Sara Y. Kim[1], Sarah M. Kark[2], Ryan T. Daley[3], Sara E. Alger[4], Elizabeth A. Kensinger[3], Jessica D. Payne[1],[1]University of Notre Dame, [2]University of California Irvine, [3]Boston College, [4]Walter Reed Army Institute of Research

Sleep and stress can both enhance emotional memory consolidation. During slow wave sleep (SWS), oscillatory features such as slow oscillations (SO), sleep spindles (SS), and critically, their coupling, are believed to facilitate consolidation. How they relate to emotional memory consolidation is less clear, and how stress interacts with these oscillations is unknown. In this study, participants either underwent a psychosocial stressor (the Trier Social Stress Task; n=32) or a control task (n=32). Next, they encoded 150 neutral, negative, and positive images while undergoing fMRI. Participants then slept overnight in the lab with polysomnographic recording. The next day they were given a surprise recognition test. Behavioral results show better memory for emotional compared to neutral items, but only in the stress group. Sleep analyses revealed that percentage of time spent in SWS positively correlated with consolidation for emotional items (r=.37, p=.039) in the stress group. However, SO-SS coupling during SWS was negatively correlated with emotional memory in the stress group (r=-.47, p=.007), driven by participants who showed a high cortisol response (cortisol * coupling interaction p=.03) following the stressor (r=-.58, p=.019). Results were similar when negative and positive items were analyzed separately. No correlations with neutral item memory were found. These results suggest that sleep stage time and sleep oscillatory activity exert different effects on emotional memory following stress, and that SO-SS coupling does not always promote episodic memory consolidation. SO-SS coupling can impair emotional memories when encoded during periods of elevated stress, and accompanying neuromodulators such as cortisol are high.

Topic Area: LONG-TERM MEMORY: Episodic

B70 Enhancing object-location associative memory through reward

Evan Grandoit[1], Michael S. Cohen[2], Paul J. Reber[1], [1]Northwestern University, [2]University of Pennsylvania

The influence of dopamine on memory in the medial temporal lobe has been linked to enhanced memory consolidation for stimuli associated with reward. The conditions under which reward potentiates memory and memory associations for immediate and delayed retrieval tests are not yet well-characterized. Here, participants (n=24) learned a series of object-location associations for stimuli placed around a 2D-ring (12 lists of 8 item-location pairs, 96 total stimuli presented twice each) followed by a reward-induction task. Participants were challenged to perform a time-estimation task in the presence of a subset of the memory stimuli for which success was rewarded with points. In a contrasting low-reward condition, participants simply responded to an image at a fixed delay for minimal points. Each list of stimuli contained two categories, one associated with high-reward and one for low, with half of each presented in the reward task. Memory for the location of each item was assessed both within the first session and after a 48-hour delay. On the first memory test, participants exhibited significantly higher accuracy in retrieving the spatial location of high reward-associated images (M=89.6%, SE=2.4%) compared with low reward-associates (M=86.7%, SE=3.2%), F(1,23)= 4.3, p

Topic Area: LONG-TERM MEMORY: Episodic

B71 Memory for Feedback Events Depends on Feedback Valence and Timing: Evidence from Event-Related Potentials

Gerrit Höltje[1], Axel Mecklinger[1], [1]Saarland University

The processing of temporally delayed feedback is supported by brain structures associated with declarative memory, but it is unknown how delayed feedback processing and memory encoding interact. We employed a subsequent memory paradigm to investigate how the incidental encoding of feedback pictures presented with a short (SD, 500 ms) or long (LD, 6500 ms) delay in a probabilistic learning task affects feedback processing as reflected in the feedback-related negativity (FRN). The FRN was measured in feedback-locked event-related potentials (FRN-peak) and in negative minus positive feedback difference waves (FRN-diff). In Experiment 1, task-unrelated scene pictures were presented together with performance feedback in the learning task. Pictures were remembered better when presented together with positive than with negative feedback, and event-related potential amplitudes in the FRN-diff time window predicted subsequent memory only for positive feedback pictures. However, feedback timing did not affect memory, presumably because participants did not need to process the scene pictures in order to learn from feedback. In Experiment 2, the picture category signaled the valence of the feedback. LD feedback pictures were associated with better memory and more recollective processing than SD feedback pictures. Feedback processing as reflected in the FRN-peak was attenuated for remembered as compared to forgotten LD feedback pictures. This suggests that when feedback was delayed, feedback processing and memory encoding competed for similar neural processing resources. The processing of positive and delayed feedback can boost memory for feedback events, but enhanced memory for delayed feedback events comes at the cost of diminished feedback processing.

Topic Area: LONG-TERM MEMORY: Episodic

B72 Spatiotemporal dynamics between interictal spikes and ripples during associative memory processing in humans

Simon Henin[1], Anita Shankar[2], Helen Borges[1], Adeen Flinker[1], Werner Doyle[1], Daniel Friedman[1], Orrin Devinsky[1], Gyorgy Buzsaki[3], Anli Liu[1], [1]NYU Langone Medical Center, [2]The Ohio State University, [3]NYU Neuroscience Institute

Epilepsy patients undergoing invasive electroencephalography (iEEG) for surgery allow fine-grained dissection of the spatiotemporal dynamics of memory. We describe the course of high gamma activity (HGA, 70-180 Hz) across the brain and hippocampal ripples during an associative memory paradigm. We examine the impact of pathological interictal epileptiform discharges, or spikes, by region, on encoding and retrieval using a computerized face-profession association task in 15 surgical epilepsy patients. Electrode localization and spike identification was performed with automated processes and expert review. We analyzed: (i) spectrotemporal differences in HGA across brain regions, (ii) ripple rate (60-170 Hz) in the hippocampus and (iii) distribution of spikes by region between successful and failed encoding and retrieval trials. Successful encoding trials demonstrated greater HGA during late (1000-2000 ms) encoding in medial temporal lobe (hippocampus, and amygdala) and frontal regions (pars triangularis/orbitalis, superior temporal gyrus), whereas successful retrieval trials sustained later HGA in hippocampus (1000-2000 ms). Hippocampal ripple rates were greater during successful encoding and retrieval trials. Interictal spikes in hippocampus, temporal pole, and middle temporal region during encoding predicted a 15-19% decreased odds of remembering. Spikes in hippocampus during retrieval predicted a 19-45% decreased odds of remembering. Odds of remembering were further reduced during if spikes occurred during the 1000-2000 ms of encoding or retrieval. Hippocampal spikes seen during the 1000-2000 ms of encoding were followed by a decrease in ripple rate. Our results suggest that spikes impair associative memory in a regionally and temporally specific manner, potentially via decreasing hippocampal ripple rate.

Topic Area: LONG-TERM MEMORY: Episodic

B73 Hippocampal-targeted theta-patterned stimulation immediately enhances memory processing: A simultaneous TMS/fMRI study

Molly S. Hermiller[1], Rachael A. Young[1], Yu Fen Chen[1], Todd B. Parrish[1], Joel L. Voss[1], [1]Northwestern University

Hippocampal theta-band rhythmic activity (4-8 Hz) is thought to provide a temporal framework for coding experiences into memory, but this has not been directly tested in humans. We used simultaneous TMS/fMRI to deliver theta-patterned noninvasive stimulation while measuring its immediate effect on hippocampal memory processing via functional MRI. During scanning, subjects (N=16) performed a task that allowed us to measure hippocampal-dependent memory processing (complex scene encoding), relative to a numerical processing control task that does not engage the hippocampus (odd/even number judgments). Brief (2 sec) trains of either theta-patterned or beta-frequency stimulation were delivered immediately prior to each stimulus onset. Stimulation targeted either the hippocampus (indirectly via its network locations) or an out of network control site (supplemental motor cortex). We found that hippocampal-targeted theta-patterned stimulation increased hippocampal activity during successful memory formation and strengthened subsequent recollection, relative to scenes studied without stimulation. There was no effect of stimulation on numeric processing, indicating that hippocampal theta is selective in its contribution to episodic memory. Control stimulation conditions using beta-frequency and non-hippocampal targeting did not influence hippocampal memory processing. Therefore, stimulation targeting hippocampal theta was therefore unique in its immediate influence on hippocampal memory processing, suggesting privileged access to hippocampal neuronal function. This finding supports the crucial role of theta rhythmic activity in hippocampal-dependent episodic memory in humans and could motivate stimulation interventions to rescue hippocampal function in individuals with memory impairments.

Topic Area: LONG-TERM MEMORY: Episodic

B74 Remembering the link: Free-recall performance in individuals at risk for schizophrenia

Aslihan Imamoglu[1], Claudia Foubert[1], Stephanie Langella[1], Aysenil Belger[2], Kelly Giovanello[1], [1]University of North Carolina, Chapel Hill, [2]UNC Frank Porter Graham Child Development Institute

Schizophrenia is a mental disorder that affects approximately 1% of people. Cognitive changes, specifically impairments of memory, are widespread in schizophrenia. Such memory impairments are also seen in first-degree relatives, who are at risk for developing the disorder (i.e. 10-16%). Other risk factors include having a first-degree relative with schizoaffective and/or bipolar disorder (i.e. high-risk) and having ADHD and/or anxiety disorders (i.e. mid-risk). To further elucidate the nature of this impairment in young individuals at-risk for schizophrenia, we employed a word-list based free recall task. Twenty-nine first-degree relatives and non-relatives between the ages of 9-16 years-old were recruited for the current study. Participants were categorized into one of three groups (high-risk, mid-risk, and low-risk). We hypothesized that higher levels of risk would predict worse free recall performance. Preliminary analyses show worse performance in the high-risk group (M = 4.6), relative to the mid-risk (M = 5.6) and low-risk (M = 6.4) groups. Additionally, we decomposed free recall performance by examining serial position functions, first-recall probability, and interresponse times. These preliminary analyses suggest that, despite all groups showing primacy and recency effects, the

high-risk group appeared to commence retrieval from the middle-end of the list more often than the mid- and low-risk groups. Finally, no slowing of the interresponse times throughout the recall period was observed. These preliminary findings may reflect a cognitive disorganization that has been previously detected in at-risk individuals in other cognitive domains, including working memory and executive functions.

Topic Area: LONG-TERM MEMORY: Episodic

B75 Hippocampal activity mediates the relationship between successful memory encoding and pupil response

Alex Kafkas[1], Nanne Kukkonen[1], Daniela Montaldi[1], 1University of Manchester

The pupil response at encoding has previously been found to predict later memory strength (Kafkas & Montaldi, 2011). Here we aimed to understand the causal link between encoding-linked pupil response and the role of key brain regions involved in long-term memory. To this end, eye tracking and functional MRI was employed concurrently during an incidental encoding task. Twenty healthy volunteers (mean age: 25.7 years, SD = 3.6 years; 12 females) underwent fMRI/eye tracking, while they incidentally encoded a series of man-made and natural pictorial stimuli. After scanning, participants engaged in a recognition memory task in which studied and unstudied (new) stimuli were rated as new, familiar (weak, moderate, strong) or recollected. We replicated our previous pupillometric finding showing that the extent of pupil response was predictive of subsequent memory. This is characterised by reduced levels of pupil dilation at encoding for subsequently strongly familiar and recollected stimuli, while subsequent misses and weaker familiarity responses were associated with increased pupil dilation at encoding. Importantly, activity in the right hippocampus (for hits versus misses) was parametrically modulated by the degree of pupil response and this effect was most pronounced in the case of subsequently recollected stimuli. The findings strongly support the close link between pupil response and long-term memory formation and have implications for the role autonomic control (as reflected by pupil response) and selective neurotransmitter function in driving hippocampally-mediated novelty detection and memory formation.

Topic Area: LONG-TERM MEMORY: Episodic

B76 Computational accounts for memory in reinforcement learning

John Ksander[1], Christopher Madan[2], Angela Gutchess[1], [1]Brandeis University, [2]University of Nottingham

It seems intuitive that rewarding experiences may be remembered differently from unremarkable ones. Moreover, our decisions would benefit by remembering salient experiences. Episodic memory in value learning has become a recent focus in decision?making research, however the existing literature shows a complicated relationship between reward and memory. The current study provides a computational account that unifies mixed results from several experiments. Here participants first learned reward values associated with words through two-alternative forced choice tests. Participants were then asked to recall as many words as they could remember. Crucially, differences in the value learning procedure produced three qualitatively different results: linear, U-shaped, and attenuated relationships between reward and memory. Prior work interpreted these mixed results in terms of additive psychological processes (e.g. reward, salience, and boundary effects). The current results demonstrate these results can be explained by assuming a memory's strength depends on its contextual utility. That is, memory strength depends on how much mnemonic information changes reward expectations. This concept is distinct from assuming people merely remember highly rewarding experiences better (i.e., strictly linear relationship between reward and memory). We modeled our hypothesis within a reinforcement learning framework, and simulated participants' learning and memory behavior during these experiments. The model successfully reproduced all three reward-memory relationships observed in these experiments, without requiring additional psychological processes. This result provides a more parsimonious explanation for the data in this literature.

Topic Area: LONG-TERM MEMORY: Episodic

B77 Where does this go? Memory accuracy for object locations across egocentric and allocentric space in aging

Natalia Ladyka-Wojcik[1], Nathanael Shing[2], Jennifer D. Ryan[1, 2], Rosanna K. Olsen[1, 2], Morgan D. Barense[1, 2], [1]University of Toronto, [2]Rotman Research Institute

Aging is associated with deficits in spatial memory for object locations across egocentric (first-person) and allocentric (map-based) spatial frames of reference. However, little is known about how this age-related decline interacts with cognitive status. In this study, we used desktop virtual reality to compare object-location memory across spatial frames of reference in older adults, both healthy and at-risk for mild cognitive impairment (MoCA score

Topic Area: LONG-TERM MEMORY: Episodic

B78 Moment-to-moment and individual differences in spontaneous lapses of attention at encoding predict subsequent memory

Kevin P. Madore[1], Anna Khazenzon[1], Anthony Norcia[1], Anthony Wagner[1], [1]Stanford University

The ability to sustain attention prior to an experience may impact the event's encoding and later remembering. Extant research indicates that experimentally induced blocks of full vs. divided attention impact episodic encoding and subsequent memory. We recorded concurrent EEG+pupillometry (N=80) during a goal-directed encoding and retrieval task to answer two related questions: How do spontaneous lapses of attention at the trial level relate to goal coding and goal-directed behavior during learning, and subsequent memory? Are trait-level differences in memory partially explained by differences in the ability to sustain attention? During incidental encoding, subjects classified objects via either a conceptually- or perceptually-cued goal; subsequent memory was assessed via source and item recognition. In addition, subjects completed a separate attention go/no-go task (gradCPT). During encoding, moment-to-moment pre-trial tonic lapses of attention assayed from posterior alpha power (8-12Hz) and pupil diameter significantly predicted RT slowing for object classifications; these effects were partially mediated by the strength of goal coding, assayed from a midfrontal ERP cluster. These multimodal lapse markers also significantly predicted subsequent source memory for the cued objects at retrieval, partially mediated by changes in established difference-due-to-memory effects at encoding from a midfrontal ERP cluster and RT. At the individual level, we further observed that no-go errors on the independent attention task, and neural lapsing and RT variability at encoding, were significantly negatively related to memory discriminability. These results indicate that moment-to-moment and individual differences in attention lapsing partially account for why we sometimes remember and sometimes forget.

Topic Area: LONG-TERM MEMORY: Episodic

B79 Unexpected but plausible: The consequences of disconfirmed predictions for episodic memory formation

Axel Mecklinger[1], Gerrit Höltje[1], Lika Ranker[1], Kathrin Eschmann[2],[1]Saarland University, [2]Cardiff University

The semantic congruency of an event in a given context has a strong impact on subsequent memory performance. It is assumed that semantically congruent events are rapidly assimilated into a schema and thereby support the acquisition of new schema congruent knowledge. However, events which are unexpected in a given schema context, or completely incongruent, also show a mnemonic advantage relative to unrelated events, even though it is unclear by which mechanisms episodic memory formation for these events is supported. We recorded EEG during the encoding of words which were of high typicality (expected), low typicality (unexpected), or incongruent with a preceding category cue phrase. High and low typicality words were remembered better than incongruent ones. Subsequent memory effects in the event-related potential emerged at parietal recording sites for congruent words (high and low typicality) but not for incongruent ones, suggesting that semantic congruency strengthens memory by supporting the encoding of item-specific details. Low typicality words, which were unexpected but nevertheless plausible in the categorical context, elicited a late frontal positivity which correlated negatively with the amount of false positive responses in the ensuing recognition memory test. These words also elicited an increase in late fronto-midline theta power in the non-phase-locked EEG data, which suggests that the theta effect is not just the spectral manifestation of the late positivity. Together, these findings suggest that the frontal positivity and theta activity reflect control processes initiated by disconfirmed predictions that support the contextual integration of unexpected words and the inhibition of expected ones.

Topic Area: LONG-TERM MEMORY: Episodic

B80 Interactions between categorical and temporal structure during retrieval

Daniel Rubinstein[1], Christoph Weidemann[2], Nora Herweg[2], Ethan Solomon[2], Michael Kahana[2], Michael Sperling[1], [1]Thomas Jefferson University, [2]University of Pennsylvania

Recent evidence demonstrates the contribution of medial temporal lobe (MTL) theta activity to the semantic organization of unrelated items during free recall (Solomon et al., 2019). Here we asked whether the study of categorically structured word lists would mediate theta's role in the semantic and/or temporal organization of memoranda. Lists were organized in word pairs of the same category, with two pairs of each of three categories. Pairs of each category were separated by at least one pair from a different category (e.g. A1A2, B1B2, A3A4). We asked how different types of transitions between consecutively retrieved words would mediate MTL theta power. We define four transition types, depending on semantic (either within- or between-category), and temporal relation (either adjacently presented during encoding or 'non-adjacent' -- separated by at least 1 word). For example, for an encoding segment of A1A2,B1B2,A3A4, a transition during retrieval of A2-A3 would be within-category non-adjacent. Intracranial EEG was recorded from implanted electrodes in 105 epilepsy patients being monitored for seizures. We find that MTL theta power is greater for temporally adjacent transitions, only for between-category transitions. For both temporally adjacent and within-category transitions, MTL theta power is relatively unchanged. These results are consistent with previous work showing that MTL theta codes for inter-item semantic and temporal distance, but further suggest that this relation may not apply to items that may have joined into a unitary memorandum due to sharing both semantic and temporal contexts.

Topic Area: LONG-TERM MEMORY: Episodic

B81 Actively testing hypotheses using acquired information during encoding enhances delayed memory

Xinxu Shen[1], Vishnu Murty[1], David Smith[1], [1]Temple University

Testing hypotheses we have in the world using acquired information is critical for goal-directed behaviors. Previous studies suggest that information seeking is related to memory enhancements, yet little is known about how hypothesis testing influences memory for acquired information. Here, we developed an innovative paradigm to characterize the effect of hypothesis testing on memory encoding state and we predict that actively testing hypotheses will enhance memory. Twenty-two participants were presented with three stimuli, each consisting of one feature on three different dimensions. Participants were either instructed to figure out the target feature (hypothesis testing condition), or were forced to select one stimulus (control condition). Trial-unique images were presented when participants selected the stimulus with the target feature. Target feature changed after four consecutive choices of the stimulus with the target feature. A surprise memory test was administered at a 24-hour delay. We found that mean response time before rule changes is shorter than mean reaction time after rule changes (p

Topic Area: LONG-TERM MEMORY: Episodic

B82 How is Intentional Forgetting Reflected in Implicit Eye Movements?

Jonathon Whitlock[1], Yipei Lo[1], Judy Chiu[1], Lili Sahakyan[1], [1]University of Illinois at Urbana-Champaign

Intentional forgetting of unwanted information is studied with directed forgetting (DF) procedures, which involves presenting forget (F) or remember (R) cues after each item (item-method), or after an entire list (list-method). Both methods impair memory for F-items, but due to different underlying mechanisms. DF has been largely studied by examining memory for items that survived in memory despite the F instruction. In contrast, we employed a novel approach, by using eye-tracking in conjunction with relational memory paradigm in order to examine whether eye-movements differentiate successful intentional forgetting (subsequently forgotten F-items) from accidental forgetting (subsequently forgotten R-items). Research indicates that eye-movements are a sensitive marker of relational memory even in the absence of conscious recollection. Across two experiments, participants studied object-scene pairings, in either an item-method (Experiment 1) or a list-method (Experiment 2) procedure. At test, participants indicated which of three previously studied objects was presented with the background scene during encoding (i.e., target), while their eye-movements were recorded. Behaviorally, participants were less likely to correctly select object-scene pairings followed by an F than R instruction in Experiment 1, but not Experiment 2, indicating that item-method, but not list-method, DF impaired relational memory. Eye-movements also revealed differences across experiments. In Experiment 1, the eyes preferred to view missed R-targets, but not missed F-targets, indicating that accidental forgetting retained implicit memory for targets, whereas successful intentional forgetting eliminated memory for targets in item-method DF. In contrast, list-method DF preserved implicit memory for targets regardless of accidental forgetting or successful intentional forgetting.

Topic Area: LONG-TERM MEMORY: Episodic

B83 Hippocampal Contributions to the Acquisition of Response Contingencies during Value-Based Reinforcement Learning

Virginie M. Patt[1,2], Daniela J. Palombo[3], Mieke Verfaellie[1,2], [1]Boston University, [2]VA Boston Healthcare System, [3]University of British Columbia

To shed light on the nature of hippocampal contributions to value-based reinforcement learning, we applied computational modeling to amnesic performance and neuroimaging data, obtained in a probabilistic learning task involving learning the value of six visual patterns (Palombo et al. 2019). Two models were constructed. The first model used well-established reinforcement learning, which models values for stimulus-response contingencies and updates them depending on prediction error whenever a stimulus is presented. This model assumes maintenance of acquired knowledge without decay across non-consecutive presentations of a stimulus. The second model was similar but added the possibility of decay. Responses of control subjects were better fit by the model without decay (N=22, Log(Bayes Factor)=-1.2). By contrast, responses of amnesic patients with hippocampal lesions were better fit with decay (N=8, Log(Bayes Factor)=2.3), suggesting impaired maintenance of information supporting acquisition of response contingencies. Next, using fMRI data from healthy subjects (N=30), time series were computed for trial-by-trial prediction error and progressively acquired knowledge, and were used as parametric modulators in a whole brain general linear model analysis (cluster-based threshold: p=.001). Consistent with previous studies, prediction error correlated with activation in the basal ganglia, amygdala, and ventromedial prefrontal cortex. Critically, prediction error also correlated with activation in the anterior hippocampus. Progressively acquired knowledge correlated with activation in the dorsal precuneus and middle cingulate gyrus, key regions of the parietal memory network. Taken together, these results suggest a critical contribution of the hippocampus in the updating and maintenance of response contingencies during value-based reinforcement learning.

Topic Area: LONG-TERM MEMORY: Other

B84 The varied influence of prior knowledge on perception, retention, and new learning

Erik A. Wing[1], Ford Burles[1], Jennifer D. Ryan[1], Asaf Gilboa[1], [1]Rotman Research Institute, Baycrest

Prior knowledge and experience strongly influence both low-level stimulus processing and a range of higher-level cognitive operations. In the present study, we explored how specialized knowledge benefits multiple types of memory, while also facilitating visuosemantic comparisons. In a modified item memory test, expert birdwatchers successfully recognized new exemplars of local bird species more often than control participants. A similar, albeit smaller, benefit was also found for recognition of species unfamiliar even to experts, indicating that both personal familiarity and generalized domain schemas contribute to episodic memory function. A corresponding enhancement was also found in an associative memory test containing pairs of birds and inanimate objects, suggesting that arbitrary terms can be linked efficiently with well-known information. In addition to mnemonic effects, the performance of experts on a visuosemantic matching test also reflected separate benefits of semantic knowledge and generalized domain schemas when contrasted with control group performance. Several sessions of training led to an improvement in matching performance for both experts and controls. Notably, the experts showed greater transfer of training to new, untrained, exemplar versions of trained material suggesting prior knowledge supports more generalized forms of learning. These findings suggest that expertise can encompass both increased semantic familiarity and generalized schemas, which may facilitate memory and perception.

Topic Area: LONG-TERM MEMORY: Other

B85 Long-term memory-guided attention and alpha-band oscillations: Implicit access to spatial information

Manda Fischer[1], Morris Moscovitch[1], Claude Alain Rotman[2], [1]University of Toronto, [2]Research Institute at Baycrest Hospital

Can implicit (non-conscious) associations facilitate auditory target detection? Participants were presented with 80 different audio-clips of familiar sounds, in which half of the clips included a lateralized pure tone. Participants were only told to classify audio-clips as natural (i.e. waterfall) or manmade (i.e. airplane engine). After a delay, participants took a surprise memory test in which they were presented with old and new audio-clips and asked to press a button to detect a lateralized faint pure tone (target) embedded in each audio-clip. On each trial, they also indicated if the clip was (i) old or new; (ii) recollected or familiar; and (iii) if the tone was on the left, right, or not present when they heard the audio-clip prior to the test. The results show good explicit memory for the clip, but not for the tone location or tone presence. Target detection, however, was faster for old clips than for new clips but did not vary as a function of the association between spatial location and audio-clip. Alpha power was greater for audio-clips that were associated with a left compared to right target over left occipital-parietal and right frontal regions. The neural data suggest that target location was implicitly encoded and may index top-down control of auditory spatial attention. Together, the results provide converging evidence that implicit associations were formed and used for anticipatory mediation of auditory attentional resources. The implications of these findings in the context of theories of memory-guided attention are discussed.

Topic Area: LONG-TERM MEMORY: Priming

B86 Laying the tracks for memory integration: Semantic processing of the first premise

Julia Wilson[1], Nicole Varga[2], Patricia Bauer[1], [1]Emory University, [2]University of Texas at Austin

Self-derivation of new knowledge through memory integration is a means of expanding semantic memory. Even among high-performing college students, there are pronounced individual differences in the process. Prior research has characterized the neurophysiological profile of individuals who perform well on the task (Varga & Bauer 2017). In this study, we sought to elucidate the neurophysiological profile of low performers (scoring less than 50% correct), in the service of understanding factors that may hinder successful memory integration. We analyzed event-related potentials (ERPs) elicited on incorrect trials of low-performing participants previously excluded from a published study (Varga & Bauer, 2017). We report preliminary evidence of effects at encoding on incorrect trials that suggest low performers may not successfully process the semantic meaning of the first member of pairs of related premises, and thus fail to 'lay the tracks' for integration. The results suggest that instances of unsuccessful memory integration are associated with lack of deep processing of the semantic meaning of the first premise. These preliminary data may eventually have broad theoretical implications for understanding the temporal process of memory integration, as well as the potential to contribute to facilitating learning for individuals who do not capitalize as effectively on memory integration opportunities.

Topic Area: LONG-TERM MEMORY: Semantic

B87 Probing the effects of sleep reactivation on the kinematics and dynamics of movement with an EMG biofeedback task

Larry Y. Cheng[1], Tiffanie Che[1], Goran Tomic[1], Ken A. Paller[1], Marc W. Slutzky[1], [1]Northwestern University

People learn a wide variety of motor skills. Whereas performance on finger-tapping tasks has been found to benefit from sleep, acquiring a motor skill can

encompass a broad range of learning beyond the elementary sequence-learning required in such tasks. In particular, motor-skill acquisition involves learning at both the level of action selection (choosing from multiple alternatives) and action execution (improving the quality of movement kinematics or dynamics), which are not easily disentangled using measures of response speed in such sequence tasks. Here we investigated de novo motor skill learning using a novel task sensitive to changes in the kinematics and dynamics of movement execution. We trained healthy adults to control biofeedback motion of a computer cursor using myoelectric signals recorded from proximal and distal arm muscles. Participants learned to move the cursor from the center of a screen to one of eight peripheral target locations for each arm after a sound signified which target. Successful performance required precise control of one muscle (eight targets) or two arm muscles conjointly (eight targets). After learning to criterion, performance was tested. Next, eight sounds were selected to be played quietly during a nap to reactivate corresponding muscle-control networks. Additional testing after sleep revealed faster performance for cued target locations compared to other locations. In addition, cursor movement was more efficient for cued locations, with more selective control in activating target-relevant muscles. These results show that movement quality of a novel motor skill can be selectively improved during sleep, with implications for motor rehabilitation.

Topic Area: LONG-TERM MEMORY: Skill Learning

B88 The relevance of a movement sequence enhances procedural memory consolidation in children

Shoshi Dorfberger[1], Hazar Moadi[2], Avi Karni[2], [1]Gordon college of education, [2]Sagol Department of Neurobiology, University of Haifa

Although memory consolidation processes, generating long-term memory for skills ('how to' knowledge) are faster and perhaps less selective in children compared to adults, these processes in children, like in adults, are susceptible to interference by subsequent competing experiences. Here, using the finger-to-thumb opposition sequence (FOS) learning task, we show that, in 12 year-olds, the affordance of a context in which task relevance is increased can lead to more robust, and biased, consolidation-phase related (delayed, 'offline') performance gains. All of the children were given an identical training experience on a 5-element FOS. Children who practiced the sequence of movements in the more meaningful context - they were told that the performance of the FOS was a secret key to obtaining an entry code to a website with games - showed a small advantage in performance speed and accuracy within the training session, but in addition were able to express larger delayed gains, at 24 hours post training, compared to children practicing the sequence of movements in a neutral context. Moreover, practicing the sequence of movements in the more meaningful context resulted in significantly reduced susceptibility of the trained movement sequence to interference by a subsequent learning experience; robust delayed gains were expressed despite interference. We propose that task relevance, reward expectation, may constitute a factor which gates the generation of procedural memory in pre-adolescents, biasing the selection of what is to be maintained in long-term 'how to' memory.

Topic Area: LONG-TERM MEMORY: Skill Learning

B89 An Automated Method For Correcting Ocular Artifacts In EEG

Brian Kraus[1], [1]Northwestern University

A critical aspect of electroencephalography (EEG) pre-processing is treating ocular artifacts. One of the most popular methods for correcting ocular artifacts is the regression-based method proposed by Gratton et al., (1983). This method applies a separate regression correction for vertical saccades and blinks. However, one drawback of this method is that it can artificially introduce noise into the data due to differences in the estimation of beta coefficients for blinks and saccades. If the betas for blinks and non-blinks are not very close in magnitude, this will introduce an artificial discontinuity into the timeseries between blinks and non-blinks. In addition, the correction is sensitive to low frequency drifts in the data. Here, a new version of regression-based correction is proposed to address these issues. Both the original correction and the new correction were tested on a sample of 114 participants from published data (Kraus & Kitayama, 2018). The new correction retained data for significantly more participants by automatically removing epochs with low-frequency drifts (?2(1) = 4.167, p = .0412). In addition to removing these epochs, performing one correction on blinks and saccades retained data for significantly more participants than the original method (?2(1) = 19.047, p < .0001). The quality of the corrected data was not significantly different between corrections (p > .05). This new method of regression-based correction provides an equivalent correction to commonly used correction algorithms. However, it also has the advantage of retaining more data than the other methods and automatically removing epochs with low frequency drifts.

Topic Area: METHODS: Electrophysiology

B90 Prior reproductive experience modulates neural responses to infant faces across the postpartum period

Madison Bunderson[1], David Diaz[1], Angela Maupin[1], Nicole Landi[1,2], Marc Potenza[1, 3], Linda Mayes[1], Helena Rutherford[1], [1]Yale Child Study Center, [3]Yale University School of Medicine, [2]Haskins Laboratories, UConn

Infant-cue processing facilitates sensitive maternal care, which is necessary in the formation of healthy mother-infant attachment; this attachment in turn is a significant predictor of childhood wellbeing and development. Mothers may be particularly focused on infant-cue processing during the early postpartum period, contributing to intense preoccupation with their own infant's well-being. Another factor that may impact this intensity of infant-cue processing is prior reproductive experience, or parity, which has previously been found to influence neural responses to infant faces. In particular, parity has been shown to impact the P300, an event-related-potential component associated with attentional processing, during pregnancy and at 2 months postpartum. Specifically, primiparous (or first-time) mothers evidenced a larger P300 neural response to infant faces as compared to multiparous mothers. However, we do not know whether this parity effect persists further into the postpartum period. Thus, we utilized electroencephalography methodology to examine the P300 to infant faces in 59 mothers at 2 and 7 months postpartum. Our main finding was that primiparous, as compared to multiparous, mothers evidenced a significantly higher P300 response to infant faces, which was unaffected by the time elapsed postpartum, suggesting continuity in the neural response to infant faces across the postpartum period. Consequently, there may be more long-term changes in neural processing of salient infant cues beyond the immediate postpartum period. These findings also emphasize the importance of studying prior reproductive experience and its impact on the neural processing of infant faces in maternal brain research.

Topic Area: METHODS: Neuroimaging

B91 Brain response to action-observation in the angular gyrus relates to autistic-like traits in healthy adults

Helga De Oliveira Miguel[1], Thien Nguyen[1], Emma Condy[2], Kosar Khaksari[1], Hadis Dashtestani[1], John Millerhagen[1], Sheida Shahmohammadi[1], Amir Gandjbakhche[1], [1]National Institute of Child Health and Human Development, [2]National Institute of Mental Health

The action-observation network (AON), also referred to as the Mirror Neuron System (MNS) is associated to the ability to recognize and interpret others actions and emotions. It is suggested that this network is impaired in

individuals with ASD and might underlie the difficulties presented in action perception and imitation in this population. The aim of this study was to examine brain activity during a live action-observation and action-execution task and understand if patterns of brain activation relate to autistic traits in typically developing adults. Sixteen adults reached for objects or observed an experimenter reaching for objects while their brain activation was being recorded in the sensory-motor and parietal regions. Measures of oxy-hemoglobin (HbO2) and deoxy-hemoglobin (Hbb) were recorded using functional near infra-red spectroscopy (fNIRS). Autistic traits were measured using the Autism Spectrum Quotient (A-Q). A significant hemodynamic increase of HbO2 in the right ($p = 0.039$) and left ($p = 0.009$) angular gyrus was observed for individuals with higher autistic traits for the observation condition. The findings suggest that brain activity on angular gyrus for action observation might be related to individual differences on interpreting other's actions and emotions. Moreover, our study provides a framework for the use of fNIRS to study the AO network in neurodevelopmental disorders, namely ASD.

Topic Area: METHODS: Neuroimaging

B92 Integrating MVPA & graph theory methods: informational connectivity reveals dissociable functional networks in the brain

Ariana M. Familiar[1], Alice Xia[1], Sharon L. Thompson-Schill[1], [1]University of Pennsylvania

Network neuroscience methods have become increasingly useful for characterizing brain dynamics at the macro-level. Defining functional networks typically involves parcellating the brain into distinct regions, and computing connectivity between regions based on the covariance of univariate BOLD signal over time. Here, for the first time, we instead define networks using multivariate pattern analyses (MVPA) to measure the temporal synchrony of cognitive information transfer between regions (informational connectivity). We examine graph properties of task-based networks based on fMRI data collected while people viewed face images. Participants were scanned before and after four days of a behavioral point allocation task in which they learned associations between the faces, reward values (points), and social values (generosity). We defined connectivity between regions based on timecourses of face identity decoding, as well as decoding of learned value categories, and compare pre- and post-learning network properties. Our results show that: (1) different value types recruit separate but overlapping networks with distinct patterns of connections, (2) the architecture of these networks is related to individual differences in behavior during learning, and (3) after learning, core (fusiform gyrus) and peripheral (anterior temporal lobe) face processing areas act as hubs that connect regions across separate community modules, increasing the overall efficiency of processing face identity and value information. More generally, we demonstrate how MVPA-based connectivity can be used to define networks that are otherwise inseparable with univariate functional connectivity measures. We aim to make this approach more accessible by providing open source code that utilizes publicly available MATLAB toolboxes.

Topic Area: METHODS: Neuroimaging

B93 The relationship between brain structure and peak alpha frequency in children with autism and controls

Heather L. Green[1], Marissa Dipiero[1], Jeffrey Berman[1], Luke Bloy[1], Song Liu[1], Lisa Blaskey[1], Emily Kuschner[1], Megan Airey[1], Mina Kim[1], Rose Franzen[1], Theresa Mowad[1], Timothy P. L. Roberts[1] J.Christopher Edgar[1], [1]Children's Hospital of Philadelphia

Electroencephalography (EEG) and magnetoencephalography (MEG) studies have demonstrated abnormal resting state (RS) alpha activity in children with autism spectrum disorder (ASD).The present study sought to better understand RS alpha activity by examining associations between brain structure and peak alpha frequency (PAF) in typically developing children (TDC) and children with ASD. Eyes-closed RS MEG and structural and diffusion MRI data were obtained from 51 TDC (M=12.8years) and 70 children with ASD (M=11.9years). For each participant, PAF was identified (7-13Hz) from the posterior brain region showing the largest amplitude alpha activity. Lasso analyses examined function-structure associations, focusing on brain structures hypothesized to play a role in alpha generation: left/right cuneus, precuneus, parietal, and occipital surface area, left/right thalamic volume, and midline parietal fractional anisotropy (FA). In TDC, all examined brain structures predicted variance in PAF ($r2=0.36$). In ASD, only midline parietal FA, left cuneus and left occipital grey-matter surface area accounted for variance in PAF ($r2=0.08$). Although no group differences in PAF or brain structure were observed, age was associated with structure and function brain measures in TDC but not ASD. Present findings suggest the RS alpha network involves thalamic, posterior white matter, and posterior cortical areas in TDC, and that this thalamo-cortical RS network is disturbed in ASD. Overall, findings suggest abnormal brain maturation in ASD, with less organized brain development perhaps accounting for the paucity of RS structure-function associations in ASD.

Topic Area: METHODS: Neuroimaging

B94 The central executive network in Alzheimer's Disease: A meta-analysis of structural and functional MRI

Malvina Pietrzykowski[1], Katrina Daigle[1], Abigail Waters[1], Lance Swenson[1], David Gansler[1], [1]Suffolk University

The central executive network has been identified as a site of significant pathology in Alzheimer's disease (AD). The degree to which this network is associated with observable cognitive deficits varies across the literature, particularly between imaging modalities. The goal of this meta-analysis was to assess the concordance between structural and functional MRI studies of the central executive network in AD. Method: Studies were included if (1) participants were human subjects over 50 with a diagnosis of AD and (2) functional BOLD or structural grey matter volumetric MRI was used to measure the relationship between tasks of executive functioning and the central executive network (i.e., dorsolateral prefrontal and posterior parietal cortex). Six structural (N = 250) and six functional (N = 282) studies were included. Random effects modeling was used to calculate mean effect sizes and CIs. Results: The strength of the brain-behavior relationship pooled across both modalities was medium ($pr = 0.36$), comparatively stronger than previous meta-analysis in healthy adults, ranging from .08 - .23 (Yuan & Raz, 2014). Subgroup analyses of effect sizes showed no significant difference in the strength of brain-behavior association ($p = .431$) between structural ($pr = 0.28$) and functional ($pr = 0.44$) modalities, suggesting concordance. Neither mean age ($beta = -0.39$, $p = .458$) nor percentage of female participants ($beta = 0.53$, $p = .316$) significantly impacted concordance between findings. Discussion: Findings from this study contribute to understanding of the relationship between structure and function in the brain, and help to contextualize previous AD research.

Topic Area: METHODS: Neuroimaging

B95 Modeling of Mood States Using Multimodal Biometric Data

Akiko Obata[1], Masashi Kiguchi[1], Stephanie Sutoko[1], Hirokazu Atsumori[1], Ayako Nishimura[1], Tsukasa Funane[1], Hiromitsu Nakagawa[1], Masashi Egi[1], Hiroyuki Kuriyama[1], [1]Hitachi,Ltd. Research & Development Group

We have developed an IoT system in purpose of mental monitoring and disorder prevention. This system is practical for office use and embedded with

multimodal biometric measurement. We performed an experiment using this system in our R&D group (39 subjects; December 2017 to March 2018). Subjects were equipped with 'Life Microscope' and 'PC logger' to measure daily physical activity and working performance, respectively. Several measurement stations with optical topography (OT) instruments were prepared to weekly collect brain activity and cognitive performance data (e.g., memory). In total, 51 biometric variables could be obtained. Two standard questionnaires, the Brief Job Stress Questionnaire and K6, were weekly done to monitor subject's mood states (e.g., lassitude, irritation, fatigue, anxiety, depression, physical stress). In this study, we aimed to model mood states from biometric variables. The multiple linear regression method was adopted with 3?5 variables. 2,619,785 variable combinations were evaluated, cross-validated, and optimized to result in low model estimation error. Each mood state was independently modelled, and the obtained models revealed high correlations between questionnaire and estimated scores (r = 0.6?0.8) with relatively low errors (

Topic Area: METHODS: Other

B96 Linking hierarchical cortical gradients to cognitive effects of intracranial electrical stimulation in the human brain

Kieran Fox[1], Lin Shi[1], Sori Baek[1], Omri Raccah[1], Brett Foster[2], Srijani Saha[1], Daniel Margulies[3], Aaron Kucyi[1], Josef Parvizi[1], [1]Stanford University, [2]Baylor College of Medicine, [3]Centre National de la Recherche Scientifique

For more than a century, intracranial electrical stimulation (iES) of brain tissue in awake neurosurgical patients has been known to elicit a remarkable variety of cognitive, affective, perceptual, and motor effects, including somatosensations, visual hallucinations, emotions, and memories. To date, a comprehensive, whole-brain mapping of these effects has not been attempted, nor has there been any effort to integrate patterns of iES effects with other models of large-scale cortical organization. Toward these aims, we analyzed the effects of iES at 1559 cortical sites in 67 patients implanted with intracranial electrodes. We found that intrinsic network membership and the principal gradient of functional connectivity strongly predicted the type and frequency of iES-elicited effects in a given brain region. While iES in unimodal brain networks at the base of the cortical hierarchy elicited frequent and simple effects (such as muscle twitches and phosphenes), effects became increasingly rare in heteromodal and transmodal networks higher in the hierarchy, and the elicited effects more heterogeneous and complex (e.g., complex emotional states and multimodal sensory experiences). Our study provides the first comprehensive exploration of the relationship between the hierarchical organization of intrinsic functional networks and causal modulation of human cognition with iES. Although iES has long played a seminal role in understanding human brain function, our study goes beyond prior work by showing that iES can shed light not only on local functional properties, but also global patterns of brain organization and their relationship with subjective experience.

Topic Area: NEUROANATOMY

B97 Macroanatomical morphology of superior temporal lobe in adults with dyslexia

Alexandra Kapadia[1], Gabrielle-Ann Torre[1], Terri Scott[1], Yaminah Carter[1], Tyler Perrachione[1], [1]Boston University

The morphology of the human superior temporal plane is highly variable across individuals, and a long history of research has investigated whether variation in this morphology is related to speech, language, or musical abilities. In particular, the transverse temporal gyrus (Heschl's gyrus; HG), which is the location of primary auditory cortex, has several distinct morphological forms, including a single HG and various patterns of reduplication. Prior reports, usually involving small sample sizes, have suggested that these reduplicated forms may occur more often in individuals with developmental disorders of reading and language. Here, we classified the morphology of HG in adults with dyslexia (n=24) or typical reading skills (n=24) as either a single gyrus, a common stem duplication, or a complete posterior duplication. We also measured the grey matter volume of each gyrus (and duplication) in both hemispheres. There was no group difference in the morphological patterning of HG in either hemisphere, such that neither single nor duplicated HG was more likely in either group. There was also no group difference in the volume of HG or its duplication, nor any group x hemisphere interaction. These results suggest that prior reports of anomalous superior temporal morphology in dyslexia may reflect false positives in small samples. Our ongoing work involves performing these measurements in a sample of more than 1000 brains of children and adults with and without dyslexia to better characterize this disorder in the context of numerous neuroanatomical features, including macroanatomical morphology of HG.

Topic Area: NEUROANATOMY

B98 Local field potential phase preference to song onset in avian premotor region HVC

Jairo I. Chavez[1], [1]University of California, San Diego

The Zebra Finch's highly stereotyped song is an excellent model for deconstructing the neurophysiology of vocal production. Neural data was recorded from awake free-behaving birds that were implanted with depth electrodes in the avian brain region HVC, used as a proper noun. Previous research has shown HVC to be related to song production and timing, potentially homologous in function to human sensorimotor regions. Previous work in the human motor cortex has shown that movements preferentially initiate at certain phases of local field potential (LFP) oscillation bands. These LFP oscillation data have been used, in humans, to decode speech and language, toward the goal of building a speech prostheses. However, at present there are few studies examining the potential functional role of the LFP in birdsong production. Here, we measure phase consistency within the beta (13-30 Hz) oscillation band, across vocal production events, using inter-trial coherence (ITC), similar to prior human LFP work. We show preliminary evidence that similar phase preference, as is seen in human motor cortex, occurs in avian HVC when looking at the onset of syllables in the finch's vocalization. Our finding that there is an oscillatory phase preference to song onset for LFP may be one of the first steps in determining whether HVC is homologous to the premotor cortex, leading to the collaboration between two science communities to motivate a speech prosthesis.

Topic Area: OTHER

B99 Bio-electro stimulation therapy for the treatment of the non-motor symptoms of Parkinson's disease: a pilot study

Shiraz Mumtaz[1], Marina Ritchie[1], Karin Schon[1], [1]Boston University School of Medicine

Parkinson's disease (PD) is a progressive neurodegenerative disorder driven by loss of dopaminergic neurons in the substantia nigra. While this loss of function is typically associated with motor impairments, individuals with PD also experience non-motor symptoms. Although PD treatments have focused on increasing intracerebral dopamine through pharmacologic intervention, there is anecdotal evidence suggesting micro-current stimulation may help improve both motor and non-motor symptoms. The goal of this pilot study was to use Bio-Electro Stimulation Therapy with the e-Tapper TT-R1 and apply micro current stimulation to either the 'Head Point' (HP) or 'Leg Point' (LP) of an individual's hand. Baseline quality of life, sleep quality, and cognitive data were collected in 15 older adults (mean age 62±6.18) with PD (HY stages I-

III). Participants were randomized into HP or LP groups and underwent a 6-week e-tapper intervention in which they self-administered the intervention twice daily for 30 min. Assessments identical to those administered at baseline were completed post-intervention. Paired samples t-tests demonstrated increased performance on delayed visuospatial memory for LP compared to HP group participants following the intervention, but no effects for spatial cognition, divided attention or verbal learning. Paired samples t-tests also demonstrated increased perceived quality of life and perceived sleep quality in HP compared to LP group participants following the intervention. These results suggest subjective increase in quality of life and sleep quality following the HP intervention and potentially indicate that further exploration of alternate treatment modalities such as Bio-Electro Stimulation Therapy for PD with objectively measured outcomes is needed.

Topic Area: OTHER

B100 Dissecting the pathophysiological circuit substrates of reward and anhedonia subdomains

Lena Trebaul[1], Victoria Ho[1], Kristen Ellard[1], Tracy Barbour[1], Joan A. Camprodon[1], [1]Massachusetts General Hospital

Patients with depression exhibits diverse sets of symptoms that correspond to alteration of different pathologically affected brain networks. Anhedonia, a critical clinical affective dimension resulting from maladaptive changes to the reward circuitry, is comprised of behaviorally- and clinically-relevant subdomains: e.g. consummatory (liking) and anticipatory (wanting) anhedonia. In this study we aimed to identify the distinct and overlapping functional connectivity substrates of anhedonia subconstructs. 67 patients with major depressive disorder (MDD) were scanned with a multimodal MRI protocol including resting fMRI-BOLD. They were clinically characterized using syndromal and dimensional measures, including reward processing measures: Temporal Experience of Pleasure Scale (TEPS) ? anticipatory (ANT), TEPS - consummatory (CON), Snaith-Hamilton Pleasure Scale (SHAPS), and their reward behavior was assessed with: an effort task and a probabilistic reward task, focused on reward learning. Functional connectivity (FC) was assessed using standard preprocessing and analytical approaches with the CONN matlab toolbox for critical nodes of the reward system: ventral tegmental area (VTA), nucleus accumbens (NAcc), amygdala and hippocampus. Correlates of TEPS-ANT and TEPS-CON were found in the FC between the NAcc and amygdala and clusters belonging mostly to the DMN, and anticorrelations between the VTA, somatomotor and attention networks areas. We also found significant differences between anticipatory and consummatory anhedonia in limbic and visual areas. Correlations with behavioral measures were found in somatomotor, attention and frontoparietal networks for the NAcc, hippocampus and VTA. Clinical and behavioral measures of anhedonia mapped unto different parts of the functional networks.

Topic Area: OTHER

B101 High-level neural categorization of human voices as revealed by fast periodic auditory stimulation

Francesca Barbero[1], Roberta Pia Calce[1], Bruno Rossion[1], Olivier Collignon[1, 2], [1]University of Louvain, Belgium, [2]University of Trento, Italy

Voices are arguably among the most relevant sounds in humans' everyday life and several studies have demonstrated the existence of voice-selective regions in the human brain. However, whether this preference is merely driven by physical (i.e., acoustic) properties specific to voices, or whether it reflects a higher-level categorical response is still under debate. Here, we address this fundamental issue with Fast Periodic Auditory Stimulation combined with electroencephalography (EEG) to measure objective, direct, fast and automatic voice-selective responses in the human brain. Participants were tested with stimulation sequences containing heterogeneous non-vocal sounds from different categories presented at 4 Hz (i.e., 4 stimuli/second), with vocal sounds appearing every 3 stimuli (1.33 Hz). A few minutes of stimulation are sufficient to elicit robust 1.33 Hz voice-selective focal brain responses over superior temporal regions of individual participants. This response is virtually absent for sequences using frequency-scrambled sounds, but is clearly observed when voices are inserted in sounds from musical instruments matched in pitch and harmonicity-to-noise ratio. Overall, our Fast Periodic Auditory Stimulation paradigm demonstrates high-level categorization of human voices, and could be a powerful and versatile tool to understand human auditory categorization in general.

Topic Area: PERCEPTION & ACTION: Audition

B102 Distributional learning of non-native contrasts in speakers of two languages, English and Korean

Mihye Choi[1], Yoonsung Kim[2], Youngon Choi[2], Mohinish Shukla[1], [1]University of Massachusetts Boston, [2]Chung-Ang university, Seoul

A sensitivity to distributional properties of phonetic tokens has been hypothesized to lead learners to induce the appropriate underlying phonemic categories. Listeners infer two underlying phonemes when presented with a bimodal distribution of tokens along an acoustic continuum, and a single phoneme for a unimodal distribution. In this study, we examine distributional learning of non-native contrasts in speakers of two languages that differ in their use of specific phonetic cues: Korean, but not American English speakers use both voice-onset time (VOT) and fundamental frequency (f0) as cues for classifying stop consonants. In a first study we investigated how English and Korean speakers discriminate an eight-step continuum from Hindi [ba] to [pa] that changes on both VOT (pre-voiced to 0) and f0 (low to high) dimensions. The results showed that, while English speakers had more /ba/ responses than Korean speakers, this was primarily due to the last 4 tokens being significantly different between the groups; Korean speakers rated these tokens significantly less often as /ba/. In a second study, we tested if this group difference leads Korean speakers to have sensitivity to distributional learning of the non-native Hindi contrast. They were exposed to the previous continuum with a unimodal (occurrence frequency of the tokens peaked at the center of the continuum) or a bimodal distribution (highest frequencies at the ends of the continuum). The bimodal group performed significantly better than the unimodal in discriminating the end tokens of the continuum, suggesting their sensitivity to distributional cue could affect non-native phonetic discrimination.

Topic Area: PERCEPTION & ACTION: Audition

B103 Hearing Loss is Associated with Grey Matter Thickness Following Close Blast Exposure

Francesca Fortenbaugh[1], Michael Esterman[1], Alexander Sugarman[1], Catherine Fortier[1], Jennifer Fonda[1], David Salat[1], William Milberg[1], Regina McGlinchey[1], [1]VA Boston Healthcare System

While hearing loss is a common consequence of blast injuries in Post-9/11 Veterans, the relationship between hearing loss and cortical structural integrity remains under studied. The present study examined this relationship in a sample of 145 Post-9/11 Veterans. Within this sample, 40 Veterans had a history of close blast exposure (0.30 for both). Additional analyses show that while Veterans with close blast exposure had higher thresholds on average, the relationships between hearing thresholds and cortical thickness were not explained by higher thresholds in this group. These results suggest that hearing deficits following close blast exposure is associated with large-scale changes in grey matter thickness.

Topic Area: PERCEPTION & ACTION: Audition

B104 Assessing auditory processing endophenotypes associated with Schizophrenia in individuals with 22q11.2 Deletion Syndrome

Douwe J Horsthuis[1], Ana A Francisco[1], John J Foxe[1, 2], Sophie Molholm[1], [1]Albert Einstein College of Medicine, [2]University of Rochester

22q11.2 Deletion Syndrome (22q11.2DS) is the strongest known molecular risk factor for schizophrenia. Brain responses to auditory stimuli have been studied extensively in schizophrenia and described as potential biomarkers of vulnerability to psychosis. We sought to understand whether these responses might aid in differentiating individuals with 22q11.2DS as a function of psychotic symptoms, and ultimately serve as signals of risk for schizophrenia. A duration oddball paradigm and high-density electrophysiology were used to test auditory processing in 26 individuals with 22q11.2DS (13-35 years old, 17 females) with varying degrees of psychotic symptomatology and 26 age- and sex-matched neurotypical controls (NT). Presentation rate varied across three levels, to examine the effect of increasing demands on memory and the integrity of sensory adaptation. We tested whether N1 and mismatch negativity (MMN), typically reduced in schizophrenia, related to clinical/cognitive measures, and how they were affected by presentation rate. N1 adaptation effects interacted with psychotic symptomatology: Compared to an NT group, individuals with 22q11.2DS but no psychotic symptomatology presented larger adaptation effects, whereas those with psychotic symptomatology presented smaller effects. In contrast, individuals with 22q11.2DS showed increased effects of presentation rate on MMN amplitude, regardless of the presence of symptoms. While IQ and working memory were lower in the 22q11.2DS group, these measures did not correlate with the electrophysiological data. These findings suggest the presence of two distinct mechanisms: One intrinsic to 22q11.2DS resulting in increased N1 and MMN responses; another related to psychosis leading to a decreased N1 response.

Topic Area: PERCEPTION & ACTION: Audition

B105 The Development of Neural Responses to Faces in Infancy

Stefania Conte[1], John Richards[1], [1]University of South Carolina

We examined the development of the N290 and P400 event-related potentials (ERPs) during the first year of life by comparing upright vs. inverted (Experiment 1) and intact vs. phase-scrambled (Experiment 2) faces and houses. We predicted that developmental changes would occur in the inversion effect for faces for both ERP components. Infants should exhibit larger N290 and P400 responses to intact faces than houses by 12 months of age. In Experiment 1, N290 and P400 amplitude values were analysed as a function Stimulus Type (face, house), Orienatation (upright, inverted) and Age (3, 4.5, 6, 7.5, 12). Six- and 7.5-month-old infants showed larger N290 amplitudes in response to inverted than upright faces, and upright than inverted houses (ps < .037). At 12 months of age, there was a significant inversion effect for faces (p = .007), but not for houses (p = .179). Starting at 6 months of age, the P400 was larger in response to inverted than upright stimuli (ps < .001). In Experiment 2, peak amplitude of the N290 and P400 were analysed as a function of Stumilus Type (face vs. house), Texture (intact, scrambled), and Age (6, 12). Only at 12 months of age both the N290 and P400 were larger for intact faces than intact houses (ps .372). Overall, these results revealed developmental changes in face-sensitive ERP responses. Infants showed adult-like neural responses to faces by the end of the first year of life.

Topic Area: PERCEPTION & ACTION: Development & aging

B106 Flickering light stimulation to promote brain gamma connectivity in aging

Yeseung Park[1], Kanghee Lee[2], Sang-Su Kim[3], Do-Won Kim[3], Eunchan Na[2], Wheesung Lee[2], Seung Wan Suh[2], Jaehyeok Park[4], Seunghyup Yoo[4], Ji Won Han[2], Ki Woong Kim[2], [1]Seoul National Univ., [2]Seoul National University Bundang Hospital, [3]Chonnam National University, [4]Korea Advanced Institute of Science and Technology

Brain photobiomodulation is getting attention as a novel therapy for Alzheimer's disease (AD). Gamma oscillation entrained by 40Hz flickering light was known to lead to a decreased amyloid ? production and an increased amyloid endocytosis by microglial activities in the visual cortex of mouse model. To apply gamma entrainment to the therapeutics for AD, this study aims to find the optimal conditions of light stimuli including colors, intensities and flickering frequencies for entraining gamma oscillations in the brains of elderly. Electroencephalography (EEG) responses to flickering light stimulus (FLS) from eyeglasses with attached organic light emitting diodes (OLED) panels was presented in two colors (white & red), two intensities (400 & 700 cd/?) and five different frequencies (32-40Hz with 2 Hz steps). Each frequency condition was comprised with 10 times repetition of 2-sec with inter-stimulus interval (ISI). Significant entrainment by FLS was observed at parietal region. The FLS of red is more effective on gamma EEG functional connectivity. The FLS of 700 cd/m2 is more effective on gamma evert-related synchronization (ERS) and functional connectivity. Specifically, lower gamma frequencies than 36Hz are more effective on gamma EEG ERS and functional connectivity than other frequencies. Long wavelength is more effective in enhancing functional connectivity, which is beneficial to the visual characteristics of the elderly. Optimal conditions of FLS for entraining brain gamma activity in human may be useful for developing AD therapeutics.

Topic Area: PERCEPTION & ACTION: Development & aging

B107 Unexpected Perturbation of Immediate and Final Action Goals during Grasp Planning

Lin Yu[1], Schack Thomas[1], Dirk Koester[2], [1]Bielefeld University, [2]BSP Business School Berlin

Previous studies found people re-plan their movements to adapt to unexpected changes in the target object (size, orientation, etc.), as well as the action goal. For grasping, an action goal is not restricted to reaching and grasping the object (immediate goal; how to grip). The action goal is also important for a later, subsequent goal (final goal; the action effect). The planning and coordination (i.e., processing) of immediate and final action perturbation on re-planning grasp movements are still unknown. Here, we cued participants to grip a handle (immediate) and then rotate it to a target position (final). The immediate or final goals changed unexpectedly for some trials (25%) and participants had to re-plan their movement when the goals changed. Event-related potentials (ERP) were used to examine the neurophysiological mechanisms of re-planning in different perturbed conditions. Behaviorally, goal perturbation slowed down the reaction time as well as the execution time. Additionally, participants reacted and executed more slowly when immediate goals were perturbed, as compared to the final-perturbed and non-perturbed. Larger frontal P2, as well as more positive centro-parietal slow waves (500-700ms) time-locked to perturbation cues, were found for immediate-perturbed trials. No difference was found for frontal N2 and parietal P3 between the immediate- and final-perturbed conditions. The results suggest that re-planning grasping movements to adapt to the unexpected changes in immediate goal need more efforts and the immediate demands seem to be more demanding than the final demands for modifying an existing movement plan.

Topic Area: PERCEPTION & ACTION: Motor control

B108 Decoding Multisensory Speech Deficits in Autism

Michael Crosse[1], Aida Davila[1], Egor Sysoeva[1], John Foxe[2], Sophie Molholm[1], [1]Albert Einstein College of Medicine, [2]University of Rochester

Children with autism spectrum disorder (ASD) are typically impaired in their ability to integrate audiovisual speech in adverse hearing conditions, which may be linked to some of the social and communicative deficits that are so prevalent in this population. Understanding the neural basis of this multisensory deficit is critical to improving intervention strategies, but there are few neurophysiological studies that have investigated this directly. Here we implement a hierarchical predictive modelling framework that allows us to directly probe discrete stages of multisensory speech processing, from low-level acoustic representations, to phonetic and lexical-semantic representations. Movies of a trained actress reciting children's stories were presented to children and teenagers with a diagnosis of ASD (n = 22) and a group of age/IQ-matched controls (n = 16) while recording high-density EEG. The movies were randomly alternated in modality between audio-only, visual-only and audiovisual speech, and were accompanied by acoustic noise at signal-to-nose ratios of -3, -6, -9, -12, -15 dB, as well as a no-noise condition. Audio files extracted from the movies presented were transformed into spectrotemporal, phonetic and semantic representations and used to construct a hierarchical model that mapped each representation to the recorded EEG responses. Based on our ability to predict the neural responses to unseen passages of speech, our data suggest that multisensory deficits in autism manifest at every stage of the speech processing hierarchy and become more pronounced downstream at the categorical level.

Topic Area: PERCEPTION & ACTION: Multisensory

B109 Sensory hyper-responsivity mediates intrinsic brain connectivity in Autism Spectrum Condition (ASC) and their parents

Yang-Teng Fan[1], Ming-Chu Chung[2], Ling Chu[3], Yawei Cheng[3], Chung-Hsin Chiang[4], Chih-Mao Huang[1], Chien-Te Wu[2], Ovid J. L. Tzeng[5], [1]National Chiao Tung University, [2]National Taiwan University, [3]National Yang-Ming University, [4]National Chengchi University, [5]Academia Sinica

Altered sensory responsiveness is a common feature for individuals with ASC. Although it is well-known that ASC is a highly-heritable neurodevelopmental condition, the concordance in sensory features between parent and child dyads in ASC families is mostly unknown. The current study, therefore, examined the patterns of sensory responsiveness in 30 individuals with ASC, 23 matched controls (CON), and 45 the biological parents for both groups (P-ASC and P-CON, respectively) through questionnaire- and lab-based sensory evaluations as well as resting-state brain connectivity measurements. Behaviorally, ASC and P-ASC exhibited hyper-responsivity to the sensory stimuli than CON and P-CON, respectively. In particular, only ASC parent-child dyads showed significant intra-class agreement on both the total scores of Sensory Profile (SP) and Autism Spectrum Quotient (AQ). Neurophysiologically, the connectivity patterns of 11 functional connectivity links (among areas including the occipital cortex, Heschl gyrus, hippocampus, prefrontal cortex, and posterior cingulate) positively correlated with total scores of SP within ASC parent-child dyads. Of these links, the connectivity between occipital and hippocampus also positively correlated with total scores of AQ. Mediation analysis further revealed that sensory hyper-responsivity specific to ASC and P-ASC significantly mediated the association between the occipital-hippocampus connectivity and autistic symptoms. These results support the idea that ASC and their parents share similar sensory responsiveness patterns in both behavioral performance and neural indices, and such sensory hyper-responsivity aberrantly mediates the association between intrinsic brain connectivity and autistic traits. The findings have implications for early detection, prognostic predictions and potential future interventions for individuals with ASC.

Topic Area: PERCEPTION & ACTION: Multisensory

B110 Hippocampal dentate gyrus lesions interact with categorical face perception: A pattern separation story

Stevenson Baker[1], Ariana Youm[2], Yarden Levy[3], Morris Moscovitch[2, 4], R. Shayna Rosenbaum[1, 4], [1]York University, [2]University of Toronto, [3]McMaster University, [4]Rotman Research Institute

Perceptual judgments of faces with great featural overlap typically recruit the perirhinal cortex. Recent evidence, however, hints that discrimination and identification of highly confusable faces may be related to pattern separation mediated by the dentate gyrus of the hippocampus. Prior knowledge may also be a factor. To test whether the hippocampus is implicated in identifying and discriminating among highly similar faces, we tested healthy controls and BL -- an amnesic person with a lesion selective to the dentate gyrus. We used morphed images of famous and nonfamous faces in a standard categorical perception (CP) experiment with morphs of two faces varying from 0 - 100%, and tested identification and discrimination. Controls and BL exhibited predicted non-linear identification of famous faces with a typical category boundary. Newly learned nonfamous faces were identified with lesser fidelity by controls, though the category boundary along the performance continuum was at the expected threshold of maximum ambiguity (50% morphs). In contrast, BL revealed an idiosyncratic shift in his category boundary that was significantly different from that of controls (p

Topic Area: PERCEPTION & ACTION: Other

B111 Somatosensory stimulation during REM sleep produces changes in dream content

Elizaveta Solomonova[1], Claudia Picard-Deland[2], Kaila Cencora Mikutra[1], Simon Dube[3], Arnaud Samson-Richer[4], Tyna Paquette[4], Tore Nielsen[2], [1]McGill University, [2]University of Montreal, [3]Concordia University, [4]Center for Advanced Research in Sleep Medicine

Background: The relationship between dream content and sensations of the sleeping body remains unclear. Recent theories of dream formation stress the associative nature of dreaming and propose that dreams integrate information in a multisensory manner. Previous work showed that somatosensory stimulation produces chances in dream content. In this study we aimed at characterizing how REM sleep dreams change in response to somatosensory stimulation. Methods: We recruited 35 healthy participants and randomly assigned them to two groups: stimulated (STIM, N=20) and control (CTL, N=15). Both groups were fitted with standard polysomnography and a blood pressure cuff on an ankle, and were awakened for dream report collection in REM sleep during a daytime nap. Dream reports were scored by independent judges. The scoring technique consisted of selecting dream passages associatively related to sensation of blood pressure on the leg, and then extracting specific categories using thematic analysis. Results: 17 STIM participants (85%) incorporated somatosensory stimulation into dream content. STIM group showed higher rates of dreams about the laboratory (p=.04), higher rates of themes with body alteration (p=.003), and trends towards more dreams with motion (p=.06) and altered sense of space (p=.09). No group differences were found in dream content related to leg representation. Conclusions: Our results show that somatosensory stimuli are processed during REM sleep and are integrated into dream content in a distorted and associative manner. This suggests that the mind in REM sleep is not entirely isolated from the environment, and that somatic sensations play a role in dream formation.

Topic Area: PERCEPTION & ACTION: Other

B112 Aesthetic preferences modulate Mu activity over sensorimotor cortices during action observation of dance

Jorge Almansa[1], Claudia Corradi[1], Eirin Sabel[1], Alexander Jones[2], Jonathan Silas[2], Beatriz Calvo-Merino[1], [1]City, University of London, [2]Middlesex University

It has been proposed that sensorimotor processing is involved in aesthetic appraisal, providing evidence for an embodied mechanism at the core of the aesthetic experience. Here we aimed to explore how sensorimotor activity during action observation of dance movements is modulated by individual preferences. EEG activity was recorded in 32 participants while observing videos of dance movements expressing either happiness or sadness. Participants watched these videos and answered questions about the emotion and the direction of the movement. After the EEG session, participants provided aesthetic ratings (using a liking scale) to each individual dance movement. We compared levels of mu-band (8-13 Hz) activity over the sensorimotor cortex between the most liked movements and the less liked movements. Results showed a differential mu desynchronization during dance observation for preferred and non-preferred movements. This effect appeared both in the emotion and in the direction task, suggesting an overall and general embodied effect of liking and individual preferences during action observation. Together, these results suggest sensorimotor simulation may be differentially engaged depending on preferences, and highlight the importance of an embodied mechanism underlying aesthetic appraisal and aesthetic judgments.

Topic Area: PERCEPTION & ACTION: Vision

B113 Computational insights into human expertise for familiar and unfamiliar face recognition

Nicholas Blauch[1], Marlene Behrmann[1], David Plaut[1], [1]Carnegie Mellon University

Faces have provided a window into expert human perceptual mechanisms. But, if humans are face experts, why is it so difficult for humans to verify identity matches in images of unfamiliar faces? Are we really just familiar face experts (Young and Burton, 2018). We sought to better understand the perceptual representations underlying unfamiliar face recognition performance, and how familiarity may build upon these representations to form robust identity representations. We adopted a computational approach, probing representations learned by a high-performing deep convolutional neural network (DCNN) trained for visual recognition. By manipulating prior experience of the network, we found that previous experience with faces, but not with objects in general, enabled the network to achieve human-level performance in matching unfamiliar faces, and that increasing experience with faces led to consistently increasing performance. Simulating acquisition of familiarity with these individuals, we found that extensive prior experience with faces led to superior learning of the novel identities, and a sharp boost in verification following familiarization. Further, this familiar face advantage did not require changes to perceptual representations, but only a learned mapping between existing perceptual representations and identity. Our results suggest that humans can extract substantial identity-related perceptual information from unfamiliar faces, a skill which is acquired over a lifetime of experience recognizing faces, but which may be fundamentally limited by the variability of face images. For familiar individuals, a post-perceptual identity-based representation may be activated from even highly variable face images, providing a sharp advantage in identity matching.

Topic Area: PERCEPTION & ACTION: Vision

B114 Early Emotional Face Processing Deficits in Schizophrenia: a MEG Study

Yuki Fujishima[1], Yuichi Takei[2], Yumina Nakane[1], Manami Mizuyama[1], Yutaka Kato[3], Masato Fukuda[2], Minami Tagawa[2], Takako Mitsudo[1], Yoji Hirano[1], Naruhito Hironaga[1], [1]Kyushu University School of Medicine, [2]Gunma University Graduate School of Medicine, [3]Tsutsuji Mental Hospital

Emotional expression processing, which is thought to be essential for social interaction, is known to be disturbed in schizophrenia (SZ). Face processing is one of the most intensively studied topics in cognitive neuroscience, and many researchers, therefore, have paid much attention to the deficits in face processing in SZ. While several neurophysiological studies have reported the reduction of the face-specific activity of N/M170 in the fusiform in SZ, it is still largely unknown how other cortical areas are involved in face processing within its time course. In this study, we hypothesized that the differentiation of N/M170 activity between SZ and healthy control (HC) will not only present in the fusiform area but also occur in the early spatio-temporal stages of the human visual system including V1, V2, V3, V4, and MT. We recorded brain responses using magnetoencephalography from 17 patients with SZ and 22 HC participants. The participants watched multiple series of images with the one-back working memory task embedded, and each series consisted of images of the same category (fearful faces, neutral faces, or houses). We employed source reconstruction techniques to investigate the source waveforms of the specified ROIs in the visual system. The source waveform analysis showed a clear differentiation between SZ and HC for the fearful and neutral faces in many visual system areas including early M100 component in V1, followed by M170 component in the fusiform area. Our results revealed very early spatio-temporal profile abnormalities during emotional face processing in SZ.

Topic Area: PERCEPTION & ACTION: Vision

B115 Serial processing of multiple identities in single faces

Matthew Harrison[1], Lars Strother[1], [1]University of Nevada, Reno

Face recognition is thought to involve the integration of facial features into a holistic representation of face identity. The degree to which we can process multiple face identities in parallel is not known. To investigate the limits of parallel visual processing during face recognition, we tested whether observers could perceive two face identities at the same time or not. In one experiment, observers viewed two faces, one in each visual hemifield. In a second experiment, observers viewed a single face comprised of two distinct half-face identities, with each half-face falling in one or the other hemifield. In both experiments, observers were either cued to match one (single-task) or both (dual-task) identities corresponding to either whole faces or half-faces. We compared accuracy data for the single-task and dual-task conditions using an attention operating characteristic (AOC) plot which allowed us to assess potential capacity limits. Both the whole-face and half-face AOCs matched an all-or-none serial processing model, rather than alternative parallel processing models. This means that for two simultaneously viewed face identities only one identity is recognized at a time. We propose that single faces contain two conflicting identities which compete for selection. If so, some stages of holistic face processing may be better characterized as selective rather than integrative.

Topic Area: PERCEPTION & ACTION: Vision

B116 Expertise effects on Embodied Emotion of Facial Expressions: A study using Somatosensory Evoked Potentials

Vasiliki Meletaki[1], Bettina Forster[1], Beatriz Calvo-Merino[1], [1]City, University of London

Dance expertise modulates sensorimotor responses during observation of familiar movements. Recent behavioural and physiological studies have shown how expertise with the observed action enhances visual and emotion sensitivity (ability to discriminate actions/emotions) on familiar movements. This study investigates if the enhanced expert emotion sensitivity is domain specific (i.e. only related to emotion expressed on familiar movements) or general to other forms of emotional expressions (i.e. facial expressions). We compare neural responses to facial expression (happy, fearful, neutral) in two groups of participants (professional dancers/experts and non-dancers/controls). To explore activation in cortical regions related to embodied emotion (somatosensory/sensorimotor cortices), we measured Visual Evoked Potentials (VEP) and Somatosensory Evoked Potentials (SEP -by applying an irrelevant touch 105 ms over the fingertip after visual onset), while participants performed a visual emotion or a gender task on emotional faces, as described in (Sel, Forster and Calvo-Merino, JoN, 2014). In line with previous work, results show an overall main effect of emotion over somatosensory cortex (80-100ms) over and above visually-driven carry-over effects. Importantly, we also find an interaction between group and emotion (80-120 ms) in the SEPs, suggesting a differential embodied response to facial expression between experts and non-experts. Taken together, this data talks in favour of an enhanced general emotion sensitivity in experts, that is reflected beyond the observation of their motor acquired skill but onto general and everyday emotional expressions. Finally, these results point towards new venues for emotional sensitivity training based on engaging motor and artistic knowledge.

Topic Area: PERCEPTION & ACTION: Vision

B117 Interleaved training improves category learning by increasing perceptual similarity of within-category exemplars

Sharon Noh[1], [1]University of Texas at Austin

Category learning paradigms using naturalistic stimuli have found that interleaving exemplars across categories during training (as opposed to blocking exemplars by category) leads to superior category learning. Because real-world stimulus representations are not known a priori, it is difficult to assess the mechanisms that drive this interleaving benefit using traditional category learning models. Using a cognitive model that infers feature representations from similarity judgments, referred to as psychological embedding, we quantified changes in perceptual representations that occur as a function of different learning schedules. Participants first made similarity judgments for various paintings in the absence of any category knowledge. During training, participants learned to identify paintings by six artists in either a blocked or interleaved fashion. After training, participants completed tests of category generalization, followed by a second similarity judgment phase. Cognitive modeling of similarity judgments performed before and after category learning was used to infer a global psychological embedding and separate attention weights for each condition (pre-training, blocked, interleaved). The attention weights quantified the degree that similarity judgments were driven by specific feature dimensions. Model fits indicated that category learning resulted in attentional shifts that increased perceptual similarity among all paintings. However, within-artist perceptual similarity increased more than between-artist perceptual similarity. Consistent with these results, a separate analysis of similarity ratings revealed that participants were more likely to judge same-category stimuli as more similar after training, and more so after interleaved training. These findings demonstrate how interleaved training shapes perceptual representations and improves category induction by emphasizing within-category similarities.

Topic Area: PERCEPTION & ACTION: Vision

B118 Applying microstructural models to understand the role of the fornix white matter in online scene processing

Marie-Lucie Read[1], Andrew D Lawrence[1], Kim S Graham[1], C. John Evans[1], Katja Umla-Runge[1], [1]Cardiff University, Wales

Representational accounts of Medial Temporal Lobe (MTL) function suggest that two distributed networks that extend from the MTL support processing of distinct visual modalities in the perceptual as well as the mnemonic domain. We previously found that Diffusion Tensor Imaging (DTI)-derived properties of the fornix, a component of a 'posteromedial' or 'extended-navigation' network, correlated with scene-discrimination performance, whereas those of the Inferior Longitudinal Fasciculus (ILF) (underpinning an 'anteromedial' or 'feature memory' network), correlated with face-discrimination. However, multiple biological phenomena can contribute to DTI measures. To address this lack of specificity, here, participants (n=40) performed perceptual tasks with scenes, faces or circles (control) and separately underwent microstructural imaging to acquire DTI measures and also Restricted Fraction (FR) and Macromolecular Volume Fraction (MVF), which give indications of axon density and myelin fraction, respectively. Scene and face task performance correlated with fornix and ILF DTI-properties, and control task performance did not. Together, DTI, FR and MVF of the fornix were associated with scene, but not face-task performance. ILF microstructure did not predict scene-task performance. Our novel findings provide further support for representational accounts of MTL function and allow for more detailed inference about the role of the underlying microstructure of the fornix in underpinning network function.

Topic Area: PERCEPTION & ACTION: Vision

B119 ERP Measures Of Human Cortical Long-Term Depression

Grace Vogel[1], Harlan Fichtenholtz[1], [1]Keene State College

There are two main cellular mechanisms which demonstrate memory electrophysiologically, long term potentiation and long-term depression. A few studies have attempted to show event-related potential representations of long-term potentiation in humans. Recently, cortical long-term potentiation has been shown in response to both auditory and visual high frequency stimulation (9 Hz). Following the high-frequency stimulation, enhanced evoked sensory responses were found in both auditory and visual domains. Using similar methods, the current study found a decrease in early visual cortical activity following 9Hz stimulation. This pattern of response is indicative of long-term depression of the visual cortical response. In contrast to the previous studies, the current results demonstrate a decrease in the amplitude of the visual P1 following high frequency stimulation at contralateral electrode sites. The reduction in P1 amplitude was seen at all 3 post tetnus assessments (2-min, 15-min, 30-min). This P1 reduction was also seen at the ipsilateral and midline electrodes, but not to the same extent. This pattern of continued reduction of the visual evoked response is suggestive of long-term depression of the visual signal, not long-term potentiation as expected. Long-term depression usually occurs in response to strong synaptic stimulation or from persistent weak synaptic stimulation. While the current study does not clarify the mechanism underlying the measurement of scalp electrophysical measures of long-term cellular learning it does demonstrate that long term depression can also be measured from human visual cortex.

Topic Area: PERCEPTION & ACTION: Vision

B120 Neurophysiological correlates of purchase decision-making

Ítalo Alí Diez[1], Josep Marco-Pallarés[1], [1]University of Barcelona, IDIBELL

One of the most common decisions we have to face in our daily life is to choose what to buy and when to do it. The goal of the present study was to identify the neurophysiological markers associated with this process. 24 healthy subjects participated in a new experimental paradigm, the Purchase Decision Making Task (PDM), while EEG was recorded from 32 electrodes in the scalp. In this task, a price for one new product was presented in an uncertain environment, and participants had to decide whether to buy it at this price or wait for a potential cheaper offer. Results revealed an increase in the P3 event-related potential for those prices that were chosen by the subjects compared to those in which participants decided to wait. In addition, selected prices also showed significant increase in the theta and beta induced power. These results reflect the engagement of attention and executive function in purchase decision-making and might help in the understanding of brain mechanisms underlying economic decisions in uncertain scenarios.

Topic Area: THINKING: Decision making

B121 Neurocognitive Underpinning of Cross-cultural Differences in Risky Decision Making

Lan Ba[1], Xingjie Chen[1], Youngbin Kwak[1], [1]UMass Amherst

While much research demonstrates cultural influence on behavior, there exists a misconception that economic decision making is relatively free from cultural influences because it involves basic cognitive processes considered to be invariant. We addressed this misconception by investigating the neurocognitive processes underlying decision making in participants from East Asian and European American cultures. Participants performed a risky gambling task that captures gain maximizing and loss minimizing strategies. Participants were presented with a probability cue indicating the probability of winning vs. losing and were asked to either bet high ('8') or low ('2'). EEG was recorded throughout task performance. Event-related potentials (ERPSs) P2 associated with emotional arousal and P3 associated with effortful attentional allocation were examined in both pre-decisional and post-decisional stages to determine the cultural effects on the underlying mental processes. Behavioral results showed a higher loss minimization than gain maximization in Americans compared to Asians. ERPs during pre-decisional stage showed modulatory effect of different probability cues on both P2 and P3, but no interaction with culture. A significant cultural effect was found during post-decision stage when the gain and loss outcomes (i.e., gain/loss of 2 or 8) were revealed. While Asians' P2 was strongly modulated by the different levels of gains, Americans' P3 was strongly modulated by losses. These results suggest that Americans make conscious efforts to be self-reliant when facing financial losses, while Asians are more emotionally aroused by financial gains, which invites a refinement to the current theoretical propositions about cultural influence on decision making.

Topic Area: THINKING: Decision making

B122 Depressed individuals display distinct behavioral and neural representations in economic decision-making tasks

Avijit Chowdhury[1], Rongjun Yu[1], [1]National University of Singapore

Past research has established a connection between regret (negative emotions connected to cognitions about how past actions might have achieved better outcomes) and clinical depression (MDD). It is yet to be investigated, however, how cognition related to regret and other counterfactual values may explain behavioral and neural differences between MDD and healthy participants. We compared neural activity and choices among 17 patients with Major Depressive Disorder to 12 demographically-matched controls in two behavioral-economic tasks, wherein the tasks incorporated both factual and counterfactual values in the decision-making process. Behaviorally, individuals with higher depressive symptoms were less adept in incorporating prospective regret signals during choice and were also less sensitive to the experience of regret in their affect ratings - demonstrating the common emotional blunting observed in depression. In response to greater regret across both win and loss trials, patients with MDD manifested lower prefrontal (left middle and superior frontal gyri) activations in areas previously associated with the processing of painful events. During choice, healthy participants showed a greater correlation of activity in the right anterior insula and orbitofrontal cortex with regret experienced in the previous trial, compared to patients with depression. Our results provide evidence on how MDD patients differentially engage counterfactual values in their decision-making and how it may be related to the atypical brain activations.

Topic Area: THINKING: Decision making

B123 Using EEG to investigate the neuro-modulatory systems underlying stress and decision making

Thomas D. Ferguson[1], Olave E. Krigolson[1], [1]Centre for Biomedical Research, University of Victoria

When we make decisions and multiple options are available, we compare the known benefits of the best choice (exploiting) to the possible benefits of the other options (exploring). When people are stressed their ability to effectively manage this explore-exploit trade-off is diminished, as stress leads people to over-exploit. However, it is not entirely clear why this is the case as multiple neuro-modulatory systems play both a role in both the explore-exploit trade-off and the stress-response. Here, we used computational modeling and electroencephalography (EEG) to further investigate the explore-exploit trade-off under stressful conditions. More specifically, we sought to determine how different neuro-modulatory systems that play a role in the explore-exploit trade-off - our decisions to explore (in which norepinephrine plays a role) and our ability to learn from feedback (in which dopamine plays a role) - were affected by stress. In the current study, participants were acutely stressed before playing a multi-option slot machine (Bandit) task. We used a reinforcement learning model to classify participant's trials as either exploration or exploitation and found that both exploration rate and the neural learning signals indicative of norepinephrine (the P300) and dopamine (the Reward Positivity) were modulated by stress in a negative fashion. Our results show that stress affects multiple neural learning systems that underlie exploration and exploitation. These findings in turn suggest that EEG is an important tool in revealing the interplay between behaviour, neuro-modulatory systems, and stress.

Topic Area: THINKING: Decision making

B124 Neither Threat of Shock nor Acute Psychosocial Stress Affect Ambiguity Aversion

Deshawn Sambrano[1], Candace Raio[2], Elizabeth Phelps[1], [1]Harvard University, [2]New York University

Imagine you are at the doctor's office, recently diagnosed with a life-threatening disease, and you have two treatment options. The traditional treatment offers a 50% success rate, while a newly designed drug has a success rate somewhere between 30% and 80%. Which drug would you take? Economists describe the traditional drug as a risky option because you know the probabilities of success and the new drug as ambiguous because the outcomes probabilities are unknown. It is well established that, across types of decisions, people find ambiguity more aversive than risk even when the ambiguous choice has a higher expected value (Ellsberg, 1961). It has been shown that arousal to a choice predicts ambiguous but not risky choices

(Feldmanhall et al., 2016) and that activation of the amygdala is uniquely observed to ambiguous choices (Levy et al. 2010). Building on these correlational findings, we explored whether arousal, incidental to the choice, causally impacts ambiguity preferences via two independent experiments. One study manipulated incidental arousal via an acute psychosocial stressor and the other induced an anticipatory threat response. The efficacy of the manipulations were confirmed via salivary cortisol response and pupil dilation, respectively. Participants made choices between a guaranteed $5 option and a lottery with either a known (risky) or unknown (ambiguous) probabilistic outcome. Consistent with previous findings, participants were risk and ambiguity averse. However, in contrast to our hypothesis, we found no evidence of a causal relationship between incidental arousal and ambiguity preferences.

Topic Area: THINKING: Decision making

B125 1 Hour of Lost Sleep Impacts Financial Markets: Daylight Saving Time Compromises Financial Trading

Frank Song[1], Matthew Walker[1], [1]UC Berkeley

A lack of sleep has negative effects on motivational-effort and optimal decision-making (Krause et al., 2017). However, whether sleep loss impacts real-life financial choice behavior, en masse, has yet to be examined. Here, we tested the hypothesis that a 1-hour sleep manipulation, imposed by daylight saving time (DST), influences appetite for financial decision-making in financial markets. Trading activity of E-mini S&P 500 Futures contracts was analyzed on each Sunday after DST change from 2002-2019, compared with the surrounding Sundays (N=165 trading days, N=6.17 million contracts). Based on the hypothesis of sleep-loss impairments in motivational drive and effort, analyses focused on daily trading volume (representing cumulative trading activity) and intraday volatility (representing price variations linked to trading activity). Following the Spring DST change, resulting in a 1-hour loss of sleep opportunity, both these effort-based trading metrics dropped significantly (38-43%), relative to the surrounding Sundays (p=0.0001-0.0013). Following the Fall DST change, providing a 1-hour increase in sleep opportunity, there was no significant relative change in these trading metrics. Together, these findings establish that a modest reduction in sleep opportunity (1-hour) significantly impacts trading activity, while a converse increase in sleep opportunity (Fall DST) may not be capitalized upon by individuals, obviating a beneficial behavioral effect. These results support a biological framework of sleep loss reflecting a marked state of impaired motivational-effort. Moreover, such data illustrate how even very subtle, ecologically common, reductions in sleep time across the population can have non-trivial societal and economic ramifications.

Topic Area: THINKING: Decision making

B126 Aesthetics in motion: Do motor responses to artworks predict aesthetic preferences?

Stacey Humphries[1], Clifford Workman[1], Gregor Hayn Leichsenring[2], Franziska Hartung[1], Anjan Chatterjee[1], [1]University of Pennsylvania, [2]University of Jena

Viewing art engages the sensory and motor systems in the brain. Theories of embodied aesthetics predict that parts of the motor system should respond even to abstract art, where visible artistic gestures and brushstrokes may imply movement of the artist rather than movement of a figure in the painting. We hypothesized that simulating the artist's movements contributes to aesthetic responses in observers. Alternatively, motor simulations may simply occur alongside aesthetic responses, without influencing them. We used fMRI to measure neural responses to abstract paintings in 31 adults. Participants made liking decisions as they viewed high motion, gestural action paintings by Jackson Pollock and low motion, static abstract paintings by Piet Mondrian. Post-scanning, participants rated the same paintings for motion, liking, interest, balance and complexity. Relative to Mondrians, Pollocks elicited greater activation in visual cortex, hippocampus and sensorimotor cortex. Hemodynamic response amplitudes in visual (but not motor) cortex were parametrically modulated by motion ratings for both sets of paintings. Activity in somatosensory, premotor, and dorsolateral prefrontal cortices negatively predicted liking of the Pollock paintings, while activity in primary visual cortex and fusiform positively predicted liking of the Mondrians. Greater percent signal change in motor cortex when comparing Pollocks to Mondrians negatively predicted liking of and interest in Pollock paintings. These results suggest that identifying motion in abstract art is linked to visual rather than motor responses. In line with our hypothesis, activity in motor areas did predict aesthetic appreciation, but the relationship was negative.

Topic Area: THINKING: Other

B127 Facilitating Creativity: Using Machine Learning EEG Classification to Provide Neurofeedback in a Divergent Thinking Task

Carl Stevens[1], Darya Zabelina[1], [1]University of Arkansas

Previous EEG studies have found spectral differences between individuals who are more and less creative, and between conditions that differ in creative demand. Differences have been most consistently reported in the alpha band (Benedek, 2018). In the current study, a spectrally weighted common spatial patterns approach was used to reduce data dimensionality and extract EEG features, and a quadratic discriminant analysis machine learning algorithm was used to classify more and less creative brain states. Twenty-nine participants completed an Alternate Uses Task (AUT; adapted from Abraham et al., 2014, and Jauk et al., 2017), in which they thought of Normal or Uncommon (creative) uses for everyday objects (e.g., brick). We hypothesized that a) reaction time would be greater for the Uncommon condition, compared to Normal, b) alpha power would be greater for the Uncommon condition, c) EEG data would be reliably classified based on condition, and d) more and less creative individuals would be successfully classified. We found that both reaction time and alpha power were significantly greater for the Uncommon condition, compared to Normal. Classification accuracy for the two conditions varied widely among individuals (36.7% to 93.3%), with a mean of 63.9%. For more vs. less creative individuals, 82.3% classification accuracy was attained. Using the same version of the AUT and the same condition classification strategy, future studies will determine whether neurofeedback training based on subject-specific classification models can facilitate easier access to, and the improved maintenance of, more creative brain states.

Topic Area: THINKING: Problem solving

B128 Frontoparietal transcranial alternating stimulation (tACS) modulates visual analogical reasoning

Robert Cortes[1], Robert Morrison[2], Sydney Samoska[2], Sara Temelkova[2], Shana Ward[2], Adam Green[1], [1]Georgetown University, [2]Loyola University Chicago

Previous research has linked prefrontal and posterior parietal cortices (key hubs of the Frontoparietal Network; FPN) to analogical reasoning performance. Past theory and research have suggested that connectivity within the FPN may be important for analogy performance including its development. However, aside from Morrison and colleagues' (2004) computational study of frontotemporal lobe degeneration, the evidence linking brain networks to analogical reasoning performance has thus far been correlational. Here we applied transcranial alternating current stimulation (tACS) at theta frequency (6 Hz) to nodes in dorsolateral prefrontal cortex (DLPFC) and posterior parietal cortex (PPC) to investigate the causal role of

FPN connectivity in both visual and verbal analogical reasoning. 94 participants (collected across two sites) participated in a between-subjects, double-blind design with three conditions: 1) 0-degree in phase 'synchronized' theta tACS (N=32), 2) 180-degree out of phase 'desynchronized' theta tACS (N=28), and 3) sham stimulation (N=34). Contrary to previous evidence that 'synchronized' theta tACS to DLFPC and PPC enhances working memory (Polania, 2012), we found that 'desynchronized' stimulation led to enhanced visual analogical reasoning compared to both the sham and 'synchronized' stimulation conditions (F=4.31, p=.016, ?p2 = .086), even when controlling for baseline intelligence and vocabulary. In addition, we found no differences in performance 9on forward digit span (working memory) or the verbal analogy task between the three different stimulation conditions. These findings support a causal role of the FPN in visual analogical reasoning, and call into question whether 180-degree out of phase stimulation truly 'desynchronizes' cortical oscillations between brain regions.

Topic Area: THINKING: Reasoning

B129 Symbolic and Non-Symbolic Fractions Relate to Different White Matter Tracts:A Cross-Sectional Diffusion MRI Tractography

Yunji Park[1], Douglas Dean III[1], John Binzak[1], Percival Matthews[1], Edward Hubbard[1], [1]University of Wisconsin-Madison

Growing evidence suggests the existence of a system dedicated to processing nonsymbolic ratio magnitudes (e.g., the ratio of two line-lengths). Lewis, Matthews, & Hubbard (2015) dubbed this system as the Ratio Processing System (RPS) and proposed it can be leveraged to help acquire symbolic fractions. Neuroimaging studies suggest the RPS and fraction processing engage overlapping fronto-parietal networks (Mock et al., 2018), but the white matter pathways connecting this network remain unexplored. We therefore investigated the relationship between white matter pathways and fraction processing. 47 2nd- and 45 5th-graders participated in a diffusion MRI scan and performed a series of ratio comparison tasks during fMRI scanning. Children decided which of two ratio stimuli was numerically larger in three different notations: symbolic fractions, nonsymbolic line ratios, and mixed symbolic/nonsymbolic ratios. RPS functioning was defined as mean reaction times (RT). We performed deterministic tractography for the superior longitudinal fasciculus (SLF) and inferior longitudinal fasciculus (ILF). Interestingly, we found significant correlations with RPS functioning in 5th graders, but not 2nd graders: bilateral ILF was correlated only with symbolic notation (Left: r(41) = -.33, Right: r(41) = -.32), whereas bilateral SLF was correlated only with nonsymbolic notation (Left: r(41) = -.30, Right: r(41) = -.34). Consistent with previous studies, nonsymbolic ratios related to frontal-parietal networks, but symbolic fractions processing related specifically to pathways linking visual/language areas. Taken together, these findings suggest that, although representations of symbolic vs. nonsymbolic ratios converge on similar areas, they may depend on different structural pathways to get there.

Topic Area: THINKING: Reasoning

Session C

Sunday, March 15, 1:00–3:00 pm, Exhibit Hall C

C1 Highway to the Danger Zone: Fatigue Assessment in a Flight Simulation

Gregory Gill[1], Chad Williams[1], Marielle Timmins[1], Olave E. Krigolson[1], [1]University of Victoria

Fatigue can pose a serious threat to individual safety as well as the safety of others, especially in aviation. With this in mind, it is imperative that both military and commercial aircraft personnel maintain alertness to ensure operational safety. Interestingly, a component of the human event-related brain potential (P300) has been demonstrated to be indicative of fatigue in experimental and real-world settings. While much of the existing literature suggests that task engagement is necessary in order to illicit the P300, prior work from our laboratory has shown that it can also be generated using unattended stimuli. In the current experiment, participants completed a challenging six-hour flight simulation in Microsoft Flight Simulator X during which EEG data was recorded. In a key manipulation, and unbeknownst to our participants, throughout the task a passive auditory oddball task was also occurring. An analysis of our data revealed that the passive auditory oddball task elicited a P300 response ? the aforementioned neural signal associated with fatigue and task engagement. Importantly, we found that the P300 response diminished with increasing fatigue in a non-linear manner. Further, we found contaminant changes in the EEG power spectra that were also indicative of increasing fatigue (i.e., an increase in frontal theta power). Our results show promise for the potential use of unattended, non-intrusive stimuli to probe various aspects of brain function during real world task performance as well as illustrating the practicality of utilizing portable devices in various settings to improve environmental validity of the research.

Topic Area: ATTENTION: Auditory

C2 Musical rhythm training improves temporal attention and working memory in aging

Theodore Zanto[1], Vinith Johnson[1], Avery Ostrand[1], Tiffany Ford[2], Adam Gazzaley[1], [1]University of California San Francisco, [2]University of California Berkeley

Recent years have seen an increase in research indicating a positive effect of musical training on cognitive ability, particularly in attention and working memory. However, it is less clear whether the effects of musical training may help remediate age-related declines in attention and working memory. To address this, a double blinded, placebo controlled, musical rhythm training intervention was conducted in older adults (N=40) aged 60 ? 80 years. Participants were randomly assigned to either a rhythm training or a word search training (control) group, and engaged in the intervention for 8 weeks. Both interventions were conducted at home on mobile tablets, however, only the rhythm training incorporated real-time closed-loop adaptivity. Measures of temporal attention (the ability to orient attention in time) and working memory were assessed pre- and post-intervention, while electroencephalography (EEG) data were recorded. Results indicate both temporal attention and working memory abilities were improved in the rhythm training, but not control, group. These results corroborate prior research indicating musical training has a positive effect on cognitive abilities, which may be used as a means to help remediate age-related declines in cognitive control.

Topic Area: ATTENTION: Development & aging

C3 Electrophysiological modulation of peripersonal space in the presence of threatening faces

Julia Fellrath[1], Silvia Serino[1], Giulia Ellena[1], Petr Grivaz[1], Andrea Serino[1], [1]MySpaceLab

Peripersonal space (PPS) is a multimodal sensory-motor interface that mediates the interaction between the individual and the environment. Previous behavioral studies have shown that the valence of a stimulus moving in space has an impact on the sensorimotor mechanisms of the PPS. However, knowledge about temporal dynamics of PPS modulation with emotional information is lacking. Here, we recorded electrophysiological processing while administrating a multimodal interaction task with vibrotactile stimulation and concurrent looming faces. The vibrotactile stimulation was appearing when the looming face was either near or far from participant's body. An experimental group (N=13) was exposed to neutral and threatening faces, and a control group (N=13) was exposed to neutral faces only. We used cluster-based permutation statistics to identify clusters of electrodes showing a PPS effect â?' a multisensory response that is dependent on the distance of the visual information to the body (visuo-tactile near vs visuo-tactile far). In the experimental group, a PPS effect over central channels was observed around 200ms with neutral faces (p=0.02). However, there was no PPS effect with the sick faces. In the control group, a PPS effect was observed over central channels around 180ms (p=0.03). These results show that in contrast to neutral faces, threatening faces affect multisensory integration already at a distant position, probably for an appropriate defensive reaction: the difference between the near and the far space is blurred and a threatening face appears similarly relevant weather it appears in near of far space.

Topic Area: ATTENTION: Multisensory

C4 Rapid electrophysiological activations within anterior insula anticipate spontaneous pupil dilations

Aaron Kucyi[1], Josef Parvizi[2], [1]Northeastern University, [2]Stanford University

Spontaneous activation within neuronal populations is often of similar magnitude to activation evoked explicitly during cognitive performance. We hypothesized that spontaneous 'task-like' activations in the dorsal anterior insular cortex (daIC) signify self-generated cognitive processes that can be indexed by non-luminance-mediated pupil dilation, a marker of internal mental state. Using human intracranial electroencephalography in three subjects with electrodes implanted in the insular cortex, simultaneous pupillometry was recorded during multiple sessions of continuous task performance and wakeful rest (visual fixation). We found that within each subject, task-evoked pupil dilations scaled with the magnitude of preceding high-frequency broadband (70-170 Hz) activations in the daIC. Critically, during wakeful rest, spontaneous pupil dilations were anticipated by rapid daIC activations that emerged less frequently but that were of similar magnitude and form to task-evoked activations. Thus, daIC activations- in coordination with a distributed network and large-scale neuromodulatory systems- may signify the emergence of self-generated cognitive processes with similar attributes to explicitly evoked cognition.

Topic Area: ATTENTION: Nonspatial

C5 Targeting Neural Correlates of State- and Trait-Boredom

Ofir Yakobi[1], James Danckert[1], [1]University of Waterloo

Boredom is frequently associated with risk-taking, attention deficits, and more recently â?' with distinct modes of self-regulation. These results are primarily derived from behavioral and self-reported data, leaving the neurophysiology of boredom underexplored. The present work aims to investigate the oscillatory brain activity involved in trait- and state-boredom, namely â?' resting state EEG and event-related potentials (ERP). Fifty undergraduates completed a boredom proneness (BPS) questionnaire, a go/no-go task and the Balloon Analogue Risk Task (BART), while their brain activity was recorded using EEG. State boredom ratings were taken before and after each task.We compared Frontal Alpha Asymmetry (FAA) before and after the two tasks were completed. High boredom prone individuals showed a rightward drift in brain activity, reflecting a shift from approach to avoidance motivation. Low BPS individuals, in contrast, showed a non-significant trend toward a reversal of this pattern. Trait boredom was correlated positively with risk-taking in the BART, and to the latency of the feedback-related negativityâ?' an ERP reflecting feedback processing. State boredom was associated with poorer accuracy in the go/no-go task and smaller magnitude of the error-related negativity and the stimulus locked P3. Trait boredom proneness was also correlated with decision-time in the BART, such that high-BP individuals exhibited shorter decision times.These findings provide neural-level evidence for alterations in activity in the bored brain. The difference in spontaneous EEG asymmetry between high- and low-BP individuals, along with the negative correlation between the P3, ERN and state-boredom, map onto recent studies linking boredom, self-regulation and attention.

Topic Area: ATTENTION: Other

C6 Two dominant brain states reflect optimal and suboptimal attention

Ayumu Yamashita[1], David Rothlein[1], Aaron Kucyi[2], Eve Valera[3], Michael Esterman[4], [1]Boston University School of Medicine, [2]Northeastern University, [3]Harvard Medical School, [4]VA Boston Healthcare System

Attention is not constant but fluctuates from moment to moment. Previous studies dichotomized these fluctuations into optimal and suboptimal behavioral states based on performance and investigated the difference in brain activity between these states. Although these studies implicitly assume there are two states, this assumption is not guaranteed. Here, we reversed the logic of these previous studies and identified unique states of brain activity during a sustained attention task and provided evidence for behaviorally optimal and suboptimal attentional states based on this dynamic functionally different brain systems' activities constrained by brain network. In this study, we demonstrate a systematic relationship between dynamic brain activity patterns and behavioral underpinnings of sustained attention by explaining behavior from two dominantly observed brain states. A brain state characterized by default mode network activity was behaviorally optimal and a brain state characterized by dorsal attention network activity was suboptimal. These results converge with the results of previous studies where states were defined behaviorally. We validated our results by using an independent validation dataset. We further demonstrated how these brain states were impacted by motivation, mind wandering, and ADHD. Our study not only provides evidence for behaviorally optimal and suboptimal attentional states from the viewpoint of brain activity but also provides the functional linkage of the mechanisms coordinating between functionally different brain systems related to sustained attention through the intermediary of their brain activity.

Topic Area: ATTENTION: Other

C7 Global integration of intrinsic brain activity is related to attention and ADHD

Agnieszka Zuberer[1], Aaron Kucyi[2], Eve Valera[3], Michael Esterman[1], [1]Boston University, [2]Stanford, [3]Harvard Medical School

Most of our brain activity unfolds in an intrinsic manner and is unrelated to effects due to immediate external stimuli. The dissociation of this intrinsic (stimulus-unrelated) from extrinsic (stimulus-related) brain activity has been a major challenge to investigate how those two differential effects give rise to

behavior. We present a unique gradual continuous performance task to map fluctuations of sustained attention which are self-emergent/not task-evoked and thus constitute an ideal candidate to study behavior relationships with fluctuations of the intrinsic network account. Behavioral correlates of suboptimal attention, defined both objectively and subjectively (higher reaction time variability and lower self-rated attention focus), are related to a connectivity state of global integrated neural processing, a brain state more akin to resting state. Subjects with ADHD showed a baseline task state perpetually more rest-like, accompanied by higher variability and lower task focus. In contrast, rare behavioral errors were followed by a transient reduction of global integration of the global connectivity state. ADHD subjects displayed stronger post-error reductions of this integrative property. The results suggest that the magnitude of these effects on intra-brain communication across network communities are uniform and not restricted to specific putative cortical systems suggesting that global integration of brain activity reflects a truly global measure of cross-talk in the brain, which is sensitive to within-subject attentional fluctuations and clinical abnormalities of attention.

Topic Area: ATTENTION: Other

C8 Gamma band activity acts as a trigger for long-range apparent motion. Towards an integrative theory of apparent motion

Yasuhiro Sakamoto[1], Hideyuki Hoshi[1], Yoshihito Shigihara[2], Winfried Menninghaus[1], David Poeppel[3, 4], [1]Max Planck Institute for Empirical Aesthetics, [2]Hokuto Hospital, [3]MPI for Empirical Aesthetics, [4]New York University

Apparent motion is one fundamental perceptual attribute in the internal construction of visual world. Previous studies have examined the conditions in which apparent motion can be perceived. However, the implementational question of the neural mechanisms involved in apparent motion has not been investigated extensively. This MEG study characterizes how the visual cortex classifies and processes identical stimuli that elicit apparent motion or not, employing a range of inter stimulus intervals (ISI). In some of these, over multiple trials, perceptual uncertainty arises such that a participant perceives physically identical stimuli sometimes as apparent motion and sometimes not. Event related fields (ERF) in the occipital region for both response-types showed no significant differences prior to ~200 ms. This is presumably due to the fact that the stimuli are always identical; only participants' responses differed. In contrast to the ERF results, spectral-temporal analyses revealed a significant difference in the low gamma-band on the right parietal sensors. This finding correlates with the source of the ERF peak roughly in in visual regions V3a and V3d (~140 ms). This suggests that apparent motion is not classified passively based on visual processing; rather, sensitivity to apparent motion - a kind of Gestalt perception - is influenced by the low-gamma state during stimulus presentation. Our findings give rise to further questions, including how the low gamma-band (de)synchronization on stimulus onset influences the low-level visual perception that makes for a rational interaction between perception and real world.

Topic Area: ATTENTION: Spatial

C9 Inhibitory rTMS over the right parietal cortex modulates functional connectivity

Selene Schintu[1], Catherine A. Cunningham[1], Michael Freedberg[1], Stephen J. Gotts[2], Sarah Shomstein[3], Eric M. Wassermann[1], [1]NINDS – NIH, [2]NIMH – NIH, [3]George Washington University

Hemispatial neglect is thought to result from hyper-activation of the left (intact) frontoparietal network, via its release from inhibition by the right hemisphere. Inhibitory rTMS over the left posterior parietal cortex (PPC) improves neglect and normalizes hyper-active left frontoparietal functional connectivity (FC). Delivered over the right PPC in healthy individuals, rTMS shifts midline judgment rightward, mimicking neglect, possibly by changing frontoparietal FC. We investigated whether inhibitory rTMS over the right PPC produces neglect-like behavior and changes frontoparietal FC. Seventeen participants received 40 sec of continuous theta-burst rTMS at 80% of active motor threshold, to the right PPC or vertex (control) in sessions separated by ? 5 days. We targeted area 1 of the intraparietal sulcus, where TMS affects visuospatial behavior. Before and after rTMS, participants underwent 10-minute resting state fMRI and performed line bisection tasks. Diffusion tensor imaging data were acquired separately. As expected, rTMS caused a rightward shift in line bisection judgment. A whole brain, seed-based, analysis found increased FC between the PPC target and the left superior temporal gyrus (STG). Follow-up exploratory analysis showed that the left STG increased FC with the right medial frontal gyrus and right precuneus, both nodes of the frontoparietal network. Furthermore, the fractional anisotropy (FA) of PPC to PPC white matter predicted the change in FC between the right PPC and left STG for PPC, but not vertex, rTMS.

Local inhibition of the right PPC reshapes the attentional network via an interhemispheric pathway and the FA between the PPCs predicts such change.

Topic Area: ATTENTION: Spatial

C10 Anatomical correlates of line-bisection peformance: what can be learnt from a game theoretical analysis?

Monica Toba[1, 2], Melissa Zavaglia[3], Caroline Malherbe[3], Tristan Moreau[1], Federica Rastelli[1], Anna Kaglik[1], Romain Valabregue[1], Pascale Pradat[4], Claus Hilgetag[3] , Antoni Valero-Cabré[1], [1]Brain and Spine Institute, ICM, [2]UPJV Amiens, [3]Institute of Computational Neuroscience, UKE, [4]APHP Paris

Line bisection is among the most used clinical tests to assess right brain-damaged patients with neglect, a neurological condition involving a rightward attentional bias. This test involves perceptual (line length estimation), motor (manual bisection) and attentional components. Here, we used the Multi-perturbation Shapley value Analysis (MSA) based on coalitional game theory to infer from 25 neglect patients, causal contributions for gray and white matter regions of interest (ROI) to visuospatial attention, on the basis of lesion location and line bisection outcomes. Analyses revealed positive contributions (i.e., regions facilitating performance) for the frontal eye fields (FEF), the intraparietal sulcus (IPS), the temporo-parietal junction (TPJ), the inferior occipital gyrus (IOG) and for the optic radiations (OR), inferior fronto-occipital fasciculus (IFOF), superior longitudinal fasciculus (SLF) and the posterior cingulum (CP). Negative contributions (i.e., regions hindering performance) were found for the inferior frontal gyrus (IFG) and the anterior cingulum (CA). Interactions between grey matter areas mirrored the trajectory of the white matter bundles involved. Our approach provides a picture of visuospatial attention systems and functions, which is overall compatible with existing accounts. Additionally, it characterizes a substantial number of interactions between regions, which should be tested with brain stimulation approaches. Our contribution maps should be used to design rehabilitation approaches based on transcranial magnetic/electrical stimulations. Such methods could contribute to individualize interventions, according to patient behavioral (i.e., double dissociations between performance in line bisection vs. other tests) and anatomical (i.e., presence/absence of lesions of positive/negative ROI contributors) profiles.

Topic Area: ATTENTION: Spatial

C11 Age differences in vmPFC functional connectivity during the processing of socioemotional information

Ryan T. Daley[1], Holly J. Bowen[2], Eric C. Fields[1, 3], Katelyn R. Parisi[1], Angela Gutchess[3], Elizabeth A. Kensinger[1], [1]Boston College, [2]Southern Methodist University, [3]Brandeis University

Socioemotional information processing may be partially supported by activity in the ventromedial prefrontal cortex (vmPFC) in older adults (OAs) and younger adults (YAs; Gutchess & Kensinger, 2018). It is unclear how age relates to vmPFC functional connectivity (FC) with other regions during socioemotional information processing. Here we ask two questions: Does the vmPFC show age-invariant processing of socioemotional compared to neutral information? And, are there age differences in vmPFC FC during socioemotional information processing? During fMRI scanning, OA and YA participants viewed images of positive, negative, and neutral objects, and were asked to imagine placing those objects in their own home or a stranger's home. Analyses revealed greater activity in the vmPFC during socioemotional compared to neutral information processing in both groups. OAs showed stronger FC between the vmPFC and regions associated with the anterior-temporal (AT) memory subsystem during emotional processing (Ritchey, Libby & Ranganath, 2015), for both emotional other person-relevant conditions compared with neutral: Positive-Stranger compared to Neutral-Stranger and Negative-Stranger compared to Neutral-Stranger conditions. For emotional self-relevant information, both groups showed effects of valence on vmPFC FC, although the direction of those effects differed: regions associated with the posterior-medial (PM) subsystem showed stronger FC with the vmPFC for Positive-Self compared to Negative-Self conditions in OAs and for Negative-Self compared to Positive-Self conditions in YAs. These results demonstrate that although both YAs and OAs recruit the vmPFC during socioemotional information processing, there are age reversals in the effects of valence on FC.

Topic Area: EMOTION & SOCIAL: Development & aging

C12 Impact of persistent depression on telomere length, cognitive decline and white matter alteration in aging adult

Hyeon Min Ahn[1], Regina Ey Kim[1], Soriul Kim[1], Inkyung Baik[2], Chol Shin[1], [1]Korea university, [2]Kookmin university

Depression is associated with an acceleration of the cognitive decline in aging adults. The acceleration of aging in depression can affect telomere length shortening. However, recent studies about the relationship between telomere length and depression have shown inconsistent results. This study aimed to investigate the association of persistent depression symptoms with telomere length in aging adults and whether this is related to cognitive decline and possible cerebral modification of white matter integrity using diffusion tensor imaging (DTI). A cohort study of 2213 cognitively normal elderly adults from the Korean Genome Epidemiology Study was evaluated. All participants underwent a brain MRI scanning, a comprehensive neuropsychological test battery that included memory and executive function measures. Participants were also asked to answer questions on the Beck Depression Inventory (BDI) to measure levels of depressive symptoms. A linear regression analysis showed that persistently depressive participant had significantly shorter telomere length than control groups ($p = 0.002$). There is a significant relationship between persistent depression and memory tests ($p = 0.013$). The white matter results also showed a significant difference between persistent depressed group and control group in multiple areas such as frontal part of the right Inferior fronto-occipital fasciculus, bilateral superior longitudinal fasciculus, and right corticospinal tract regions ($p < 0.05$). We found a negative association between depressive symptoms and telomere length. We also found synergetic interaction between persistent depression symptom and telomere length on memory tests ($p = 0.013$). These findings provide biological evidence for the acceleration of cognitive decline in persistently depressed adults.

Topic Area: EMOTION & SOCIAL: Development & aging

C13 Characterizing cortical responses to faces and scenes in infant ventral temporal cortex.

Heather L Kosakowski[1], Michael Cohen[2], Lyneé Alvez[3], Atsushi Takahashi[1], Nancy Kanwisher[1], Rebecca Saxe[1], [1]MIT, [2]Amherst College, [3]University of Denver

Adults have a variety of well-established category-selective regions in the ventral temporal cortex (VTC). For example, the fusiform face area (FFA) responds selectively to faces and the parahippocampal place area (PPA) responds selectively to scenes. Two studies in awake infant humans and non-human primates using functional magnetic resonance imaging (fMRI) demonstrated that infants have face- and scene-responsive regions that are not yet category specific (Deen et al., 2017; Livingstone et al., 2017). To determine if these results are replicable in a larger group of infants, we recruited 46 infants (2.5-11 months; 26 female). Infants watched videos of faces, objects, bodies, and scenes. In a group random effects analysis (n=26 had at least 5 minutes of low-motion data) we found face, object, and scene responses in infants that are in similar anatomical locations as those found in adults. In the fROI analysis (n=16), we replicated previous findings that infants have face- and scene-responses in VTC that are not yet category selective. Furthermore, we found a robust response to faces in the infant medial prefrontal cortex (MPFC) that was category-specific. These data suggest that awake infant fMRI produces reliable, replicable results.

Topic Area: EMOTION & SOCIAL: Development & aging

C14 Theory of Mind Task-induced Connectivity is Associated with Social Connectedness in Older Adults

Seongjae Park[1], Seyul Kwak[1], Hairin Kim[1], Naeun Oh[1], Jeanyung Chey[1], [1]Seoul National University

Humans are very social species like most primates, and thus engaging in appropriate interactions with other people is one of the most important aspects of everyday life. Social life is highly complicated and requires individuals to utilize sophisticated social cognitive processes. The social brain is known for the neural basis of the social cognitive process. However, little is known about how the social brain response to social stimuli is associated with the real-life social network property, especially in older adults. This study aimed to examine the association between the elderly's neural response in the social brain during a Theory of Mind (ToM) task and their social connectedness. Subjects were 32 healthy older adults (Mean age = 76.4, SD = 5.8) participating in the Korean Social Life, Health, and Aging Project (KSHAP) without psychiatric or neurological diseases, traumatic brain injury, or loss of consciousness. They underwent fMRI scan while watching social animation videos containing interactions between abstract figures. The ToM task-evoked functional connectivity was measured by using pre-defined seed regions, including medial prefrontal cortex (mPFC) and temporo-parietal junction (TPJ), known to be engaged in the mentalizing process. Then, we conducted seed to voxel g-PPI (generalized psychophysiological interaction) analysis using the selected seeds. As a result, people with more social connections showed increased functional coupling between mPFC and insula during the ToM task. This result suggests that neural responsivity of the social brain could be a neural basis of real-life social interactions.

Topic Area: EMOTION & SOCIAL: Development & aging

C15 Assessing the tradeoff between ecological validity and EEG signal quality in an aesthetic rating task

Dominik Welke[1], Edward A. Vessel[1], [1]Max-Planck-Institute for Empirical Aesthetics

'Real-world' visual aesthetic experiences involve open-ended exploration of highly variable artistic objects. Yet uncontrolled gaze and stimulus variability are typically avoided in electroencephalographical (EEG) experiments due to potential generation of artifacts and noise. We aimed to quantify the effect of relaxing such experimental constraints on EEG signal quality and behavioral measures recorded during an aesthetic rating task. 34 participants observed 40 'artistic' video clips depicting dynamic natural environments or dance performances plus 40 still frames drawn from these clips, while either maintaining fixation or being allowed to shift their gaze freely. Observers rated each stimulus for subjective aesthetic appeal and state of boredom while watching. Eye-tracking and 64-channel wet EEG was recorded. A task-unrelated frequency-tagged auditory stimulus (amplitude modulated pink noise) accompanied each trial, allowing to quantify Signal-to-Noise Ratio (SNR) to proxy overall signal quality. Data acquisition is continuing; here we report results from an initial analysis of N=5 participants. In our stimulus set, motion affects behavioral ratings (dynamic stimuli rated more aesthetic and less boring than static), while domain differences are present (landscape stimuli rated more aesthetic and less boring than dance). In the EEG we find only marginally lower SNR for dynamic than for static, and for dance than for landscape stimuli. These initial results suggest that it is possible to increase ecological validity without significantly disrupting the quality of EEG recordings or losing many trials to conservative cleaning, and that observers's subjective experiences will benefit from doing so.

Topic Area: EMOTION & SOCIAL: Emotional responding

C16 Associations between Risky Drinking, Suicidality and Network Activation During Emotional Response Inhibition

Julia Cohen-Gilbert[1,2], Anna Seraikas[2], Eleanor Schuttenberg[2], Emily Oot[1,2], Jennifer Sneider[1,2], Lisa Nickerson[1,2], Marisa Silveri[1,2], [1]McLean Hospital, [2]Harvard Medical School

Among young adults, suicidal ideation (SI) is strongly associated with dangerous patterns of alcohol use highly prevalent in this group, including binge drinking. The relationship between SI and drinking may be mediated by common neurocognitive factors, including dysregulated emotional impulsivity. Functional magnetic resonance imaging data were acquired during performance of an inhibitory control task (Go-NoGo) requiring participants to ignore emotionally negative or neutral background images. Subjects were 49 college freshmen (18-20yrs) who engaged in a broad range of drinking behavior (Alcohol Use Disorders Identification Test (AUDIT) scores=0-17). Seventeen subjects endorsed SI at baseline or within one year. Network template spatial activation maps, derived from HCP data, were projected onto brain activation for negative>neutral inhibitory (NoGo) trials, deriving a subject-series of activation strengths for each brain network for each participant. Multiple linear regression showed a significant interaction of AUDIT at 1-year follow-up and SI (p=.01); in the SI group only, AUDIT scores were associated with activation of a network comprising positive connectivity between regions involved in emotion (amygdala) and regulating attention (e.g., fusiform, precuneus), and negative connectivity within cingulo-opercular network nodes. These results may reflect altered shifting of cognitive resources between processing emotionally salient stimuli and maintenance of stable task performance. Accordingly, activation of this network was associated with slowed reaction times on negative versus neutral Go trials, with a particularly strong association observed in the SI group. This network activation profile may therefore serve as a potential risk marker for problematic alcohol use among youth endorsing SI.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

C17 Adults vs. neonates: Differentiation of functional connectivity between amygdala subnuclei and occipitotemporal cortex

Heather Hansen[1], Jin Li[1], Zeynep Saygin[1], [1]The Ohio State University

The amygdala, a subcortical structure known for social and emotional processing, consists of multiple subnuclei with unique functions and connectivity patterns. Tracer studies in adult macaques have shown that the lateral and basal subnuclei differentially connect to visual cortical areas, with stronger connections to anterior regions and weaker connections to posterior regions; infant macaques show robust connectivity even with posterior visual regions. Do these developmental differences also exist in the human amygdala, and what is the possible functional role of this prolonged development of connectivity? To address these questions, we explored lateral and basal functional connectivity (from resting-state fMRI data) to occipitotemporal cortex in 40 adult subjects and 36 neonates scanned within one week of life. We calculated amygdala connectivity to anterior-posterior gradients of the anatomically-defined occipitotemporal cortex, and also to putative occipitotemporal functional parcels, including primary and high-level visual and auditory cortices (V1, A1, face, scene, object, body, and temporal speech regions). Results showed a decreasing gradient of functional connectivity to the occipitotemporal cortex in adults ? similar to the gradient seen in macaque tracer studies ? but no gradient in neonates. Further, adults had stronger connections to higher level functional regions associated with face, body, and object processing, and weaker connections to primary sensory regions (i.e., A1, V1), whereas neonates showed the same amount of connectivity to primary and higher-level sensory regions. Overall, these results show that functional connectivity between the amygdala and occipitotemporal cortex is not yet differentiated in neonates, possibly facilitating experience-dependent specialization of cortex.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

C18 How Depressive Symptomology Affects Emotional Regulation Across the Lifespan

Taylor James[1], Brittany Corbett[1], Audrey Duarte[1], [1]Georgia Institute of Technology

Emerging evidence suggests that older adults spontaneously engage in downregulation of emotional affect during anticipation of negative events. Depression is known to interfere with the processing of emotional material; however, it is not known how depressive symptomology, even in the absence of a clinical diagnosis, affects anticipatory emotional processing and how this relationship may change with age. We have currently tested 15 young adults with a range of CES-D scores on an fMRI task where they view positive, negative, and neutral images preceded by auditory cues which indicate the valence of the upcoming stimulus. Participants rated the emotional intensity of the images while undergoing scanning, then, outside of the scanner, they completed a recognition task. Regardless of symptom severity, participants did not show valence differences in memory performance. Consistent with previous findings, young adults did not downregulate negative affect, as amygdala activity did not differ between negative and neutral image anticipation. Interestingly, those with lower CES-D scores showed more engagement of amygdala during anticipation of positive relative to negative and neutral images, possibly reflecting upregulation of positive affect. These preliminary results suggest that depressive symptomology impacts anticipatory processing of positive but not negative emotional images in young adults. Further analyses will be conducted as we collect data from more

individuals to determine how the relationship between depressive symptoms and emotional regulation changes across the lifespan.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

C19 The neural correlates of aversive to appetitive counterconditioning

Nicole E. Keller[1], Emily Leiker[1], Mason McClay[1], Augustin C. Hennings[1], Jarrod A. Lewis-Peacock[1], Joseph E. Dunsmoor[1], [1]University of Texas at Austin

Fear extinction, the basis for exposure based therapy, is often followed by the re-emergence of extinguished fear behaviors. Therefore, strengthening extinction memories to effectively inhibit the return of fear is critical in designing improved treatment for fear related disorders. Counterconditioning is an alternative technique to extinction, by which behavior is modified through a new association with a stimulus of an opposite valence. In the present within-subject neuroimaging study, we compared the neural correlates of counterconditioning, where an aversive shock was replaced by an appetitive stimulus, to the well-delineated neural circuitry of extinction, where an aversive shock was merely omitted. Results showed that in a whole-brain within-group contrast for items encoded during extinction, subjects exhibited higher BOLD activity in the amygdala and the striatum to counter-conditioned stimuli relative to extinguished items. Similarly, at a renewal test 24-h later, subjects displayed higher BOLD activity in the amygdala to new items from the counter-conditioned category relative to the extinguished category. One month later, in a long-term memory test, participants showed enhanced explicit memory for counter-conditioned items encoded during extinction in comparison to extinguished items. In line with previous research, these results suggest mechanisms by which safe memories can be enhanced in the long term: (1) through increased engagement of the striatum during extinction learning, and (2) through increased engagement of the amygdala during both extinction learning and consolidation (Correia et al. 2016). This has implications for boosting exposure therapy efficacy by incorporating appetitive stimuli that enhance reward system engagement.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

C20 mental workload even if learning efficiency is enhanced

Tsukasa Kimura[1], Noriko Takemura[2], Yuta Nakashima[2], Hirokazu Kobori[3], Hajime Nagahara[2], Masayuki Numao[1], Kazumitsu Shinohara[4], [1]ISIR, Osaka University, [2]Institute for Datability Science, Osaka University, [3]Daikin Industries, Ltd., [4]Graduate School of Human Sciences, Osaka University

Climate change is one of the most important issues for humanity. To defuse this problem, it is considered necessary to improve energy efficiency, make energy sources cleaner, and reduce energy consumption in urban areas. Japanese government recommended a setting of air conditioner to 28 ? in summer and 20 ? in winter. The aim of this setting was to save the energy by keeping the room temperature constant. However, it is unclear whether this setting is an appropriate temperature for workers and students. This study examined whether thermal environment influences the task performance varied with time. In addition, to examine whether the relationship between task performance and thermal environment influence psychological states of participants, we recorded subjective rating for mental workload, working memory score, electroencephalogram (EEG), heart rate variability (HRV), skin conductance level (SCL), and tympanum temperature during the task and compared among conditions. In this experiment, participants were asked to read some texts, after that, they were required to answer the questions related to the texts. The room temperatures were manipulated during the task (18, 22, 25 or 29 ?) and participants performed the task at these temperatures. The results of this study showed that temporal cost of task and theta power of EEG decreased over time. However, subjective mental workload increased with time. Moreover, LF/HF and SCL increased at the heat environment (25 and 29 ?). These results suggest that mental workload, especially implicit mental workload, increases at the heat environment, even if learning efficacy facilitates.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

C21 Using optical flow to capture movement in response to emotional stimuli among people with schizophrenia: a pilot study

Lisa Lin[1], Michelle Matvey[2], Ellen Bradley[2], Chenwei Wu[1], David Dodell-Feder[1], Josh Woolley[2], [1]University of Rochester, [2]San Francisco VA Medical Center

People with schizophrenia (SZ) demonstrate deficits in nonverbal expressivity that have important implications for social functioning. Previous work has typically relied on clinician- or observer-based ratings to measure symptoms associated with SZ. Recent advances in computer vision techniques have led to increases in automated measures to examine nonverbal behavior. In this pilot study, we assessed the relationship between automatically quantified evoked movement and clinician-rated symptoms of SZ. Men with schizophrenia (n=19) and neurotypical controls (n=17) viewed emotionally evocative videos while being video recorded. We estimated participants' movement using optical flow-a technique that estimates the pattern of apparent motion of an object between consecutive frames-from these recordings using the Farneback method. The Farneback algorithm produces estimates of the spatial-temporal changes resulting from motion and allows for the calculation of movement intensity (i.e. motion energy). We examined differences in motion energy in neurotypicals and SZ and ran correlations between motion energy and SZ symptoms. We found no differences in motion energy between SZ and controls in response to stimuli with either positive or negative valence (p's >0.05). Motion was inversely correlated with negative symptom severity for both positively ($r = -0.51$, $p=0.03$) and negatively ($r= -0.46$, $p=0.05$) valenced stimuli. Motion was correlated with positive symptom severity for negative ($r=0.66$, $p =0.002$) and for positively valenced stimuli ($r = 0.41$, $p = 0.09$). Although these preliminary findings should be interpreted with caution, they suggest that automated methods of measuring movement are potentially valuable tools that may efficiently capture meaningful differences in nonverbal expressivity.

Topic Area: EMOTION & SOCIAL: Other

C22 Neural correlates of perspective taking in youths

Min Liu[1], Tai-Li Chou[1], [1]National Taiwan University

Visual perspective taking (VPT) refers to the ability to adopt another person's visual view to understand or infer that person's belief and mental status. Such ability is regarded as an important part under the Theory of Mind (ToM) system. In the present study, the Dot Task was used to explore effects of Perspective (Self/Other) and Consistency (Consistent/Inconsistent) between Self/Other perspectives) on task performance. We used the [Self Inconsistent > Self Consistent] contrast to reflect the neural substrates underpinning perspective taking. Twenty-eight healthy Taiwanese participants (age range: 15-20 years old) were asked about how many dots he/she (Self trials) or a cartoon character (an avatar, Other trials) saw on a screen. In the Consistent condition, the participant saw the same number of dots as the avatar, while in the Inconsistent condition the participant saw a different number of dots from the avatar. Neuroimaging data were simultaneously acquired using an event-related functional Magnetic Resonance Imaging (fMRI) design. Functional imaging results for the contrast [Self Inconsistent > Other Inconsistent] yielded greater activation in the medial prefrontal gyrus (MPFC), temporal-parietal junction (TPJ) and left inferior frontal gyrus (IFG). These findings suggest that

during the Dot task, participants may have to distinguish other's perspective from one's own, and select relevant perspective while inhibit irrelevant one to calculate perspectives.

Topic Area: EMOTION & SOCIAL: Other

C23 Sexual objectification beyond the metaphor: an EEG investigation

Carlotta Cogoni[1], Jeroen Vaes[2], Giulia Cristoforetti[3], Daniela ruzzante[2], Veronica mazza[2], [1]IBEB (Instituto de Biofísica e Engenharia Biomédica), [2]University of Trento, [3]University of Ghent

Objectification refers to the focus on the individual's physical appearance over his/her mental state. Women are often the victim of this phenomenon, that occur whenever a woman is reduced to her body or certain body parts losing out on her inner mental life and moral standing. However the extent to which a woman becomes an object when objectified is still unclear. Does she actually become similar to a real object or is the object reference a mere metaphor? In a set of three experiments, male and female participants' neural activity was measured while they analyzed pictures of men and women and comparable doll-like objects. Using the well-known oddball paradigm, gender matched doll-like objects appeared infrequently among frequently presented human stimuli. Analyses were focused on a late event-related neurophysiological response (P300), which is triggered by the infrequent doll-like objects according to how different they were perceived from the repeated, human stimuli (i.e., the oddball effect). Results showed a significantly smaller oddball effect for objectified women compared to objectified men (Experiment 1). This difference did not occur for non-objectified depictions of men and women (Experiment 2). When no semantic references to the human-object divide were provided, objectified women were still perceived more similar to real objects (Experiment 3). The results are the first to demonstrate that the perception of women, when objectified, changes in essence beyond the metaphor making them more similar to objects than men.

Topic Area: EMOTION & SOCIAL: Person perception

C24 Neural correlates of affective and non-affective social interactions processing from point-light displays

Lukasz Okruszek[1], Justyna Gula[2], [1]Institute of Psychology, Polish Academy of Sciences, [2]Goldsmiths, University of London

Ability to interpret social interactions (SI) is one of the crucial skills enabling functioning in social world and has been linked to the increased activity of social brain networks, even if actions of agents are visually degraded to point-light displays (PLD). The main aim of the project was to examine the patterns of neural activity associated with processing of affective and neutral SI from PLD. During the motion-capture session, two pairs of actors were asked to perform a range of dyadic 3-second actions, including: neutral communicative interactions (COM); emotional exchanges (EMO) and independent actions (IND). Stimuli was transformed into PLD, animations with scrambled motion of agents (SCR) were also created. Fifty healthy individuals (30M; 33+/-8 yrs) were asked to categorize vignettes during a neuroimaging session. SI elicited widespread activity in bilateral superior temporal sulci (STS) and the right precentral gyrus (PG), which could have been distinguished from the pattern of activation elicited by biological motion per se (bilateral posterior STS, fusiform gyrus and precuneus). COM>EMO elicited higher activity in bilateral superior parietal lobule and left PG, while the reverse contrast was associated with left medial prefrontal cortex and right amygdala activation. Furthermore, increased connectivity between the right posterior STS and dorsomedial prefrontal and limbic regions was observed for EMO>COM. These results suggest that, regardless of their type, SI processing elicit widespread activity of the social brain networks, specific patterns of action observation and mentalizing networks activity may additionally be linked to the processing of specific types of interactions.

Topic Area: EMOTION & SOCIAL: Person perception

C25 EEG frequency-tagging of apparent biological motion dissociates action and body perception

Guido Orgs[1], Emiel Cracco[2], Goedele van Belle[3], Lisa Quenon[3], Patrick Haggard[3], Bruno Rossion[5], [1]Goldsmiths, University of London, [2]Ghent University, [3]UCL, [5]Université de Lorraine, CNRS, CRAN

Language and music are hierarchically organized with clearly identifiable components such as phonemes or notes that are combined to produce sentences or rhythms. The structure of human action, on the other hand, is less clear. Based on dance choreography, we propose that action sequences can be broken down into a series of movements from one body posture to another. By frequency-tagging fluent, non-fluent and random apparent biological motion sequences, we show that brain activity entrains not only to the presentation rate of individual body stimuli, but also to the repetition of specific body postures within the stimulus stream, and to the rhythm of whole-body movements. Entrainment to individual body postures were strongest for non-fluent sequences and across bilateral occipitotemporal electrodes, consistent with processing of static body postures in extrastriate visual cortex. In contrast, neural responses to the rhythm of movement were strongest for fluent sequences and across occipito-temporal and fronto-central electrodes. Body- and movement-related neural responses were absent for random posture sequences without compositional structure. Instead, these sequences evoked brain activity only at the visual presentation frequency. Frequency tagging of apparent biological motion thus reveals multiple brain representations for observed actions, driven by change in visual surface form, by repetition of static body postures, and by rhythm of movement. Our results are consistent with a hierarchical process of action perception that builds complex rhythmical action sequences by connecting fluent trajectories between static body postures.

Topic Area: EMOTION & SOCIAL: Person perception

C26 Neuromodulation of the Theory of Mind Neural Network with Real-Time fMRI Neurofeedback

Abhishek Saxena[1], Emily Dudek[1], J. Steven Lamberti[1],David Dodell-Feder[1], [1]University of Rochester

Theory of mind (ToM)-the ability to attribute and reason about the beliefs, intentions, and emotions of others-is a vital component to successful social interaction. Deficits in ToM are a hallmark of some of the most debilitating mental disorders, including autism and schizophrenia. A large body of research has demonstrated that these behavioral deficits are sub-served by impairments to a network of brain regions including dorsal medial prefrontal cortex (dmPFC) and tempo-parietal junction (TPJ). For individuals with impairments in ToM, the ability to volitionally modulate these brain regions, and bring them online during social interaction, may alleviate deficits in ToM and concomitant social difficulties. Thus, here, we present a proof-of-concept study to evaluate the efficacy of using real-time fMRI towards training volitional control of the ToM network. Participants underwent four separate scan sessions. In the first session, we localized TPJ using validated ToM tasks. In sessions two through four, we provided feedback to participants from TPJ during which participants were instructed to up- and down-regulate neural activity (percent signal change). Preliminary results suggest that with neurofeedback, participants are able to modulate neural activity in the TPJ as well as other ToM-related brain regions (dmPFC) that participants did not receive feedback on. Further, participants were able to volitionally modulate the network during a transfer scan in which no feedback was provided.

Together, these data highlight the potential utility of real-time fMRI for improving social deficits in psychiatric illness.

Topic Area: EMOTION & SOCIAL: Person perception

C27 The Power of the Personal Narrative

Brandy Tiernan[1], Bunderson Madison[2], Margaret Deane[1], Caroline Martin[1], Clara Davis[1], Andrew Dyar[1], Hannah Peterson[1], Mary Cecil[1], Gracen Kelly[1], Abigail Rapuano[1], Allyson Salazar[1], [1]Sewanee: The University of the South, [1]Yale University

Our cultural background influences how we communicate about mental health and wellness. It also impacts what symptoms we are likely to report to practitioners. My lab team and I used qualitative, behavioral, and neural methods to examine the impact of culture related to stigma and negative self-labels. In the focus groups, we found that intergenerational trauma and low socioeconomic status deeply affect our ability to construct a coherent personal narrative. A loss of a sense of purpose and meaning in life, feeling helpless, and failure to develop positive intimate relationships may occur without a cohesive account of identity. Such ideas perpetuate a self-fulfilling prophecy in which others' actions towards us reinforce our beliefs about ourselves and influence our actions towards others going forward. Our investigation examined using mentalization to describe the mental states of others instead of stigmatizing language ('us vs. them'). Saying 'appears anxious' rather than 'acting psycho' is considered socially desirable behavior, and participants processed stigmatizing words similarly to semantic violations. The findings support the use of language to find an impactful 'frame' to shift self-referential thinking, update our personal narrative, change our goals, and locus of control.

Topic Area: EMOTION & SOCIAL: Self perception

C28 The Developmental Trajectory of the Domain General Cortex

Athena Howell[1], Zeynep Saygin[1], David Osher[1], Jin Li[1], [1]The Ohio State University

The human cortex is not fully mature at birth. In particular, the frontoparietal regions take the longest to mature, and take longer to mature in humans than in other primates. The behavioral consequence of this maturational delay for humans remains unknown. In human adults, parts of frontal and parietal cortices are engaged in 'domain general' mental functions (i.e. required for tasks that involve extra mental effort, working memory, and attention, regardless of task or mental domain). Consequently, in adults, these areas show greater activation during difficult tasks vs. easy tasks; further, these areas are more connected to each other than to other networks (e.g. more intra-network connectivity vs. internetwork connectivity). It remains to be seen, however, whether these areas in neonates and children show a more prolonged development than adjacent areas engaged in other mental processes in either i) functional activation to task difficulty and/or ii) connectivity within and between functional networks. In this study, we assessed both the functional activation and connectivity of frontoparietal cortical areas in adults vs kids; and connectivity of these regions in adults vs neonates. Results indicate children exhibit generally weaker activation in domain-general areas as compared to adults. Further, neonates and children show similar intra- and inter-network connectivity whereas adults exhibit higher intra- vs inter-network connectivity for domain general regions. Ongoing and future longitudinal work will relate individual immaturity of function and connectivity to behavioral assessments and developmental milestones.

Topic Area: EXECUTIVE PROCESSES: Development &aging

C29 ERP P3 during visual 3-stimulus oddball task and intelligence at school aged children: the Hokkaido Study

Keiko Yamazaki[1], Atsuko Araki[1], Chihiro Miyashita[1], Sachiko Itoh[1], Sonomi Nakajima[2], Reiko Kishi[1], [1]Hokkaido University, [2]Sapporo Medical University

P3 is one of the most extensively studied event-related brain potential (ERP), whose characteristics change from children to adult. We investigated correlation between P3 and scores of the WISC-III (Wechsler Intelligence Scale for Children-third edition), which is consist of the tasks to need variable ability. The basic information of participants was obtained from a prospective birth cohort study, the Hokkaido Study on Environment and Children's Health. We enrolled pregnant women from 2002 to 2005 in Japan (n=514). The WISC-III was implemented when the children were at 7 years old, and ERP data was recorded at 13 years old. We analyzed data from 33 children who had both WISC-III and ERP data. The task was 3-stimulus visual oddball paradigm (standard, 70%; target, 15%; non-target, 15%), in which the stimuli were once every 2 s, with two condition for discrimination of the stimulus (easy/difficult condition). Mean age of children was 12.1 years old (SD 0.8). We observed P3a for non-target over the central electrodes, and P3b for target over the parietal electrodes from 300 to 500 ms. We found no significant correlation between P3a and any task score in WISC-III. Only P3b amplitude was decreased as increasing of Vocabulary score in difficult condition, and as increasing of picture arrangement score in the both conditions. These results are inconsistent to previous study, which reported correlation between P3b during auditory oddball task and digit span score (Boucher, 2010). This inconsistency might be due to visual modality task employed in this study.

Topic Area: EXECUTIVE PROCESSES: Development &aging

C30 The striatal feedback response reflects goal updating

Ian Ballard[1], Mark D'Esposito[1], [1]University of California, Berkeley

Decades of neuropsychology and neuroanatomical research has converged on the theory that the striatum is a gate: it selects between potential action or goal representations in cortex. In contrast, fMRI investigations often characterizes the striatal BOLD response as a reward prediction error signal arising from midbrain dopaminergic inputs. However, prediction error is confounded with updating: if you discover that your decision resulted in a disappointing outcome, you must both represent that disappointment and update your behavior. We test whether apparent reward prediction error BOLD responses in the striatum are better described as goal updating responses, and reflective of gating functions rather than the activity of dopaminergic inputs. Subjects performed two tasks: a standard 2-arm bandit task (in which prediction error and updating are confounded), and a variant of the 2-arm bandit that dissociates goal updating from reward prediction error. We accomplish this by introducing conditions where losing money indicates the need to change goals. We find that in the traditional 2-arm bandit where goal updating and reward prediction error are confounded, the striatal BOLD response is consistent with both interpretations. However, in the same subjects performing the task where they are de-confounded, the striatal BOLD response tracks goal updating and not reward prediction error. Specifically, the accumbens and putamen respond more strongly to losing than winning money when losing money is more informative for goal selection. These results suggest that the striatal feedback response reflects updating of cortical goal representations, consistent with the gating theory of striatal function.

EXECUTIVE PROCESSES: Goal maintenance & switching

C31 Using a Memory Game to Enhance Frontal Activation: An fNIRS Study

Bhoomika Nikam[1], Meagan Smith[1], Sammy Perone[2], Aaron Buss[1], [1]University of Tennessee, Knoxville, [2]Washington State University

The dimensional change card sort task (DCCS) is a standard measure of executive function used in early development. The task requires children to sort cards by one dimension (e.g. shape) and then switch to sort by another dimension (e.g. color). Typically, 3-year-olds perseverate and continue to use the pre-switch dimension, while 4-year-olds are able to switch rules when prompted. Previous research suggests that prior exposure to the post-switch dimension in the form of a memory game facilitates better performance for 3-year-olds in the post-switch phase of this task (Perone et al., 2015; 2019). The goal of this study was to explore the neural basis of this effect with 3.5-year-olds. We used functional near-infrared spectroscopy (fNIRS) to measure activation from left frontal, left temporal, and right parietal regions previously implicated in dimensional attention (Morton et al., 2009; Buss & Spencer, 2018). Children participated in either a standard tic-tac-toe (control task) or color memory game prior to the DCCS. Although no performance differences were observed between groups, which has been reported in previous studies, neural activation differences between groups were observed in the left frontal cortex ($F(1,30)=7.129$, $p=.012$). Children with prior exposure to the post-switch (color) dimension showed stronger activation compared to children in the tic-tac-toe group. Our results support predictions of a dynamic neural field model (Buss & Spencer, 2014; Perone et al. 2015), which demonstrates how experience with perceptual dimensions can enhance activation of frontal cortex.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

C32 Neural dynamics during dimensional label learning predicts dimensional attention performance in early childhood

Hollis Ratliff[1], Aaron Buss[1], [1]University of Tennessee, Knoxville

Previous research suggests that children's ability to label visual features (e.g., 'green') and dimensions (e.g. 'color') can change aspects of their dimensional attention (Buss & Kerr-German, 2019). Based on this research, the goal of this project was to investigate whether children's dimensional attention can be predicted by the neural dynamics of dimensional label learning. Thirty-three preschool aged children (M=46.6mo.) performed dimensional label learning tasks assessing color production, comprehension, and matching. Dimensional attention was measured using the dimensional change card sort task (DCCS) which measures flexible dimensional attention, a dimensional attention priming task which measures attentional stability, and the triad classification (TC) task which measures children's selective attention. We used functional near-infrared spectroscopy (fNIRS) to measure activation in frontal, parietal and temporal cortices previously implicated in dimensional attention (Buss & Spencer, 2018). Performance in the DCCS was positively correlated with activation in the frontal cortex during the comprehension task $r(30)=0.375$, $p=0.041$. Better performance on the TC task was associated with deactivation of the parietal lobe $F(2,52)=3.96$, $p=0.025$. Better performance on the priming task was positively correlated with activation in the temporal cortices during the comprehension task $r(27)=0.407$, $p=0.035$, and deactivation in temporal cortex, $r(24)=-0.451$, $p=0.027$. These results suggest that the neural dynamics elicited during the dimensional label tasks predicts performance across a range of tasks that measure dimensional attention.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

C33 Effects of post-error arousal on cognitive control: Adaptive or maladaptive?

Rebecca Compton[1], Marc Jaskir[1], Jianing Mu[1], [1]Haverford College

Neural reactions in the moments following a performance mistake may reflect heightened arousal that could either enhance or impair subsequent attention and performance. To investigate these alternative possibilities, 55 undergraduates completed a spatial cued Stroop task indexing several aspects of selective attention while EEG and pupil diameter were measured. Performance errors (~8% of trials) were followed by a set of physiological and behavioral changes, including increased pupil diameter ($F(5, 265) = 4.6$, $p = .012$) and EEG alpha suppression that extended into the next trial (during inter-trial interval, $F(1,53) = 13.9$, $p < .001$; following next-trial cue, $F(1,53) = 20.1$, $p < .001$); both of these measures likely reflect post-error arousal. Furthermore, next-trial performance was slower ($F(1,53) = 5.6$, $p < .03$) and less accurate ($F(1,53) = 3.9$, $p < .06$) following errors, a pattern that was unaltered by increasing the inter-trial interval to allow more time for adaptive control. Moreover, EEG and behavioral indices of attention involving Stroop congruency and spatial cue-validity effects were not affected by whether the prior trial was an error, counter to the prediction that post-error adaptive control sharpens attentional focus. Finally, within-participants correlations indicated that greater post-response pupil diameter, reflecting arousal, predicted slower next-trial reaction time, especially following errors (mean correlations for correct and error trials separately, $ps < .001$; error-correct contrast, $p < .02$). Together the results imply that errors are followed by increased arousal that predicts general slowing rather than enhanced attentional focus.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

C34 A cautionary tale about the importance of taking individual differences intoaccount when examining whether tDCS can enha

Sydney Darling[1], Keisha Alexander[1], Hannah Morrow[1], Eiling Yee[1], [1]University of Connecticut

Can inhibitory cognitive control be enhanced via anodal tDCS over left prefrontal cortex? Evidence is mixed, with efficacy likely depending on factors including electrode position and size, stimulation intensity and duration, whether the task is performed during or after stimulation,and domain of cognitive control examined (for meta-analysis, see Imburgio & Orr, 2018). We examined the impact of anodal stimulation over left prefrontal cortex on inhibitory function, as measured via Flanker and Stroop, using an F3-RSO montage. Baseline performances on Flanker and Stroop were measured before stimulation. Afterward, anodal or sham stimulation began (between participants). After 3 minutes of stimulation (1.5mA with 5x7cm saline-soaked sponges), participants repeated the Flanker and Stroop tasks (each lasting 5 minutes) while stimulation continued. If anodal tDCS enhances inhibitory function, then when comparing repeated to baseline performance, there should be a smaller incongruency disadvantage (difference incongruent and congruent trials) for anodal compared to sham-reflecting greater ease inhibiting irrelevant/incongruent information. No differences in RT or accuracy were found in either task. However, if we had compared the incongruency disadvantage after stimulation in anodal vs. sham groups without accounting for baseline performance, we would have observed (contrary to our predictions) a significantly larger incongruency disadvantage in Flanker in the anodal group (because at baseline, the anodal group had a larger incongruency disadvantage). Results suggest that the F3-RSO montage with the simulation parameters we used may not impact inhibitory control, and highlight the importance of using designs that take into account individual differences in baseline inhibitory function.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

C35 The Effects of Bilingualism on Resistance to Proactive Interference and Brain Integrity Across the Adult Lifespan

Alessandra Macbeth[1], Eve Higby[2], Natsuki Atagi[3], Christine Chiarello[1], [1]University of California, Riverside, [2]California State University, East Bay, [3]California State University, Fullerton

Resistance to proactive interference (PI), or the ability to inhibit access to previously learned material that has become irrelevant, has not been examined before in the bilingualism literature. Seventy-four participants completed directed forgetting and proactive interference tasks and underwent a structural MRI scan. We hypothesized that behavioral differences would only be evident among the older adults (N=26, 13 bilingual), with bilinguals displaying greater resistance to PI than monolinguals. We also predicted brain structure would differ between monolinguals and bilinguals in both the young adults (N=48, 24 bilingual) and older adults, with bilinguals showing enhancement/preservation of cortical structures implicated in resistance to PI. Performance on directed forgetting revealed a significant age effect for to-be-remembered words: older adults remembered fewer. The proactive interference task yielded a significant age effect for both correct recall and intrusions; older adults recalled fewer words correctly and committed more intrusion errors. All groups showed release from PI. No language background effects were evident for either task, suggesting no differences in resistance to PI performance between bilinguals and monolinguals of either age group. When comparing brain structure, left and right pars triangularis cortical thickness was greater in monolinguals, contradictory to our hypothesis. However, correlations between behavioral and cortical measures showed that fewer intrusion errors among bilingual older adults were associated with greater cortical thickness in the left rostral and caudal middle frontal gyrus, with no comparable relationship for older monolinguals. These findings suggest the possibility of distinct neural correlates supporting inhibitory performance of bilingual versus monolingual older adults.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

C36 Best of both worlds: Integrating EEG and fMRI in the study of inhibition

M. Fiona Molloy[1], Brandon Turner[1], [1]The Ohio State University

A task commonly used to measure response inhibition is the stop-signal task. Variations of this task have been studied using a wide range of populations and diverse methodologies, which makes it difficult to integrate these findings into a unifying theory. Here, we show how analyses from one modality, such as electroencephalography (EEG), can inform future analyses in a different modality, such as functional magnetic resonance imaging (fMRI). We use data from four previously published stop-signal tasks, with both auditory and visual stop-signals requiring motor or verbal responses: two fMRI (Xue et al., 2008; Aron, et al., 2007) and two EEG (Castiglione, et al., 2018; Wagner et al., 2018). First, in the two EEG studies, we identified eight clusters of stopping, including bilateral inferior frontal areas, using temporal and spatial properties of individual's components. Then, probabilistic dipole maps from these EEG clusters were used to define the regions of interest (ROIs) for the fMRI datasets. Finally, hierarchical Bayesian analyses revealed larger pair-wise coactivation between these ROIs for successful and failed stopping than going. While the overall pattern was the same in the two datasets, successful and unsuccessful stopping had different signatures. Furthermore, in both datasets, the correlation between the left and right inferior frontal clusters increased for successful stopping. These analyses demonstrate how EEG data can inform analyses of fMRI data to aid in fully understanding response inhibition, but they lack mechanisms for causality. Further research using dynamical models is needed to determine causality and allow full integration of these modalities.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

C37 Activity Flow over Intrinsic Networks Explains Stimulation-Evoked Activations

JING JIANG[1], Manjari Narayan[1], Yu Zhang[1], Wei Wu[1], Colleen Mills-Finnerty[1], Carena Cornelssen[1], Rachael Wright[1], Michael Cole[2], Amit Etkin[1], [1]Stanford University, [2]Rutgers University

Human brain functions depend on complex activity flow between regions that constitute large-scale intrinsic networks, yet the principles governing causal activity flow throughout these networks remain unclear. We test two contrasting theories to reveal how stimulation-evoked local activity spreads in the brain, by empirically modulating local cortical activity in 11 cortical regions using noninvasive transcranial magnetic stimulation (TMS) and concurrently recording consequent whole brain activity through functional magnetic resonance imaging (fMRI) in 81 healthy participants. The resting-state fMRI data are also collected from these participants. Based on an activity flow mapping model, we find that TMS-evoked activation in a held-out region can be significantly better predicted via estimated activity flow over resting-state functional connectivity (RSFC) from all other regions collectively ('all-to-one') than that from the stimulated region exclusively ('one-to-one'). Furthermore, network features such as positive RSFC (versus negative or whole-brain RSFC) and within- (versus between-) network connectivity contribute significantly more to the prediction accuracy. Among all the 7 networks, the default mode network and frontoparietal control network provide the largest contributions to the activity flow prediction. Finally, the prediction is also robust via structural connectivity based on the diffusion tensor imaging data from Human Connectome Project. Together, these results demonstrate critical spatially-organized principles of intrinsic networks that shape causal global activity spreading in the brain and highlight the therapeutic potential of flow-based modulation.

Topic Area: EXECUTIVE PROCESSES: Other

C38 How does Feedback Processing Affect Learning in People with Traumatic Brain Injury?

Corina Mangione[1], Gwendolyn Meredith[1], Jessica Kenworthy[1], Yael Arbel[1], Lauryn Zipse[1], [1]MGH Institute of Health Professions

Learning and memory deficits are often present in people who have experienced a traumatic brain injury (TBI). Errorless learning, which entails learning through repetition without opportunities to make mistakes, is one technique frequently used to teach people who have learning deficits secondary to TBI. However, errorless learning is not as functional or flexible as learning from feedback (i.e., errorful learning). The goal of this study was to examine how feedback processing affects learning in people with TBI. Nine individuals with TBI and 27 control participants completed a paired-associate word learning task under three conditions: Errorless, where participants practiced the correct response; Errorful, where participants learned from visual feedback; and Strategy, where participants learned from feedback but were taught a simple strategy for attending to and managing the feedback. EEG was recorded during learning in order to evaluate event-related potentials (ERPs) associated with feedback processing, namely the feedback-related negativity (FRN) and the fronto-central positivity (FCP). Behavioral learning outcomes were measured at three different time points after learning: immediately, at a short delay, and at a long delay (~one hour later). Results indicate that learning outcomes were best for both groups in the Errorless condition, and better for Strategy relative to Errorful at some testing time points. ERP data revealed different responses to feedback between the two groups. People with learning deficits secondary to TBI appear to be processing feedback differently than controls, and their learning outcomes in an errorful environment may be supported by applying metacognitive strategies.

Topic Area: EXECUTIVE PROCESSES: Other

C39 Memory and Metamemory Deficits in First-Episode Schizophrenia: Effects of Psychosis on Value-Directed Remembering

Tara Patterson[1], Alan Castel[1], Barbara Knowlton[1], Kenneth Subotnik[1], Keith Nuechterlein[1], [1]University of California, Los Angeles

Memory deficits in individuals with schizophrenia are well established, but less is known about how psychosis affects metacognitive processes such as metamemory, which refers to awareness of and control over one's own memory. We investigated metamemory ability using the value-directed remembering task, which assesses the degree to which participants use value cues to guide their learning of a list of items (i.e., their memory selectivity). Successful performance of the task requires awareness that there are more items on the list than are likely to be remembered, necessitating direction of memory resources to the higher-value items. Participants were patients undergoing treatment following a recent first episode of schizophrenia and demographically comparable healthy controls. Participants viewed six lists of 24 words where each word was paired with either a low value (1-3 points) or a high value (10-12 points), and they were instructed to maximize their score on free recall tests given after each list. Consistent with previous research, individuals with schizophrenia showed reduced free recall. They also showed reduced memory selectivity, indicating impairment in the ability to preferentially encode higher-value items. This impairment may reflect diminished ability to recruit the frontal lobe resources required for successful metamemory awareness and control.

Topic Area: EXECUTIVE PROCESSES: Other

C40 Prefrontal tuning in mnemonic chunking in a spatial self-ordered search task

Feng-Kuei Chiang[1], Erin Rich[1], [1]Icahn School of Medicine at Mount Sinai

Working memory (WM) is a key feature of intelligence but has limited capacity. We rarely notice this constraint because we are able to implement mnemonic strategies, such as grouping items together into 'chunks', to overcome WM capacity limitations. My recent study found that spatial tuning in lateral prefrontal cortex (LPFC) neurons was modulated by self-generated sequencing strategies (Chiang and Wallis, PNAS, 2018). However, it remains unclear how these neurons contribute to mnemonic chunking. To assess this, we trained two monkeys to perform a spatial self-ordered search task with six or eight identical visual targets. The subjects were required to saccade to each, one at a time in any order, returning their eyes to the center after each target. No reward delivered when monkeys revisited the targets. Therefore, the subjects had to use WM to keep track of which reward targets had been visited. We defined chunks as groups of targets that were frequently selected together and used graph theory approaches to quantify the degree of chunking in trial blocks. Preliminary data indicate that stronger chunking reduces error rates, consistent with the notion that chunking increases WM capacity. In brief, we found monkeys generated chunking strategy in self-ordered WM tasks. Using decoding approaches, we will reconstruct two-dimensional spatial locations of targets held in WM from populations of LPFC neurons which recorded simultaneously from two 8-by-8 Utah arrays. We hypothesize that, compared to the actual target configurations, chunking targets involves an efficient reorganization of location information represented in LPFC neurons.

Topic Area: EXECUTIVE PROCESSES: Working memory

C41 Using fNIRS to Probe the Effects of Response Type in a Visual Working Memory Task

Rachel Eddings[1], Aaron Buss[1], [1]University of Tennessee

Visual working memory (VWM) allows us to hold visual information in mind to be manipulated for a task. Previous research shows that performance varies based on factors such as stimulus modality and number of distractors. This study aimed to explore the effect of response type on VWM performance in 4.5- and 5.5-year-olds. A single-item probe color change detection task and a cued recall with labeling task were administered. The tasks were identical in structure until the response phase of the trial. Neural data were collected using functional near-infrared spectroscopy. Both tasks used set-sizes 1-3 and six canonical colors (red, orange, yellow, green, blue, purple). All children were given the change detection task first. Behavioral analyses show that children's performance declined as set-size increased in both tasks ($F(2,11)=65.438$, p

Topic Area: EXECUTIVE PROCESSES: Working memory

C42 Losing money and memory: The effect of loss incentives on working memory in young and older adults

Hyesue Jang[1], Richard Lewis[1], Cindy Lustig[1], [1]University of Michigan

Older age is accompanied by an increasing threat of losses (e.g., of health, financial security, driving privileges), with the opportunity to avoid such losses often used to motivate older adults. However, previous studies in our lab show that loss-based incentives reduce older adults' motivation (Jang et al., submitted). In low-constraint tasks, it also reduces their performance (Lin et al., in revision). Here, we more directly examine the impact of task constraints by manipulating them within a single task. We randomly assigned young (age: 18-26; current n = 22) and older (age: 61-86; current n = 54) participants to a control or loss incentive condition and had them perform a Sternberg-type working memory task. Task constraint is manipulated within the task by using short (4 sec) versus long (16 sec) retention intervals, randomly intermixed. Preliminary results indicate that whereas the loss incentive has no effect or a small numerical benefit on young adults' performance (n.s.), it impairs working memory performance in older adults. Moreover, older adults under loss incentive tend to report lower motivation than the other groups in a post-task questionnaire. Retention interval has the expected effect on young adults in the control condition: Better performance after the shorter interval. However, young adults in the loss condition show no difference, whereas older adults show the opposite effect: Better performance after the longer retention interval. The results suggest that loss incentives reduce older adults' motivation and working memory performance, but they may still be more motivated than young adults.

Topic Area: EXECUTIVE PROCESSES: Working memory

C43 Cerebellar Contributions to Higher Order Cognition

Ted Maldonado[1], Jessica Bernard[1], [1]Texas A&M University

Though the prefrontal cortex is highly involved in cognitive performance, the cerebellum, has an increasingly recognized role in higher order cognition as well. However, the necessity and contribution of the cerebellum to cognition remains relatively unknown. Transcranial direct current stimulation (tDCS) uses weak electrical current to modulate neural activity in an effort to alter behavior, allowing for temporary functional alteration in the cerebellum to investigate its role in cognitive functions. The current work employed a between-subjects design using a 2 pad tDCS system to apply anodal, cathodal, or sham stimulation to the cerebellum to examine the effect of stimulation on Sternberg task performance, which had low, medium, and high load conditions. We predicted performance decrements following cathodal stimulation and performance increases following anodal stimulation,

compared to sham. We assessed reaction time (RT) and accuracy and found typical load effects for both outcome measures such that low, medium and high load were all significantly different from each other. We found a main effect of stimulation on RT. RT was significantly slower following cathodal stimulation, compared to sham, consistent with our predictions. Surprisingly, there was a similar trend following anodal simulation, relative to sham. Stimulation also affected accuracy, but only under low load, such that accuracy was worse following both anodal and cathodal stimulation. The current results suggest an effect of stimulation on cognition under low load, perhaps suggesting that the cerebellum is more critical when processing is automatic but becomes less involved under higher load when processing is more prefrontally-dependent.

Topic Area: EXECUTIVE PROCESSES: Working memory

C44 Measuring working memory in visual, auditory, and tactile sensory modalities

Ningcong Tong[1], Abigail Noyce[1], Vaibhav Tripathi[1], Sean Tobyne[2], Michael Lindsay[1], Glenn Thayer[1], Daniel Gastler[1], Heitor Mourato[1], Eric Hazen[1], David Somers[1], [1]Boston University, [2]Charles River Analytics

Working memory (WM) may comprise a single, central resource that is drawn upon regardless of the nature of the memoranda (e.g. Saults & Cowan, 2007), or it may include separate, domain-specific stores (e.g. Baddeley, 2000; Fougnie et al., 2014). Our previous work has found fMRI evidence for visual- and auditory-specific regions of lateral frontal cortex that are recruited during WM for visual and auditory stimuli (Michalka et al., 2015, Noyce et al., 2017). Here, we expand on this work to incorporate the tactile modality into our paradigm. We designed and fabricated a MR-compatible vibrotactile stimulator using ceramic piezoelectric actuators mounted on an acrylic hand plate with individually adjustable finger positioning. Custom electronics and software support simultaneous, yet independent control of the spatio-temporal patterns of stimulation to each of the fingertips on one hand (left or right). This device permitted us to develop approximately-matched visual, auditory, and tactile n-back WM tasks with well-controlled stimulus properties. Visual stimuli comprised Gabor patches, varying in orientation and spatial frequency. Auditory stimuli comprised amplitude-modulated complex tones, varying in pitch and modulation frequency. Tactile stimuli comprised vibratory input to the fingertips, varying in stimulated digit(s), duration, and frequency. Subjects were able to perform 1-back and 2-back WM at levels well above chance (d' > 1) for all three sensory modalities. These task paradigms will allow us to map brain regions specifically recruited for visual, auditory, and tactile WM using well-matched sensory-specific memory tasks, as well as regions jointly recruited by all three tasks.

Topic Area: EXECUTIVE PROCESSES: Working memory

C45 Training attractor dynamics in human visual working memory

Qing Yu[1], Matthew Panichello[2], Bradley Postle[1], Timothy Buschman[2], [1]University of Wisconsin-Madison, [2]Princeton University

Humans have the ability to maintain substantial amount of information in working memory, yet their memory performance is imperfect. Previous behavioral studies have demonstrated that responses during a working memory task for colors can be strongly biased towards several stable attractors, even when memory samples were drawn from a uniform distribution. These attractors help to reduce the effect of internal noise, and are adaptive to environmental statistics (Panichello et al., 2019). Here we conducted a training study in combination with fMRI to explore the neural mechanism of attractors dynamics and their adaptive nature. Participants performed one-item delayed-recall-of-color across four separate scanning sessions. In the first session (baseline), the sample colors were drawn from a uniform distribution. In the second and third sessions (training), half of the colors were drawn from a biased distribution (four biased centers chosen randomly for each participant). In the fourth session (post-training), the stimulus distribution was again uniform. Consistent with previous work, all participants demonstrated biases toward 'endogenous' attractors in the baseline session, and, during training, these attractor dynamics flexibly adapted to the change in environmental statistics. Interestingly, participants' responses during post-training demonstrated a mixture of effects from both the baseline and trained attractors, suggesting a long-lasting influence of adapted context on behavior. Neurally, we observed attractor biases in patterns of responses in visual cortex. These results suggest the neural biases to attractors may be a stable attribute of the visual system, and that they can exert an influence on visual working memory.

Topic Area: EXECUTIVE PROCESSES: Working memory

C46 WITHDRAWN

C47 Inter- and intra-hemispheric white matter organization in relation to language skills in infancy

Jolijn Vanderauwera[1, 2], Jennifer Zuk[2], Ted Turesky[2], Ally Lee[2], Jade Dunstan[2], Nadine Gaab[2], [1]UCLouvain, [2]Harvard University

The white matter pathways underpinning language have been well specified in adults and children. Yet, it remains unclear how the neural basis of language manifests in infancy, since core language pathways are characterized by a protracted developmental trajectory within the first year of life. Therefore, the present study investigates the relation between white matter organization and language skills in 80 infants (mean age: 8.6 mo, range: 2.5-17.3 mo). More specifically, we studied how structural organization as characterized by fractional anisotropy (FA) fluctuates along the course of four intra-hemispheric and two inter-hemispheric tracts. Partial correlations controlled for infant age revealed significant relations between clusters of FA-values in bilateral intra-hemispheric tracts and inter-hemispheric connections. Interestingly, in addition to core language tracts such as the left arcuate fasciculus, relations with language skills were observed in early maturing white matter pathways, predominantly the inter-hemispheric corpus callosum and bilateral corticospinal tract. Hence, these results indicate that language skills in infancy seem to be underpinned by a network of tracts that extends beyond the core tracts and have a stronger bilateral distribution.

Topic Area: LANGUAGE: Development & aging

C48 Phonological representations of their non-spoken language help Heritage speakers to learn new words: An ERP study

Beerelim Corona Dzul[1], Keila Nava-Báez[1], Eva Velásquez-Upegui[1], Haydée Carrasco-Ortiz[1], [1]Universidad Autónoma de Querétaro

Event-related potentials (ERPs) served to investigate whether Heritage speakers of an endangered language (Hñähño) activate phonological representations while learning written words of that language. Participants were control Spanish monolinguals (n=20) and Heritage speakers of Hñähño (n=14) who were exposed to the oral form of the language in their early years but do not speak, read or write in Hñähño. All participants learned written words in Hñähño classified into high or low degree of phonological similarity with Spanish words. Phonological similarity was manipulated through the Levenshtein Distance (OLD 20). Two training sessions involved two paired-association tasks where images, auditory and written forms of the words were presented. During the third session ERPs to written words in Hñähño with high and low phonological similarity across languages were recorded while participants performed an image-word verification task. Results showed a reduction in N400 amplitude in response to Hñähño words with a high degree

of phonological similarity compared to those with low degree of phonological similarity across languages. This N400 modulation was true only in Heritage speakers but not in monolingual Spanish speakers. These findings suggest that only Heritage speakers activated the phonological representation of Hñäñho words and were influenced by phonological similarity with Spanish words. These results suggest that heritage speakers benefit from the early exposition to the oral language even for recently learned written words. These findings highlight the importance to uncover brain responses in heritage speakers on an endangered language.

Topic Area: LANGUAGE: Lexicon

C49 ERP evidence for flexibility in accessing representations associated with subject-verb agreement

Jane Aristia[1], Angèle Brunelliere[1], [1]Université de Lille

Both based-statistical and abstract feature representations have been described as being involved in the computing of subject-verb agreement. This event-related potential (ERP) study investigated whether the access of representations involved in the subject-verb agreement processing is either flexible or automatic. Two ERP experiments were conducted wherein 990 pairs of primes (i.e., pronouns and articles) and targets (i.e., congruent and incongruent verbs, nouns, and pseudowords) were auditorily presented. ERPs were recorded after the processing of verbal targets preceded by pronominal subjects in French. Twenty-three participants did a lexical decision task on the target (i.e., whether it was a word or not) in Experiment 1; while twenty-four other participants performed a noun categorization task (i.e., whether it was a noun or not) in Experiment 2. Analyses were conducted on the main ERP components that we observed (N100, N400, late frontal negativity). The results showed a stronger negative amplitude in Experiment 1 than in Experiment 2 for the N100 (p

Topic Area: LANGUAGE: Other

C50 The neural bases of phonological acceptability judgements

David Gow[1], Enes Avcu[1], Olivia Newman[1], Seppo P. Ahlfors[2], [1]Massachusetts General Hospital, [2]Athinoula A. Martinos Center for Biomedical Imaging

Linguistic theory must account for not only patterns of attested structure (observational adequacy), but also patterns of native speaker intuitions about the acceptability of novel structures (descriptive adequacy). While theorists believe that acceptability judgments reflect a combination of implicit structural knowledge (competence) and general cognitive (performance) constraints, little is known about the processing dynamics that support acceptability judgements. To address this gap, we performed high spatiotemporal resolution Kalman-filter enabled effective connectivity analyses of MRI-constrained sourcespace reconstructions of simultaneous MEG and EEG data collected during an auditory nonword phonological acceptability task. Response-locked analyses traced patterns of effective connectivity backwards in time from the onset of right precentral gyrus activation associated with the left-handed button press speakers used to signal a judgement. Right precentral gyrus activation was primarily determined by right anterior middle temporal gyrus and frontal regions involved in motor planning and response inhibition. These in turn were influenced by the right angular gyrus, a region implicated in predictive coding mechanisms. Stimulus-locked analyses of earlier processing revealed reciprocal interactions between regions implicated in acoustic phonetic representation (posterior superior temporal gyrus) and lexical representation (supramarginal and posterior middle temporal gyrus) whose strength varied with judgements of phonological acceptability. Dynamic interactions between the early lexical network revealed by stimulus-locked analyses and the response formation network revealed by response-locked analyses suggest integration between the two. These results support the hypothesis that phonological acceptability judgements primarily reflect the degree to which input forms match overlapping forms stored in the lexicon.

Topic Area: LANGUAGE: Other

C51 The universal language network

Saima Malik-Moraleda[1], Dima Ayyash[2], Jeanne Gallée[1], Zach Mineroff[2], Olessia Jouravlev[3], Evelina Fedorenko[2], [1]Harvard University, [2]Massachusetts Institute of Technology, [3]Carleton University

More than 7000 languages are spoken across the world, varying in their phonology, morphology, lexicon, and grammar (Ostler, 2005). Despite this linguistic diversity, most language research, especially in cognitive neuroscience, tends to be conducted in English and a few Western European languages (Bornkessel-Schlesewsky & Schlesewsky, 2016). Here, we investigate whether the functional architecture of the language network is similar in typologically varied languages across 10 language families (Afro-Asiatic, Austronesian, Dravidian, Indo-European, Japonic, Koreanic, Niger-Congo, Sino-Tibetan, Turkic, Uralic). Two native speakers of each of the 44 languages listened to passages of 'Alice in Wonderland' in their native language while in fMRI, along with acoustically degraded passages and passages in an unfamiliar language. Additionally, each participant completed two non-linguistic tasks (spatial working memory task and arithmetic), and two naturalistic conditions (resting state and a longer passage in their native language). The functional architecture of the language network was remarkably consistent across languages, replicating several key signatures previously discovered for English and related languages. The contrast of native passages and degraded or foreign passages elicited activations on the lateral surfaces of left frontal and temporal cortex. These language-responsive regions showed strong selectivity for language with no response to spatial working memory or arithmetic (Fedorenko et al., 2011). Finally, functional correlation analyses revealed that the language network is highly internally integrated during both naturalistic conditions but is strongly dissociated from the domain-general Multiple Demand network (Blank et al., 2014). Thus, the basic functional architecture of the language network is robust to cross-linguistic variation.

Topic Area: LANGUAGE: Other

C52 Effects of sleep-mediated memory consolidation on speech learning: evidence from Cantonese tones

Zhen Qin[1], Caicai Zhang[1], [1]The Hong Kong Polytechnic University

Recent studies showed that sleep-mediated overnight consolidation facilitated learners' generalization across talkers in their perception of novel stop contrasts. Lexical tone is characterized by high variability across talkers. Thus a similar effect of overnight consolidation could be found for perceptual learning of novel tonal contrasts. This study aims to examine whether overnight consolidation facilitates talker-independent learning of lexical tones in the identification of novel Cantonese level tones by Mandarin listeners. Two groups of Mandarin listeners were perceptually trained either in the morning or in the evening using a tone identification task with corrective feedback using stimuli from one talker (i.e., trained talker). Their post-training changes and generalization to a novel talker were then tested in three posttests following training: immediately after training, 12-hour delay, and 24-hour delay. The critical difference between the two groups is that sleep intervened between the first and second posttest in the evening group but not in the morning group. The accuracy rates showed that the evening group showed an improved trend, predicted by their individual sleep time, in identifying the level tones produced by both the trained and untrained talkers; in contrast, the morning group showed a declining trend. The finding of sleep-related identification changes over time suggests that overnight consolidation might have assisted learning

of tone stimuli produced by the novel talker, and eventually facilitated the formation of a more talker-independent representation of novel tone categories in long-term memory. The results have implications for understanding the mechanism of speech learning and human plasticity.

Topic Area: LANGUAGE: Other

C53 Acquisition context modulates affective perception of swear words

Katherine Sendek[1], Grit Herzmann[1], Stanley Donahoo[2], Valeria Pfeifer[2], Vicky Lai[2], [1]The College of Wooster, [2]University of Arizona

People who learn multiple languages sequentially have reported that they feel expressed emotions more intensely when using their first language (L1), regardless of proficiency. They also prefer to swear in their L1. One explanation is that languages are affected by the context in which they are acquired. Specifically, swears in L1 are typically acquired directly in naturalistic and informal contexts, whereas swears in L2 or non-swear words are often learned indirectly through textbooks in a formal, academic setting. To test this, we presented American English speakers with American and British taboo words (AT and BT), assuming they learned AT directly, and BT, indirectly. Participants made word/non-word decision on taboo, negative, positive, neutral, and non- words, while EEG was recorded. Manipulations of word valence, arousal, and taboo-ness were verified via online ratings, and word length and frequency were matched between conditions. We examined the ERP components of early posterior negativity (EPN) between and late positive complex (LPC), based on literature on emotional words in L2 (Conrad, Recio, & Jacobs, 2011). We found that both AT and BT elicited similarly larger EPN (150-250ms) compared to the other categories. Differences between AT and BT were found in the LPC (550-750ms), with larger LPC for AT than BT. These results show that the social context in which language is acquired influences the later, social processing associated with swears. However, it does not impact early, attention of taboo words. In conclusion, the context in which a word is acquired influences affective perception.

Topic Area: LANGUAGE: Other

C54 The origin of the second language after-effect in bilingual language production: and ERP investigation.

Agata Wolna[1], Jakub Szewczyk[2], Patrycja Ka'ama'a[1], Jonas Walther[1], Zofia Wodniecka[1], [1]Jagiellonian University, [2]University of Illinois, Urbana Champaign

Naming pictures in L1 is considerably slowed-down after naming in L2, the phenomenon known as the L2 after-effect. However, the origins of the effect are unclear: it can be a consequence of language-specific mechanism resulting in increased interference between L1 and L2 or reflect the cognitive effort related to mere reconfiguration of the task-set. To adjudicate between the two possibilities we designed a Picture Naming experiment in which L1 naming was preceded by 3 different tasks: naming in L1 (L1-after-L1), naming in L2 (L1-after-L2) and performing a non-linguistic task (L1-after-NLT). L1-after-L2 was meant to replicate the L2 after-effect, whereas the L1-after-NLT was meant to test the effect of task-set reconfiguration. 33 Polish-English bilinguals participated in the experiment. On the behavioural level we failed to observe the slow-down of naming in neither L1-after-L2 nor L1-after-NLT. On the psychophysiological level (ERPs) we found a fronto-central modulation in the P2 time-window (150-250ms) for L1-after-L2 whereas no similar effect was found for L1-after-NLT. The P2 was previously shown to be sensitive to the difficulty of lexical access and accumulation of the semantic interference. Therefore, psychophysiological measurement indicate that the L2 after-effect is rather a language-specific effect. Additionally, we observed a trial effect causing a systematic increase of naming latencies and P2 amplitude throughout the experiment, possibly reflecting the uncontrolled accumulation of semantic interference. The effect might have obliterated the behavioural measurement of L2 after-effect which could explain the discrepancy between the naming latencies and ERPs results.

Topic Area: LANGUAGE: Other

C55 Dynamic connectivity of neural networks supporting incremental speech interpretation

Yuxing Fang[1], Bingjiang Lyu[1], Benedict Vassileiou[1], Kamen Tsvetanov[1], Lorraine Tyler[1], William Marslen-Wilson[1], [1]University of Cambridge

An explanatory account of human speech comprehension, rooted in the real-time electrophysiological activity of the brain, must identify what is being computed, where and when in the brain, as speech unfolds over time. Recent research (Lyu et al, PNAS, 2019) combines computational semantic models and representational similarity analysis (RSA), operating in EMEG source space, to reveal a network of core left hemisphere regions supporting incremental semantic combination, and using a spatiotemporal pattern-based implementation of Granger Causal Analysis (GCA) to estimate the information flow between these regions. In current research we adopt two strategies to probe further the neurocomputational content both of the activity within each region and of the information that is being communicated between them over time. First, building on the earlier research, we expand the range of computational models being tested against brain activity to include the acoustic?phonetic input to the system, thereby critically augmenting the functional ROIs in terms of which the directional connectivity of the left hemisphere language network can be evaluated. Second, taking an ICA whole-brain data-driven approach, we decomposed the entire source-reconstructed neural activity of the brain during key epochs of the speech input into functional spatially-independent components. Using RSA-based measures, we filter this set of components to identify those which are significantly related to the computational semantic and acoustic?phonetic models established earlier. The interactivity between these model-sensitive components was then probed using the GCA technique to provide an integrated framework for defining and understanding the neural systems underpinning human speech interpretation.

Topic Area: LANGUAGE: Semantic

C56 Parafoveal Semantic Integration Eliminates the N400 of Foveal Semantic Violation

Chuchu Li[1], Katherine Midgley[2], Phillip Holcomb[2], [1]University of California, San Diego, [2]San Diego State University

The current study used a visual hemi-field flanker RSVP paradigm with event-related potentials (ERPs) to investigate the parafoveal-foveal semantic integration in sentence comprehension. Twenty-one English monolinguals read sentences that were presented serially in triads, with the target word at central fixation (foveal target), the upcoming word on the right (parafoveal target), and the preceding word on the left. Each triad stayed for 400ms, without any interval between two trials, following the settings of reading process in real life (i.e., stimuli do not disappear before or when foveal fixation changes). A sentence may or may not contain a word that semantically violates the sentence context (e.g., Tom just broke up with his computer/girlfriend last month), and we compared the ERPs of the critical words (i.e., computer vs. girlfriend) when they served as parafoveal and then foveal targets. Results showed a significant parafoveal N400 effect for semantic violations (350ms to 550ms time window). However, when time-locked to the critical word in foveal position, there was no longer an N400 effect but instead a broadly distributed positivity, which may reflect a long-lasting cost of semantic anomaly. The results suggested that semantic integration of

a word starts when it is in parafoveal vision in sentence comprehension in natural settings. In addition, although the processing of the same word continues when it moves to the foveal vision as evidenced by the extended duration of the N400, semantic integration has mostly been completed when readers fixate on the target word.

Topic Area: LANGUAGE: Semantic

C57 WITHDRAWN

C58 A systematic comparison between spatial similarity and evoked responses in EEG and MEG during language comprehension

Lin Wang[1], Gina Kuperberg[2], [1]Harvard Medical School, [2]Tufts University

EEG and MEG index the time-course of neural activity associated with incoming stimuli. Traditional event-related potentials/fields (ERPs/ERFs) are generally taken to reflect differences in the engaged neurocognitive processes evoked by different stimuli (e.g. the reduced N400 ERP/ERF to plausible versus anomalous words reflects easier semantic retrieval/access). More recently, it has been argued that Representational Similarity Analysis (RSA) can capture differences in the underlying representations associated with different stimuli (e.g. animate versus inanimate). Representation and process are, however, tightly linked, and so, to take full advantage of RSA, it is critical to understand where it converges and diverges from evoked responses. We therefore directly compared ERPs/ERFs and spatial similarity patterns in an EEG (n=72) and MEG (n=32) dataset, collected using a paradigm that crossed the plausibility (plausible vs. anomalous) and the animacy (animate vs. inanimate) of nouns in discourse contexts. The two measures converged in (a) their overall time-course (similarity values mirrored the peaks of the classic N1/P2/N400/P600 evoked responses), and (b) their sensitivity to plausibility (mirroring the ERPs/ERFs, spatial similarity was larger to anomalous than plausible words between 300-500ms and 600-1000ms). These findings underline the importance of considering evoked responses when interpreting differences in spatial similarity between stimuli. RSA diverged from evoked responses by revealing greater similarity to animate than inanimate plausible nouns where overall ERPs/ERFs were small. This suggests that spatial similarity can capture differences in representation, even when overall evoked activity is minimal.

Topic Area: LANGUAGE: Semantic

C59 Inhibitory TMS to the left inferior frontal gyrus modulates lexical selection in a context dependent manner

Jared Zimmerman[1], Apoorva Kelkar[1], Denise Harvey[1], John Medaglia[2], Roy Hamilton[1], [1]University of Pennsylvania, [2]Drexel University

In language production, it is often necessary to select from multiple appropriate competing words to convey intended meaning. Verbal selection has been linked to processing in the left inferior frontal gyrus (LIFG), however it is unclear how processing in the LIFG differs with differing language task demands. Here were apply transcranial magnetic stimulation (TMS) to the LIFG of subjects to modulate performance on two controlled language tasks that differ in their degree of semantic context: verb generation (low semantic context) and sentence completion (high semantic context). Subjects were randomized to receive sham TMS or active inhibitory continuous theta-burst stimulation. Subjects performed tasks before receiving TMS to the LIFG and then repeated tasks after cTBS. Effects of cTBS on verbal selection were assessed using a 2x2 ANOVA with factors of session and treatment. Trial-level reaction times were analyzed using a linear-mixed effects model to assess the effects of session, treatment and selection demands on reaction time. In the sentence completion task there was a significant session*treatment interaction in the trial level reaction time analysis such that reaction times were faster compared to baseline following active cTBS and slower compared to baseline following sham cTBS. In the verb generation task, there is a significant session*treatment interaction in the selection cost analysis such that selection cost is increased following active cTBS neuromodulation compared to sham. The results show that inhibitory cTBS to LIFG yields differential responses in language tasks.

Topic Area: LANGUAGE: Semantic

C60 Shared interpretation of an auditory narrative increases BOLD-synchrony between subjects

Maria Hakonen[1], Arsi Ikäheimonen[1], Annika Hulten[1], Janne Kauttonen[2], Miika Koskinen[3], Fa-Hsuan Lin[4], Anastasia Lowe[1], Mikko Sams[1], Iiro Jääskeläinen[5], [1]Aalto University, [2]Haaga-Helia University, [3]Helsinki University, [4]University of Toronto, [5]National Research University Higher School of Economics

The interpretation of an identical narrative varies between listeners. We studied whether similarity in the interpretation of the narrative corresponds to the similarity in the listeners' brain activity. 48 healthy volunteers listened to a 71-min narrative during ultra-fast fMRI. Afterward, the narrative was replayed in 101 segments, and the subjects were asked to produce associations related to each segment to describe what had been on their minds while they listened to the story during neuroimaging. The similarity in brain activity was estimated using inter-subject correlation analysis of the hemodynamic response, whereas similarity of the interpretation of the narrative was estimated by comparing the semantic relatedness of the associated words between each pair of subjects in semantic space (Word2Vec) generated from a large internet text corpus. An inter-subject representational similarity analysis (RSA) between the BOLD-similarities and the semantic similarities of the associated words across the subjects revealed that individuals that produced semantically similar association words were also more similar in their BOLD responses. Specifically, similarity increased in left in inferior frontal gyrus, bilateral superior temporal gyrus, precuneus, anterior cingulate cortex, and ventromedial prefrontal cortex. Our results support the notion that brain areas across different levels of narrative processing contribute to inter-individual differences in narrative interpretations, confirming and extending results from other similar studies.

Topic Area: LANGUAGE: Semantic

C61 Robust Neural Adaptation to Syntactic Structure

Jeanne Gallée[1], Hope Kean[2], Evelina Fedorenko[2], [1]Harvard University, [2]Massachusetts Institute of Technology

Humans are efficient information processors who quickly adapt to changes in the input statistics across domains. For example, during language production, we tend to re-use syntactic structures (Mahowald et al., 2016). However, whether or not structure repetition facilitates comprehension remains debated in both psycho- and neuro-linguistic literatures (e.g., Tooley & Traxler, 2010; Devauchelle et al., 2009). Across two fMRI experiments (n=13, n=23) we evaluated sensitivity to structure repetition under conditions that are most likely to reveal adaptation effects. In particular, participants processed sets of sentences where 80% of the sentences (n=240 sentences) used one structure (or similar structures, in Experiment 1), and 20% of the sentences used different (diverse) structures (n=60 sentences). In Experiment 1, the repeated structures were subject- and object-extracted relative clauses and clefts; and in Experiment 2, the repeated structure varied across participants and included six structure-types (relative clauses, pseudo-clefts, the-Xer-the-Yer construction, topicalization, sentential subjects, and X said that [clause]). The key prediction was a stronger response to the 20% of trials with diverse structures compared to the rest of the trials with the same/similar structures. To increase power (Nieto-Castanon & Fedorenko, 2012), we identified

language-responsive areas in each participant using an independent 'localizer' task (Fedorenko et al., 2010). In both experiments, we observed reliable adaptation effects in the language-responsive areas. Furthermore, these effects were present across the frontal and temporal language areas, in line with other findings of distributed syntactic effects (e.g., Blank et al., 2016). This study establishes robust adaptation to syntactic structure during language

Topic Area: LANGUAGE: Syntax

C62 Structural Connectivity and Memory Systems Across the Lifespan: Is There a Common Network?

Susan L. Benear[1], Zachary Heffernan[1], Linda Hoffman[1], Ingrid R. Olson[1], Nora S. Newcombe[1], [1]Temple University

Axonal tracts that connect disparate regions of the brain play an essential role in normal cognition. For instance, transection of the fornix, a small white matter tract connecting the hippocampus to the septal nuclei and mammillary bodies, results in dense anterograde amnesia. In neurologically normal adults, measurable variation in white matter tracts can provide information about the functional significance of various tracts and also provide information about how different brain regions interact to perform complex tasks. Here we compared and contrasted the structural brain networks involved in semantic memory and episodic memory. These memory systems have different developmental and senescence profiles, with episodic memory developing relatively later and failing relatively earlier than semantic memory. We predicted that individual differences in semantic memory would correlate with variation in a left lateralized network of tracts that include the inferior frontal occipital fasciculus and medial longitudinal fasciculus. In contrast, we predicted that episodic memory performance would correlate with variation in two limbic pathways: (bilateral) fornix and uncinate fasciculus. We tested a sample of young and older adults. Participants were required to learn new episodic and semantic information - they learned facts about animals and buildings (semantic), which were told to them by two different sources (episodic). Younger adults outperformed older adults on a delayed test of episodic memory (t=2.46, p=.03), while immediate tests of both episodic and semantic memory showed no group differences. Results of high-resolution diffusion weighted imaging scans will be discussed.

Topic Area: LONG-TERM MEMORY: Development & aging

C63 The Effect of Hippocampal Integrity and Volume on Recall Memory in Healthy Aging

Kirolos Ibrahim[1], Anu Venkatesh[1], Ilana Bennett[1], [1]University of California, Riverside

The ability to learn and subsequently recall information declines in healthy aging. Studies have separately attributed these age-related memory declines to integrity of white matter tracts connected to the hippocampus and hippocampal volume. A few studies, including our own, have also assessed the contribution of hippocampal gray matter integrity. But no studies have assessed the joint contribution of hippocampal integrity and volume to recall memory in aging, as was done here. Younger (n=45, 20.031.58 years) and older (n=47, 74.025.97 years) adults completed the Rey Auditory Verbal Learning Test (RAVLT) from which Total Recall scores were calculated. They also underwent structural magnetic resonance imaging to obtain measures of hippocampal gray matter integrity (free, hindered, restricted diffusion) and whole hippocampus volume. Results showed that increased age was related to declines in RAVLT Total Recall, hippocampal integrity (increases in all diffusion measures), and hippocampus volume. Independent of age, better RAVLT Total Recall scores were also related to higher hippocampal integrity (decreases in all diffusion measures except right hippocampus free and restricted diffusion). Finally, structural equation modeling revealed that age group differences in memory performance are more robustly explained by hippocampal volume alone rather than hippocampal volume and integrity together. These findings strengthen the notion that there are age-related differences in brain structure that contribute to individual- and age-related declines in memory.

Topic Area: LONG-TERM MEMORY: Development & aging

C64 Stronger structural connectivity in the default mode network is associated with youthful memory in superaging

Jiahe Zhang[1], Lianne Scholtens[2], Martijn van den Heuvel[2], Brad Dickerson[3], Lisa Barrett[1], [1]Northeastern University, [2]Vrije Universiteit Amsterdam, [3]Massachusetts General Hospital

'Superagers' are older adults who maintain youthful memory despite advanced age. Previous studies demonstrated that superagers have greater morphometric integrity and stronger functional connectivity in the default mode network (DMN) and salience network (SN), which contributes to their youthful memory performance. In this study, we used diffusion-weighted imaging to examine structural connectivity within the DMN and SN in 41 young adults (24 males, ages 18-35) and 40 older adults (24 males, ages 60-80). Superaging was defined as youthful performance (males: 13; females: 14) on the long delay free recall measure of the California Verbal Learning Test. We masked the DMN and SN, and their assessed the integrity of structural connectivity using fractional anisotropy. As predicted, within both DMN and SN, superagers had higher fractional anisotropy compared to typical older adults (DMN: $t = 2.51$, $p = 0.01$; SN: $t = 2.89$, $p = 0.01$). Compared to young adults, superagers had weaker DMN fractional anisotropy ($t = 2.53$, $p = 0.01$) and similar SN fractional anisotropy ($t = 0.11$, $p = 0.92$). Higher fractional anisotropy within the DMN predicted better performance on both recall ($r = 0.27$, $p = 0.07$) and recognition memory tasks (item recognition: $r = 0.48$, $p = 0.00$; associative recognition: $r = 0.43$, $p = 0.01$) in older adults. Completing a link between morphometry and functional connectivity, these structural connectivity results continue to extend the multimodal characterization of superaging.

Topic Area: LONG-TERM MEMORY: Development & aging

C65 Theta Networks of Memory in Traumatic Brain Injury

Richard Adamovich-Zeitlin[1], Paul Wanda[1], Ethan Solomon[1,2], Tung Phan[1], Brad Lega[3], Kan Ding[3], Ramon Diaz-Arrastia[1], Michael Kahana[1], [1]University of Pennsylvania, [2]Perelman School of Medicine, [3]University of Texas Southwestern

Traumatic brain injury (TBI) is a leading cause of cognitive disability in young adults, with this disability resulting prominently in impaired episodic memory. In these patients, as in healthy controls, memory exhibits marked temporal variability. Using recordings from indwelling electrodes, we sought to characterize and compare the oscillatory biomarkers of mnemonic variability in two cohorts of epilepsy patients: those with a history of moderate-to-severe TBI (n=30) and a group of closely matched non-TBI controls (n=30). Analysis of these recordings demonstrated that theta-frequency connectivity marks periods of successful memory formation in both cohorts. Periods of successful memory encoding were further marked by increased gamma power and decreased theta power across a broad set of brain regions (frontal, lateral temporal, medial temporal, parietal), a pattern seen in both cohorts. These biomarkers of successful memory, common to both TBI and non-TBI cohorts, could guide new approaches to the treatment of disordered memory in diverse forms of neurological disease.

Topic Area: LONG-TERM MEMORY: Episodic

C66 REM sleep and inferior temporal lobe recapitulation support positive memory retrieval

Ryan Bottary[1], Sarah Kark[2], Ryan Daley[1], Jessica Payne[3], Elizabeth Kensinger[1], [1]Boston College, [2]University of California Irvine, [3]University of Notre Dame

Emotional episodic memory retrieval is best when brain regions engaged during memory encoding become reactivated at retrieval, a phenomenon termed recapitulation. Additionally, slow wave sleep (SWS) is implicated in memory consolidation and rapid eye-movement (REM) sleep in emotional memory consolidation. Here, we investigate how individual differences in recapitulation and sleep affect emotional memory retrieval performance. Healthy adults (N = 22; 11F, 11M; age: 19-29 years) received fMRI scanning during an incidental encoding task and a surprise recognition memory task 24-hrs later. Overnight sleep was monitored with polysomnography. During encoding, participants viewed line drawings of negative, neutral and positive images, each followed by their full-colored photo. At recognition, participants distinguished new from encoded line drawings. Recapitulation for each valence was defined as the percentage of voxels activated at encoding that were re-activated during successful recognition (recap%); this metric was calculated within 3 ROIs (mPFC, amygdala and inferior temporal lobe (ITL)). Multiple linear regression was performed to predict valence-specific memory performance from ROI-based recapitulation and sleep. Positive memory performance was predicted by both ITL recap% and REM sleep percentage (%), but no interactive effects between recap% and REM% were observed. No effects of SWS% were observed, nor were the regression models significant in predicting negative or neutral memory. These findings support REM sleep's importance for emotional memory retrieval and further suggest that it may be particularly important for positive memory retrieval. The results also suggest that ITL recapitulation supports positive memory retrieval.

Topic Area: LONG-TERM MEMORY: Episodic

C67 Evaluating the subsequent memory effect as predictive of memory

Sucheta Chakravarty[1], Yvonne Chen[2], Jeremy Caplan[1], [1]University of Alberta, [2]Baylor College of Medicine

To isolate brain activity that reflects effective processes during the study phase of a memory task, cognitive neuroscientists commonly contrast brain activity during study of later-remembered versus later-forgotten items. This 'subsequent memory effect' method has been described as identifying brain activity 'predictive' of memory outcome. However, decades of behavioural research has told us that memory success depends not only on cognitive processes during study of an item, but on many processes that occur at other times (e.g., competition from other studied items, study-test compatibility, etc.). We show that conventional event-related potential 'subsequent memory effect' signals are predictive, but indeed, only to a small degree (N=60, 225 items/participant). This improves substantially when machine-learning classifier methods developed are applied, but the predictive effects are still modest. These findings suggest that the term 'predictive' is, at a minimum, overstating the standard subsequent memory effect. For an approach to study-related brain activity to be more predictive may require integrating the myriad and interesting other factors known to influence memory outcome, with standard univariate, as well as classifier-based approaches.

Topic Area: LONG-TERM MEMORY: Episodic

C68 The Retrieval of Context Variability in Episodic Memory: An ERP Study

SHIH-KUEN CHENG[1], [1]National Central University

This experiment aimed to examine the retrievability of encoding context variability. This was achieved by presenting objects repeatedly presented in a single encoding context (low variability) or various different encoding contexts (high variability) during the study phase. In the subsequent test, participants engaged in an exclusion task that designated items from high or low variable encoding tasks as the targets to be identified. The retrievability of context variability was indexed by the recollection and familiarity scores derived from the process-dissociative procedure (PDP) developed by Jacoby (1991).The results suggested that when the targets of retrieval were the encoding context variability per se, participants indeed could retrieve their memories of encoding variability. However, it was only when the participants were prompted to search for items that were encoded in a constant condition that the retrieved variability information could be utilized. The encoding context variability information seems to be of little use if participants were prompted to retrieve items from varied contexts. Increasing the times of exposure could enhance the capacity to retrieve the memory of encoding context variability. However, the enhancement from repetition could only be observed when the retrieval targets were items that were paired with constant contexts. To conclude, the retrieval encoding variability might not be a spontaneous process. In addition, even when the information of encoding variability is deliberately retrieved, it could only be used in a certain circumstance, namely to confirm that the consistency of the encoding context.

Topic Area: LONG-TERM MEMORY: Episodic

C69 Repulsion of hippocampal representations is time-locked to resolution of memory interference

Wanjia Guo[1], Robert Molitor[1], Serra Favila[2], Brice Kuhl[1], [1]University of Oregon, [2]New York University

The hippocampus is believed to play a critical role in disambiguating memories for similar events (Yassa & Stark, 2011). Indeed, recent fMRI studies have found that event similarity triggers an active 'repulsion' of hippocampal activity patterns (Chanales et al., 2017), and this repulsion is associated with reduced memory interference (Favila et al., 2016; Hulbert and Norman, 2014). Here, we tracked hippocampal representations of similar events over the course of learning in order to test whether hippocampal repulsion is 'time locked' to interference resolution. Participants (N = 30), completed 6 runs of a learning task. Each run began with a study phase during which scene-object associations were encoded. Critically, the scenes were comprised of pairs of highly similar images (pairmates), but each scene was associated with a unique object. After each study phaseround, participants completed an associative memory test that required selecting the object associated with each scene while avoiding interference from similar (pairmate) associations. The same set of associations was studied and tested in each round, allowing for measurement of the point in time at which interference between pairmates was resolved. Pattern similarity analyses revealed that, within the CA23/dentate gyrus sub-region of the hippocampus, there was a repulsion of pairmate representations that selectively occurred precisely when memory interference was resolved. Strikingly, this repulsion effect was fully absent in sub-region CA1 and in visual cortical areas. Thus, our findings reveal an important relationship between the repulsion of CA23/dentate gyrus representations and the successful resolution of interference between competing memories.

Topic Area: LONG-TERM MEMORY: Episodic

C70 Reactivation and updating of face memories

Robin Hellerstedt[1], Matthew Plummer[1], Stuart Gibson[1], Jon Simons[2], Zara Bergström[1], [1]University of Kent, [2]University of Cambridge

Episodic memory retrieval not only involves reactivation of stored memory traces, but can also elicit encoding of new information in the current environment into memory, which can update memory and bias future retrieval attempts. Prior research on episodic memory updating has focused on how recollection can update complex, relational event memories. Less is known regarding whether simple item memories, such as memories for human faces, can be updated during recognition attempts. We combined electrophysiological measures of brain activity with a continuous measure of face recognition with an aim to investigate the neural mechanisms underlying recognition-induced updating. Participants first encoded computer generated face images that were sampled from different locations in a multidimensional 'face space'. In a subsequent face recognition test, each trial presented a previously seen target face amongst other distractor faces that varied in similarity (face space distance) to the target, and participants were asked to select the target. This test was followed by a second test which was identical to the first. Event-related potentials and EEG oscillations revealed the involvement of multiple neural processes during retrieval and updating, which indicated that repeated recognition attempts induced both encoding of errors and reactivation-related strengthening of already encoded memories.

Topic Area: LONG-TERM MEMORY: Episodic

C71 Inhibition of related items in long-term memory specificity depends on confidence

Brittany Jeye[1], Scott Slotnick[2], [1]Worcester State University, [2]Boston College

In the current investigation, we evaluated the specificity of long-term memory representations for faces. During each study phase, participants were presented with neutral Caucasian male and female faces. During the corresponding test phase, old faces, related faces, and new faces were presented and participants made 'old'?'new' recognition judgments followed by 'unsure', 'sure' and 'very sure' confidence judgements. Related faces were created by morphing along a continuum in steps of 20% (i.e., 20%, 40%, 60% and 80% morphs) between old and new faces. Memory representations were very specific as the 'old' response rate for old faces was significantly higher than closely related faces (i.e., 20% morphs) for both 'very sure' and 'sure' confidence responses (there was no difference for 'unsure' responses). Furthermore, there was evidence of memory inhibition, as the 'old' response rate for 20% morphs was significantly lower than 40% morphs for 'sure' responses (but not for 'very sure' or 'unsure' responses). These findings may reflect an evolutionary advantage for recognizing specific faces, which may require inhibition of closely related faces. These findings also suggest that inhibition of closely related faces may be flexibly directed depending on confidence level, and may be primarily associated with intermediate confident responses. Future research will utilize event-related potentials and functional magnetic resonance imaging to investigate the brain basis of this long-term memory inhibition.

Topic Area: LONG-TERM MEMORY: Episodic

C72 EEG biomarkers of immediate and delayed verbal recall

Connor Keane[1], Brandon Katerman[1], Michael Kahana[1], Li Yuxuan[2], [2]Stanford University, [1]University of Pennsylvania

Recordings of brain activity in the moments leading up to successful verbal recall provide a window into the cognitive processes underlying memory retrieval. But these same recordings also subsume neural signals unrelated to mnemonic retrieval, such as those associated with vocalization of the recalled item. Here we examined spectral EEG biomarkers of successful recall under conditions designed to vary the mnemonic demands of the retrieval process. In an immediate test, subjects recalled a single just-presented word after a brief delay. In a long-delayed test, subjects attempted to recall items learned across multiple days but not presented in the current session. This extreme manipulation of mnemonic demands helped to isolate components of EEG activity most related to the act of interest: namely, episodic retrieval of a previously encoded item. Comparisons between these conditions revealed a unique electrophysiological signature of long-term episodic memory retrieval in the period leading up to vocalization: increased high-frequency activity and decreased low-frequency activity across multiple cortical regions, and increased frontal theta activity.

Topic Area: LONG-TERM MEMORY: Episodic

C73 Image memorability is predicted by activity across stages of convolutional neural networks and the human ventral stream

Griffin E. Koch[1], Essang Akpan[1], Marc N. Coutanche[1], [1]University of Pittsburgh

What makes some images memorable while others are forgettable? The features of an image can be represented at multiple levels, from low-level visual properties to high-level meaning. Across two behavioral studies and a neuroimaging study, we addressed the question of how image memorability is influenced by levels of the visual hierarchy. In a first behavioral study, we combined a convolutional neural network (CNN) with behavioral prospective assignment, by using one of four CNN layers to select the scene images that each of one hundred participants experience. We found that participants remembered more images when they were assigned to view stimuli that were identified as discriminable using low-level CNN layers, or identified as similar in high-level layers. A second study replicated the first experiment's results using images from a single semantic category (houses), but found that similarity predicted memorability at a slightly less high-level that holds representations of objects, suggesting this level is more important for remembering images from the same category. Finally, we analyzed neural activity collected through functional magnetic resonance imaging (fMRI) scans as independent participants viewed the same scene images. Pattern similarity analyses revealed an analogous relationship in the ventral stream between image discriminability/similarity and level of the visual hierarchy. Discriminability in early visual areas, and similarity later in the ventral stream, each predicted greater image memorability. Together, this research shows that discriminability at different visual levels can be used to predict image memorability through both CNN models and neural activity in the human ventral stream.

Topic Area: LONG-TERM MEMORY: Episodic

C74 The role of reward in encoding details of complex episodic memories for events

Azara Lalla[1], Kevin Da Silva Castanheira[1], A. Ross Otto[1], Signy Sheldon[1], [1]McGill University

Experimental evidence indicates that the presence of reward when encoding items and associations enhances memory performance. However, little is known about how reward affects the encoding and subsequent retrieval of episodic memories for complex events which contain different types of detailed information (e.g., what is happening, what objects are present, and where things are located). To investigate this question, we designed a within-subjects experiment in which young adult participants (N=45) studied a series video clips of complex, naturalistic events (e.g., a dinner party). They were informed that each video was associated with a high (25 cent) or low (1 cent) reward. The effect of this reward manipulation was tested with a recognition memory

test for event, object, and spatial details within each of the videos. A mixed-effects logistic regression predicting memory accuracy from detail type and reward condition found that memory was better for event than object or spatial details (Ã?²=-0.113,SE=0.033,p

Topic Area: LONG-TERM MEMORY: Episodic

C75 Oscillatory Mechanisms for Hippocampal Memory Encoding Tested in Humans

Sarah Lurie[1], Joel Voss[1], [1]Northwestern University

Hippocampal ensemble activity shows prominent coherence in the theta frequency band, which may serve as a rhythm to orchestrate binding of various sensory inputs into memory. Although evidence in rodents suggests that encoding ability might vary with hippocampal theta phase, this has not been demonstrated in humans. We addressed this question by testing whether theta-patterned transcranial magnetic stimulation (TMS) of the hippocampal-cortical network causes theta-periodic fluctuations in the efficacy of memory encoding. We presented brief (

Topic Area: LONG-TERM MEMORY: Episodic

C76 Do metacognitive judgments impact environment learning?

Lauren Mason[1], Holly Taylor[1], Ayanna Thomas[1], Tad Brunyé[2], [1]Tufts University, [2]Center for Applied Brain & Cognitive Sciences

When navigating an environment for the first time, people frequently use navigational aids, such as maps on smart phones, to inform navigation choices leading to a destination. This notion that individuals seek out information when feeling unsure about where they are within the environment suggests a role of metacognition in environment learning. Although research examining the role of metacognitive processes in EL is limited, recent findings from our lab suggest that people exercise control by switching between different map displays at predictable path locations, dependent on established learning goals. The present study examines the role of explicit metacognitive monitoring judgments during environment learning. We hypothesize that the act of making prospective judgments of learning may influence learners' objective performance when faced with navigating the same environment in the future or constructing a map of the environment from memory. Participants navigated a virtual environment to find a series of destinations; upon reaching each destination they made a JOL or generated a random number. We tested spatial memory by having participants re-navigate routes and construct a map. Results highlight the role of metacognitive monitoring on egocentric and allocentric environment learning. Furthermore, while modern technology has provided solutions to streamline the process of successfully navigating unknown territory, research shows that navigational aids impair spatial memory. Therefore, alternative strategies that encourage user-based monitoring and self-initiated control to optimize environment learning should be considered. This project is an early step in building a body of research that would support the development of such tools.

Topic Area: LONG-TERM MEMORY: Episodic

C77 Transfer of negative emotion in episodic memory

Daniela J. Palombo[1], Leor Elizur[1], Christian L. Esposito[1], Christopher R. Madan[2], [1]University of British Columbia, [2]University of Nottingham

To shed light on the nature of hippocampal contributions to value-based reinforcement learning, we applied computational modeling to amnesic performance and neuroimaging data, obtained in a probabilistic learning task involving learning the value of six visual patterns (Palombo et al. 2019). Two models were constructed. The first model used well-established reinforcement learning, which models values for stimulus-response contingencies and updates them depending on prediction error whenever a stimulus is presented. This model assumes maintenance of acquired knowledge without decay across non-consecutive presentations of a stimulus. The second model was similar but added the possibility of decay. Responses of control subjects were better fit by the model without decay (N=22, Log(Bayes Factor)=-1.2). By contrast, responses of amnesic patients with hippocampal lesions were better fit with decay (N=8, Log(Bayes Factor)=2.3), suggesting impaired maintenance of information supporting acquisition of response contingencies. Next, using fMRI data from healthy subjects (N=30), time series were computed for trial-by-trial prediction error and progressively acquired knowledge, and were used as parametric modulators in a whole brain general linear model analysis (cluster-based threshold: p=.001). Consistent with previous studies, prediction error correlated with activation in the basal ganglia, amygdala, and ventromedial prefrontal cortex. Critically, prediction error also correlated with activation in the anterior hippocampus. Progressively acquired knowledge correlated with activation in the dorsal precuneus and middle cingulate gyrus, key regions of the parietal memory network. Taken together, these results suggest a critical contribution of the hippocampus in the updating and maintenance of response contingencies during value-based reinforcement learning.

Topic Area: LONG-TERM MEMORY: Episodic

C78 The role of autobiographical memory processes in planning and problem solving

Sarah Peters[1], Signy Sheldon[1], [1]McGill University

Neuroimaging research proposes a common core neural network underlying autobiographical memory and future-oriented tasks that rely upon the construction of complex mental representations, such as planning and problem solving. However, behavioural research indicates that planning and problem solving may have distinct cognitive processing requirements such that planning involves implementing an established script whereas problem solving involves generating options before simulating how to implement the selected solution. Prior work has not considered planning and problem solving simultaneously, leaving it unclear how and when autobiographical processes support complex future-oriented thinking. To address this, we tested neural overlap between autobiographical memory, and future thinking across two distinct retrieval forms. In an MRI scanner, young adults viewed three cue types, memory, problem solving and planning. To each cue, participants generated multiple exemplars of memories, plans, or solutions (generation retrieval) and then selected one example to think about in detail (elaboration retrieval). Multivariate analysis revealed distinct patterns of neural activity as a function of retrieval form with generation recruiting anterior cortical regions and elaboration posterior regions. Within retrieval form, neural activity additionally dissociated as a function of task. For generation, there was common neural activity among future-oriented tasks that was distinct from autobiographical memory. During elaboration, neural overlap was observed between problem solving and memory that was distinct from planning. These dissociations were reflected in patterns of hippocampal-cortical connectivity. Together, results provide insight into the neural mechanisms of planning and problem solving and suggest that retrieval demand mediates the recruitment of autobiographical processes during

Topic Area: LONG-TERM MEMORY: Episodic

C79 MR elastography of hippocampal subfield viscoelasticity is related to relational memory outcomes across the lifespan

Hillary Schwarb[1], Peyton L Delgorio[2], Lucy V Hiscox[2], Ana M Daugherty[3], Matthew DM McGarry[4], Neal J Cohen[1], Curtis L Johnson[2], [1]University of

Illinois Urbana-Champaign, [2]University of Delaware, [3]Wayne State University, [4]Dartmouth College

Magnetic resonance elastography (MRE) is an emerging technique that provides quantitative measures of viscoelastic mechanical properties indicative of underlying neural tissue health. Previous work from our group has demonstrated that MRE is a sensitive technique for assessing hippocampal integrity that is related to relational memory outcomes. The hippocampus, however, is not a homogenous structure and each of its subfields has a unique cellular organization and unique relationship with episodic memory. Furthermore, volumetric analyses demonstrate that hippocampal subfields may decline at different rates as we age, and even more so with neurodegenerative disorders like Alzheimer's disease. While whole brain viscoelastic changes have been assessed across the lifespan, hippocampal subfield viscoelasticity has yet to be considered. Therefore, to assess viscoelasticity in the hippocampal subfields we have developed, for the first time, a high-resolution (1.25 mm) MRE protocol specific for analyzing the subfields and their relationship with memory across the lifespan. Here we demonstrate that 1) this protocol provides reliable damping ratio measurements from each of the subfields, 2) that damping ratio differs significantly between the subfields (i.e., DG/CA3, CA1/2, and subiculum), and 3) that individual subfields show distinct patterns of age-related viscoelastic differences across the lifespan. Participants also completed a short-delay relational memory task. On each trial participants studied a three-featured stimulus and were then asked to identify the learned stimulus among several test-stimuli that share zero, one, or two of overlapping features. Performance on this task correlated with DG/CA3 viscoelasticity such that participants with poorer DG/CA3 integrity performed worse.

Topic Area: LONG-TERM MEMORY: Episodic

C80 Sleep-dependent consolidation enhances episodic memory for a real-life event

Stephanie Simpson[1, 2], Nick Diamond[3], Laryssa Levesque[2], Yushu Wang[2], Catherine Le[2], Brian Levine[2], [1]University of Toronto, [2]Rotman Research Institute at Baycrest Health Sciences Centre, [3]University of Pennsylvania

Consolidation during a period of sleep, compared to wakefulness, has been shown to reliably improve episodic memory retrieval. However, it is still debated whether sleep equally benefits all aspects of episodic memory given that spatiotemporal (sequence) information appears to profit more from sleep than perceptual (item) details. Moreover, most of this prior work applied oversimplified, lab-based stimuli in one experimental session. The primary goal of this study was therefore to determine whether these results generalized to memory for more complex real-life events. Here, we examined memory for an encoded staged event in which 60 healthy adults participated in the Baycrest Tour, a museum-style, audio-guided, staged-event followed by independent assessments of sequence and item memory for items encountered during the tour. These validated online tests were serially administered at 30 minutes, 12 hours, 1 week, and 1 month after encoding. Participants were randomized to either an awake or sleep (polysomnography) condition during the 12-hour delay, allowing us to extract sleep spindle and slow-wave oscillation measures. Extending previous research, we found that sleep, particularly N2 and N3 (slow wave sleep), boosts memory performance at the 12-hour test interval, with group effects observed for both sequence and item memory. This suggests that sleep-dependent memory processing may facilitate a widespread mnemonic advantage. These results shed light on the mnemonic benefit of sleep-dependent consolidation for both the items and sequences that compose recent real-world experiences.

Topic Area: LONG-TERM MEMORY: Episodic

C81 Medial Temporal Network Representations of Conceptual Information During Naturalistic Events

Alyssa Sinclair[1], Jia-Hou Poh[1], R. Alison Adcock[1], Morgan Barense[2], [1]Duke University, [2]University of Toronto

How does the brain represent conceptual information during continuous experience? To investigate the conceptual representation of naturalistic episodes, we used fMRI to analyze patterns of neural activity. Participants (N=24) viewed 70 multimodal videos, each featuring distinct narratives, characters, and contexts. To analyze the conceptual information in these complex episodes, we submitted participants' descriptions of the videos to a text-based analysis of word meanings and frequency. We used these analyses to construct three separate conceptual similarity models for information about narrative, characters, and context. We then related these conceptual similarity models to neural activity by using representational similarity analysis and linear mixed-effects regression. Within the left hippocampus, activity patterns in the anterior hippocampus corresponded to information about both narratives (p=.014) and characters (p=.014). In the posterior hippocampus, activity patterns only corresponded to the character model (p=.005). Medial temporal lobe neocortical regions surrounding the hippocampus represented information about context (p=.026) and characters (p=.049), but not narratives. The angular gyrus and areas of the default mode network also represented information about narratives (p

Topic Area: LONG-TERM MEMORY: Episodic

C82 Functional Connectivity Differs across Cultures

Wanbing Zhang, Xin Zhang[1], Jessica Andrews-Hanna[2], Angela Gutchess[1], [1]Brandeis University, [2]University of Arizona

People from different cultural backgrounds have been found to differ in their memory specificity and their patterns of neural activation during encoding. However, little is known about how the brain areas associated to cultural differences in memory specificity behave when at rest especially after the memory task. The current study investigates how functional connectivity differs across cultures. 20 Americans and 20 East Asians completed an eyes-open resting state scan after incidentally encoding pictures of objects. Regions selected to compare resting state connectivity during rest included two cortical regions (left parahippocampal gyrus, and left hippocampus) previously identified as being more active in East Asian vs. American participants when encoding items that would later be correctly recognized as being the same or similar as items presented during encoding. Our results revealed that the left parahippocampal gyrus showed a significantly greater connection to the striatum (including bilateral caudate, left pallidum, and left putamen) in East Asian compared to American participants. The activations overlapped with striatal parcellations typically thought to project to the frontoparietal control network. This may suggest that consolidating specific information about details of items is more effortful for East Asian participants and thus requires more cognitive coordination.

Topic Area: LONG-TERM MEMORY: Episodic

C83 The effects of a moderate dose of alcohol on prospective memory: A pilot study

Xiao Liu[1], Marie Brown[2], Emily Thomas[2], Sunjeev Kamboj[2], Valerie H. Curran[2], [1]University of Southern California, [2]University College London (UCL)

Prospective memory (PM) involves planning and carrying out tasks during future events. Research suggests that excessive alcohol consumption negatively impacts prospective memory. However, alcohol's effects on PM mechanisms are not fully understood, and evidence for the efficacy of memory strategies to reverse impairment remains mixed. We completed a pilot study

to investigate the acute effects of alcohol on PM and whether implementation intentions (IIs) could be used to combat these effects. We used Virtual Week as an objective measure of PM, which is a computerized board game that simulates typical events during a week and generates PM tasks for the subject to complete. 20 participants were randomly allocated to receive alcohol or placebo in a double-blind independent group design. They played 4 experimental rounds of Virtual Week and used IIs in the final 2 rounds. There was a significant main effect of alcohol on irregular PM task scores ($p = 0.012$). Furthermore, we observed a significant interaction of memory strategy and group ($p = 0.002$), where use of IIs improved scores in the alcohol group more than in the placebo group. Pairwise Bonferroni adjusted comparisons showed significant improvement of scores while using IIs in the alcohol group ($p = 0.007$). This provides initial evidence supporting the use of IIs to help bypass pathways in PM that are impaired under acute alcohol use, which may have important clinical and theoretical implications.

Topic Area: LONG-TERM MEMORY: Other

C84 Matisse or Degas? Using paintings to investigate the relevance of sleep in memory for specific details vs generalization

Sarah (Sadie) J. Witkowski[1], Sharon M. Noh[2], Victoria Lee[1], Alison R. Preston[2], Ken A. Paller[1], [1]Northwestern University, [2]University of Texas at Austin

Sleep is important for memory, but does it favor consolidation of specific details or extraction of generalized information? Both may occur together, or generalization may be facilitated by a loss of memory details. To examine these issues, we studied participants who viewed cropped landscape paintings by six artists (six paintings per artist). Paintings were cropped to show only part of each original scene. Each painting was presented with the artist's name and a sound cue to be associated with that artist in a learning-with-feedback phase. In a test of detailed memory, participants were shown an array of six images, all by the same artist, and asked to select which had been seen previously. Some of the foils were different parts of paintings from the learning phase. Generalization was tested by asking participants to select the correct artist for new paintings by the same six artists. Initial performance was similar on both tests (specificity: 59%; generalization: 54%). After testing, participants had a 90-minute sleep opportunity with polysomnographic monitoring. When slow-wave sleep was detected, three of the sound cues were presented unobtrusively. Upon waking, participants were again tested for memory specificity and generalization. Performance declined for specificity (46%), as expected due to episodic forgetting, but generalization performance was largely maintained (52%). A further analysis related time spent in different sleep stages to changes in these two forms of memory. Additional information was provided by considering sleep physiology in conjunction with whether cues reactivated specific or general memories during sleep.

Topic Area: LONG-TERM MEMORY: Other

C85 Integrating MVPA and Connectivity in a Multiple Constraint Network to Bootstrap Brain Models

Chris McNorgan[1], Greg Smith[1], Erica Edwards[1], Jennifer Mosley[1], [1]University at Buffalo

Brain-based cognitive models draw on traditional general linear model fMRI analyses, which have been more recently complemented by multivariate pattern analyses (MVPA) and by connectivity analyses to identify regions supporting cognitive processes and the interactions between them. We describe a machine-learning approach that represents an explicit union of MVPA and functional connectivity, aiming to facilitate the integration of evidence afforded by these two analytic methods. Multilayer neural networks learned the real-world categories associated with macro-scale cortical BOLD activity patterns generated during a multisensory imagery task, while simultaneously encoding interregional functional connectivity in an embedded autoencoder. Our technique permits the MVPA and functional connectivity solutions to mutually constrain one another, and we argue that these Multiple Constraint Networks naturally generate models that best fit all available data. We find that functional connectivity encoding significantly improved MVPA classifier accuracy, and used the resulting models to simulate lesion-site appropriate category-specific impairments and identify semantic category-relevant brain regions. We conclude that data-driven Multiple Constraint Network analyses encourage parsimonious models that may benefit from improved biological plausibility and facilitate discovery.

Topic Area: LONG-TERM MEMORY: Semantic

C86 Language learning can withstand one night of total sleep deprivation

Jakke Tamminen[1], Chloe Newbury[1], Rebecca Crowley[1], Kathleen Rastle[1], [1]Royal Holloway, University of London

Sleep is thought to consolidate new memories. We tested the impact of total sleep deprivation on adults' memory for newly-learned words and on their ability to generalise knowledge to untrained words. We trained participants to read fictitious words printed in a novel artificial orthography, while depriving them of sleep the night after learning (Experiment 1, N = 47) or the night before learning (Experiment 2, N = 46). Following two nights of recovery sleep, and 10 days later, participants were tested on trained words and untrained words, and performance was compared to controls who slept normally throughout. In both experiments, participants showed a high degree of accuracy in learning the trained words and in generalising their knowledge to untrained words. There was little evidence of impact of sleep deprivation on generalisation. Given this unexpected lack of effect, we assessed the robustness of the literature on sleep deprivation and memory. We conducted a meta-analysis of studies published between 1970 and 2018. We found 27 studies looking at sleep deprivation before encoding. These showed that sleep deprivation impairs encoding with a medium effect size ($g = -0.55$). We found 35 studies looking at sleep deprivation after learning. These showed a small effect ($g = -0.34$) of sleep deprivation impairing consolidation. No statistically significant evidence of publication bias was found. Taken together, our data and the meta-analysis suggest that lack of sleep before or after encoding may have a small-to-medium size effect on episodic memory, but this effect does not extend to generalisation.

Topic Area: LONG-TERM MEMORY: Semantic

C87 Observational and Rule-based Artificial Grammar Learning in Individuals with Aphasia

Carla Tierney-Hendricks[1], Sofia Vallila-Rohter[1], Natasha De Novi[1], [1]MGH Institute of Health Professions

Learning is often characterized within frameworks of implicit and explicit learning. Implicit or observational learning is thought to operate below conscious awareness. In contrast, explicit or rule-based learning involves conscious awareness and often relies on verbally-mediated processes. In the current study, we examined observational and rule-based learning in people with aphasia, a language deficit that arises subsequent to brain injury or stroke. We hypothesized that observational learning, which does not rely on language would be intact in people with aphasia (PWA), regardless of stimulus modality, whereas rule-based learning would be impaired due to its reliance on language. Data have been collected from seven PWA and eight age-matched controls. All participants completed 3 artificial grammar learning tasks: observational visual, observational auditory, and rule-based visual. Data analyses compared performance following 1) observational training with

visual (shape sequence) versus auditory (nonword sequence) stimuli and 2) observational versus rule-based visual training conditions. Results revealed that controls and PWA performed similarly on both observational tasks, supporting the hypothesis that observational learning remains relatively unaffected by neurological injury to language. In the rule-based learning condition, control participants had higher accuracy than PWA. Findings support the hypothesis that language mediates rule-based learning. This research has implications for understanding learning mechanisms for a range of neurological populations with disordered language networks.

Topic Area: LONG-TERM MEMORY: Episodic

C88 Correspondence between Electroencephalography Analysis Techniques in Early Childhood: Evidence from a Passive Oddball Ta

Caroline Hoyniak[1], Rebecca Hailperin-Lausch[2], Lauren Wade[2],Elizabeth daSilva[2,3], John Bates[2], Bennett Bertenthal[2], [1]Washington University School of Medicine, [2]Indiana University, [3]Purdue University, Columbus

There are a number of techniques that can be used to analyze electroencephalography (EEG) data, but little research has examined correspondence among these techniques in data collected from young children. Participants included 67 42-month-olds (29 female) who participated in a Passive Auditory Oddball task while EEG data were collected using a 128-electrode sensor EGI system. These data were analyzed using three techniques: 1) traditional Event-Related Potential (ERP) identification across P3, Pz, and P4 electrodes (10-20 system), 2) ERP component identification using temporospatial Principal Components Analysis (tsPCA), and 3) time-frequency analysis measuring Event-Related Desynchronization (ERD) within the alpha frequency band, 7 ? 10 Hz, over central sites. Differences between the Frequent and Target condition occurred in the traditional ERP analysis at Pz (cohen's d = .27), and during the 200 ? 399 ms, 600 ? 799 ms, and 800 ? 999 ms bins in the ERD analysis (cohen's d = .47, .41, and .40, respectively). No significant differences emerged between conditions in the tsPCA analysis. Pearson correlations suggested correspondence between P3 amplitudes as calculated using traditional ERP analysis and as calculated using tsPCA, such that, in the target condition, the P3 component examined at Pz was significantly associated the temporospatial factor chosen to represent the P3 (r =.39). However, across time bins, alpha ERD was not associated with P3 amplitudes in either condition as calculated using either ERP processing technique. The current study is the first, to our knowledge, to compare the common EEG/ERP analytic approaches in data collected from young children.

Topic Area: METHODS: Electrophysiology

C89 A Gaussian process model of human electrocorticographic data

Tudor Muntianu[1], Lucy Owen[1], Andrew Heusser[1], Patrick Daly[2], Katherine Scangos[2], Jeremy Manning[1], [1]Dartmouth College, [2]UCSF

There is increasing evidence from human and animal studies that memory encoding and retrieval is supported by fast timescale network dynamics involving the coordinated activities of widespread brain structures. However, measuring these network dynamics directly in the human brain poses a substantial methodological challenge. In prior work, we developed a method for inferring high spatiotemporal resolution activity patterns throughout the brain, using recordings taken at only a small number of ECoG electrodes (Owen and Manning, 2017). The method, SuperEEG, builds a covariance model that describes how activity patterns throughout the brain are related as a function of their spatial location. We train the covariance model by stitching together recordings taken from a large number of patients and electrode locations. Once the covariance model has been fit, we can apply the model to ECoG recordings from a small number of locations to estimate activity patterns throughout the rest of the brain. In our prior work, we showed that the activity patterns estimated at held-out (unobserved) electrode locations were reliably correlated with the true (observed) activity recorded from those electrodes. Here we apply this same approach to two new large ECoG datasets. We first replicate our prior results, reliably estimating activity patterns from held-out electrodes across both patients and experimental tasks. In other words, the properties our approach leverages appear to be person-general and task-general. Then, we assess reconstruction quality across six frequency bands and broadband power; while quality remains stable across frequencies, highest quality reconstructions come from broadband power activity patterns.

Topic Area: METHODS: Electrophysiology

C90 Gaussian Process Joint Models for Estimating Latent Dynamics of Brain and Behavior

Giwon Bahg[1], Daniel Evans[1], Matthew Galdo[1], Brandon Turner[1], [1]The Ohio State University

For bridging implementational and algorithmic levels of analysis (Marr, 1982), Bayesian joint modeling (Turner et al., 2013) was proposed as a statistical framework for investigating shared constraints between neural activities and cognitive model parameters. However, previous joint modeling approaches have assumed linearity in estimating a covariance matrix between neural and behavioral measures, which might not always be ideal dealing with complex brain dynamics. Also, joint models based on covariance estimation often ended up sacrificing the temporal dynamics of cognitive activities. To address these limitations, we propose a Gaussian process joint model (GPJM), a data-driven and nonparametric joint modeling framework based on hierarchical Gaussian process latent variable models (Lawrence & Moore, 2007). The GPJM aims to estimate complex temporal dynamics embedded in neural and behavioral data using Gaussian processes as a linking function across modalities. The GPJM can incorporate spatiotemporal covariance structures as its constraints and evaluate the relevance of each latent dimension to data generation processes. To verify the utility of the GPJM, we tested the model performance with simulation and an application to real data. The simulation results demonstrated that the GPJM estimates cognitive dynamics while exploiting spatiotemporal constraints. In an fMRI experiment based on a continuous motion-tracking task, the GPJM could fit neural and behavioral data appropriately, and estimate non-trivial underlying dynamics governing data generation processes. Moreover, out-of-sample validation analyses showed that the latent dynamics trained with complete neural data and selected behavioral data could predict test data reasonably.

Topic Area: METHODS: Neuroimaging

C91 Military Blast Exposure and PTSD are Associated with Aging White Matter Integrity and Functioning

Emma Brown[1], Anna Etchin[1], William Milberg[1], Regina McGlinchey[1], David Salat[1], [1]VA Boston Healthcare System

Emerging evidence has demonstrated independent risks that history of military blast exposure (MBE) and PTSD pose for adverse health outcomes including changes to brain microstructure and function. Given these findings, we evaluated (a) the association of MBE and diagnosed PTSD with white matter integrity indexed by diffusion tensor imaging; (b) the relationship between MBE and PSTD with neurocognitive function; and (c) if neurocognitive function is associated with white matter alterations in a large veteran cohort. The sample consisted of OEF/OIF/OND veterans, aged 19 to 62 years (n = 191 MBE with PTSD; 106 MBE-only; 34 PTSD-only; 43 no MBE or PTSD). Delayed recall was measured by the Brief Visuospatial Memory Test (BVMT-R). PTSD diagnosis was determined by the Clinician-Administered PTSD Scale (CAPS-4). Voxelwise cluster-based statistics revealed a significant MBE and PTSD x

age interaction on diffusion parameters with the MBE and diagnosed PTSD group exhibiting a more rapid cross-sectional age trajectory towards reduced white matter integrity. We identified distinct regions of lower fractional anisotropy in those with MBE and PTSD than other groups ($p < 0.05$). MBE and PTSD demonstrated indirect influence on delayed memory recall performance ($p < 0.01$). Delayed recall performance was associated with altered white matter integrity. We found that MBE and PTSD are associated with altered cross-sectional aging at the microstructural level and may confer risk for cognitive decline. Additional work examining neurobiological underpinnings of PTSD and longitudinal changes of brain tissue integrity after blast exposure will be important in developing effective interventions for returning veterans.

Topic Area: METHODS: Neuroimaging

C92 Cross-site multiband fMRI signal validation and calibration for cross-cultural neurocognitive studies

Chi-Chuan Chen[1], Chun-Yih Lee[1], Ross Mair[2], Angela Gutchess[3], Joshua Oon Soo Goh[1], [1]National Taiwan University, [2]Harvard University, [3]Brandeis University

Comparisons of functional magnetic resonance imaging (fMRI) cognitive brain response data across different sites is becoming critical in the field, such as in cross- cultural studies. This present study comprehensively evaluated functional brain imaging data comparability between two sites (Taiwan, US) using identical multiband MRI base systems and settings. Four subjects (1 male, 3 females; 2 Caucasians, 2 East Asians) each completed 12 independent fMRI runs of both visual (flashing checkerboard) and motor (finger tapping) tasks at both sites using Siemens PRISMA 3T MRI scanners with closely matched experimental environments. Planned contrasts between the visual and motor tasks and ANOVA analysis evaluated the effects of subject, task (visual and motor task), site (Taiwan and the U.S.) and their interactions on the fMRI data. Replicating past work (Sutton et al., 2008, J. Magn. Resonance. Imaging), visual and motor tasks evoked higher brain responses in visual and motor areas, respectively, as expected. Also, main and interactive effects of subject and task were dominant across frontal, parietal, temporal and occipital areas. Main and interactive effects of site were present but largely restricted to the visual area. Overall, cross-site comparisons of functional neural responses are feasible, particularly for tasks that do not focus on low-level visual processing areas. We also suggest that site-specific fMRI signal scaling might improve comparisons. To this end, standardized procedures for between-site calibration of human brain responses, such as in this present study, is strongly recommended in future studies examining fMRI data across data acquisition sites and systems.

Topic Area: METHODS: Neuroimaging

C93 Predictable brain: Using machine learning to predict brain signals of subjects during social interaction

Candida Da Silva Ferreira Barreto[1], Guilherme Bruneri[3], José Guilherme Oliveira Brockington[1], Joao Sato[1], [1]Federal University of ABC, [3]Federal University of Sao Paulo

Brain synchronization is fundamental to successful communication between dyads in social interactions, such as teacher-student. Hyperscanning is a neuroimaging acquisition approach that consists of simultaneously measuring the brain activity of two or more individuals interacting. Combining that possibility with the fact that interbrain synchronizations (IBS) are present in social interactions lead us to an ambitious question. In a situation of teacher-student interaction, would it be possible to predict brain signals of a student using the brain signals of a teacher as predictors? To address this question, we propose this proof-of-concept study where we performed an fNIRS hyperscanning to collect brain signals from the prefrontal cortex and temporoparietal junction of eight healthy pairs of teacher-student playing a space race game. Three pairs of subjects were excluded due to poor quality of data. We used a machine learning (ML) algorithm named support vector regression (SVR) to predict the student's brain signals using the teacher's data as a predictor. As a result, the algorithm was able to predict the student's brain based on the teacher's brain for all five pairs of subjects. The predictions were related to different positions located in the TPJ. All dyads had at least two predicted signals from this region. However, only two pairs of subjects had predictions of signals from the prefrontal. Thus, pairwise brain predictions during teacher-student interactions were performed. This preliminary result is promising, therefore to move forward, we intend to increase the number of pairs, test more controlled tasks, and different ML models.

Topic Area: METHODS: Neuroimaging

C94 Reconstructing Mechanistic Models of Cognition via Simultaneous MINDy Modeling for Resting-State and Task fMRI

Matthew Singh[1], Anxu Wang[1], ShiNung Ching[1], Todd Braver[1], [1]Washington University in St. Louis

Cognitive operations are widely believed to result from a combination of long-distance signaling between brain regions as well as anatomically-local computations. Thus, mechanistic accounts of cognitive neuroscience must consider information processing at both the nodal and network scale. However, producing such mechanistic accounts remains a key challenge for task-fMRI. Current approaches have emphasized traditional statistical modeling (e.g. Granger Causality) to extrapolate causal mechanisms. However, spatial-variability in the neurovascular coupling, low sampling rates, and the high-dimensionality of brain data have proven significant barriers in adapting these approaches to task-fMRI. By contrast, generative models such as Dynamic Causal Modeling, provide inherently mechanistic descriptions. Unfortunately, current generative have been limited in the number of regions that can be considered without compromising model detail (e.g. removing hemodynamic modeling). In the current work, we aim to produce generative, large-scale models of task-induced brain activity using simultaneous Mesoscale Individualized NeuroDynamic (MINDy) Modeling of resting-state and task-fMRI. In this approach neural-mass type models are simultaneously fit to the fMRI BOLD time-series for resting-state data and task-data. Task-induced changes in the effective coupling, local time-constants/recurrent connectivity are modeled using a block-design, whereas changes in steady-state activity follow a full fMRI glm model (block and event regressors, etc.). At the same time, separate hemodynamic models are fit for each brain region. We demonstrate the approach's validity and demonstrate its superior statistical power in identifying local activity over statistical fMRI models in a variety of Cognitive Control tasks.

Topic Area: METHODS: Neuroimaging

C95 Investigating the intensity-dependent modulatory effect of TMS on functional connectivity during motion perception

Lifu Deng[1], Olga Lucia Gamboa Arana[1], Moritz Dannhauer[1], Anshu Jonnalagadda[1], Rena Hamdan[1], Fang Wang[1], Marc Sommer[1], Angel Peterchev[1], Greg Appelbaum[1], Roberto Cabeza[1], Simon W Davis[1], [1]Duke University

Transcranial magnetic stimulation (TMS) is a powerful technique in both scientific and clinical practices, and yet our understanding of how the brain responds to TMS is still limited. Concurrent TMS-neuroimaging research may bridge this gap, and emerging evidence suggests widespread neurophysiological and psychological effects of TMS beyond stimulated location. This indicates that modulatory effects of TMS may be captured

though changes in functional connectivity in addition to BOLD responses. However, the relationship between stimulation parameters and functional connectivity is unknown. In this study, healthy volunteers received concurrent TMS-fMRI while performing a dot-motion discrimination task presented in their right visual field. A figure-of-8, MR-compatible coil was used to apply bursts of 3 pulses at 10Hz over the primary visual cortex (V1) at the onset of the dot stimuli with four levels of stimulation intensity (20/40/80/120% resting motor threshold), randomized across trials. TMS-induced artefacts were repaired using ArtRepair and independent component analysis (ICA), and univariate activation and functional connectivity were subsequently estimated from the data. The results yielded two findings. First, the activation in middle temporal visual area (MT) contralateral to the visual stimuli showed a significant effect of stimulation intensity. Such effect was absent in the MT region ipsilateral to the visual stimuli. Second, functional connectivity between left V1 and MT was significantly modulated by TMS intensity, and such intensity effect was found only in the hemisphere contralateral to the visual stimuli. These findings provide evidence that TMS can modulate the activity and connectivity beyond stimulated location in an intensity-dependent manner.

Topic Area: METHODS: Other

C96 Direct electrical stimulation evidence for a dorsal laryngeal motor cortex area

Raouf Belkhir[1], Frank Garcea[2], Ben Chernoff[1], Max Sims[1], Sam Haber[3], Eduard Navarrete[4], David Paul[3], Susan Smith[3], Webster Pilcher[3], Brad Mahon[1], [1]Carnegie Mellon University, [2]Moss Rehabilitation Center, [3]University of Rochester Medical Center, [4]University of Padova

Proximate control of the laryngeal muscles during language production in humans is supported by the ventral laryngeal motor cortex (vLMC), and controversially, by the dorsal laryngeal motor cortex (dLMC). Here we present causal evidence using direct electrical stimulation (DES) in a patient undergoing language mapping during removal of a right frontal lobe tumor. Direct electrical stimulation of dLMC caused guttural involuntary vocalizations and transient 'laryngeal speech arrest'. Characteristics of the patients' errors suggest that stimulation disrupted speech at a 'late' or 'peripheral' stage of processing, because on several trials the patient resumed speaking within 200ms of removal of the stimulating probe from the brain. That short refractory time from stimulation offset to speech onset is consistent with the inference that dorsal laryngeal motor cortex supports direct control of laryngeal muscles. Stimulation of adjacent regions in the right hemisphere did not noticeably interfere with speech production.

Topic Area: NEUROANATOMY

C97 Cerebellar Dentate Connectivity Across Adulthood: A Large-Scale Resting State Functional Connectivity Investigation

Jessica Bernard[1], Hannah Ballard[1], Bryan Jackson[1], [1]Texas A&M University

Cerebellar contributions to behavior in advanced age are of great interest and importance, given its role in both motor and cognitive performance. Including cerebellar perspectives in models of motor and cognitive aging is critical for a more complete picture of the aging mind and brain. There are differences and declines in cerebellar structure in advanced age, and cerebellar resting state connectivity is decreased in older adults. However, the work on this area to date has focused on the cerebellar cortex. From a connectivity perspective, the deep cerebellar nuclei provide the primary cerebellar inputs and outputs linking it to the cortex (via the thalamus), as well as the spinal and vestibular systems. In both human and non-human primate models, networks of the dorsal and ventral dentate can be dissociated such that dorsal regions are associated with the motor cortex, while the more ventral aspect is associated with the prefrontal cortex. However, whether or not dentato-thalamo-cortical networks differ across adulthood remains unknown. Here, using a large representative adult sample (n=591) from the Cambridge Center for Ageing and Neuroscience (Cam-CAN), we investigated dentate connectivity across adulthood. First, we replicated past work showing dissociable resting state networks in the dorsal and ventral aspects of the dentate. Second, in both seeds, we demonstrated connectivity decreases with age, in network specific regions, indicating that connectivity differences extend beyond the cerebellar cortex. Together this expands our understanding of cerebellar circuitry in advanced age, and further underscores the potential importance of this structure in age-related performance differences.

Topic Area: NEUROANATOMY

C98 Oscillation-based connectivity is dominated by an intrinsic spatial organization, not mental state or frequency

Parham Mostame[1], abbas bbajani-feremi[2], sepideh sadaghiani[1], [1]University of Illinois at Urbana Champaign, [2]University of Tennessee

Coupling of oscillations across distant brain areas is thought of as a mechanism facilitating neural information exchange. Such oscillation-based functional connectivity (FC) is often considered to reflect rapidly formatting and dissolving neural ensembles. On the other hand, neuroimaging studies have shown that spatial organization of fMRI-based FC is largely stable across mental states such as resting wakefulness and cognitive tasks. Given the rapid and malleable nature of oscillation-based FC, does its spatial organization likewise contain a component that remains stable across mental states? We investigated potential state-dependency of oscillation-based FC in electrocorticography (ECoG) signals of 10 patients undergoing presurgical evaluation. FC was measured as phase coupling and alternatively as amplitude coupling in five canonical frequency bands compared across six different mental states (Resting state, pre- & post-stimulus of word recognition (Listening), pre- & post-stimulus of object viewing (Viewing), and naming of object (Naming)). We found a state-invariant spatial organization of phase coupling in all frequency bands. We further tested for frequency-dependency of phase coupling and found that the observed state-invariant FC has also a universal spatial organization over frequency bands, indicating its frequency-invariance. Dynamic FC analysis revealed that multiple frequency-specific time-varying coupling processes rather than a single set of broadband events underly the state- and frequency-invariant FC. Replicating the results with amplitude coupling, we showed that the state- and frequency-invariant FC is governed by two distinct modes of neural connectivity: phase- and amplitude coupling.

Topic Area: OTHER

C99 Educational experiences connect symbolic fractions to parietofrontal nonsymbolic ratio processing systems

Isabella Starling Alves[1], Yunji Park[1], Priya Kalra[1], John Binzak[1], Percival, Matthews[1] Edward Hubbard[1], [1]University of Wisconsin-Madison

Recent studies have suggested that humans have a neurocognitive architecture dedicated to processing nonsymbolic ratios, the Ratio Processing System (RPS), which might function as a foundation for fraction knowledge (Lewis, Matthews & Hubbard, 2015). Nonsymbolic and symbolic fractions processing have been associated with activity of frontoparietal networks in adults, but these studies leave unresolved the origins of these neural systems. We investigated the development of frontoparietal regions for symbolic and nonsymbolic fractions processing in an accelerated longitudinal design testing children prior to and after extensive fractions instruction. We collected fMRI data from 44 2nd and 39 5th graders while they performed a comparison task in three notations: nonsymbolic ratios, symbolic fractions, and mixed nonsymbolic/symbolic ratios. We are currently following up with these same

participants as 3rd and 6th graders (n = 19 and 24, respectively). For nonsymbolic comparisons, we observed robust activation of the intraparietal sulcus (IPS) in all grades, which increased across development. For symbolic fractions, we observed little activation of the IPS in 2nd graders, which increased significantly when they returned one year later. We consistently observed robust IPS activation in 5th graders and 6th graders. For mixed comparisons, IPS activation was similar to nonsymbolic comparisons in 5th graders, but similar to symbolic comparisons in 6th graders. Overall, these data are consistent with three predictions of the RPS theory: nonsymbolic ratio processing develops prior to formal instruction with fractions, symbolic fractions processing builds on preexisting frontoparietal networks for nonsymbolic ratio processing, and continued education/development refines these representations.

Topic Area: OTHER

C100 Frequency of resting-state BOLD signal in 2-month-old Bangladeshi infants growing up in poverty

Ted Turesky[1], Nadine Gaab[1,2], Charles Nelson[1,2], Shahria Hafiz Kakon[3], Nazrul Islam[4], [1]Boston Childrens Hospital, [2]Harvard Medical School, [3]The International Centre for Diarrhoeal Disease Research, [4]National Institute of Neurosciences & Hospital, Dhaka, Bangl

Previous studies have shown that frequency characteristics of the blood-oxygen-level-dependent (BOLD) signal change from early to late infancy, with peak average (across voxels) spectral power shifting from lower to relatively higher frequencies. BOLD spectral power may be an important measure as it has been associated with cognitive performance in infancy and also developmental disorder status. However, the link between BOLD spectral power and early developmental factors that may affect it have not been investigated. Importantly, risk factors associated with childhood poverty have been shown to impact other measures of brain function and we hypothesized that they may also affect BOLD spectral power. To test this, we acquired resting-state fMRI data in 32 infants (77.8 Ã?± 9.1 days) from families with low income-to-needs (5110 Ã?± 3100 Tk) and low maternal education (5.69 Ã?± 3.5 years) in Dhaka, Bangladesh. Power density spectra were computed voxel-wise, then averaged across all gray matter voxels and subjects to identify the frequency corresponding to peak average spectral power (i.e., 'peak frequency'). Spectral power at this peak frequency negatively correlated with maternal education ($r = -.42$; $p < .05$). Also, qualitatively higher spectral power estimates were localized to primary visual and anterior frontal brain regions upon visual inspection of surface topography. These findings demonstrate the first link between measures of poverty and BOLD frequency characteristics.

Topic Area: OTHER

C101 Transitional knowledge within counting sequences is processed across multiple levels of cortical hierarchy

Eli Zaleznik[1], Joonkoo Park[1], [1]University of Massachusetts Amherst

Learning the count list (one, two, three, ...) is a critical stepping-stone for the acquisition of number concepts. Most research about counting, however, is done in the behavioral domain, and little is known about the neural representations underlying counting sequences. Here, we test the hypothesis that transitional knowledge within a counting sequence exist both at sensory and conceptual (ordinal and magnitude) levels. To test this hypothesis, we employed a passive-listening violation-to-expectation fMRI paradigm where adult participants heard auditory count sequences that were correct (4 5 6 7) or violated at the end (4 5 6 8; consecutiveness) and, orthogonally, that were ordered or unordered (orderedness). Another orthogonal dimension was the manipulation of sensory sequence violation where the voice speaking the numbers was consistent throughout the trial or could change on the last number (voice identity). This 2x2x2 factorial design was analyzed using univariate and multivariate pattern analyses. Three clusters in the right fronto-parietal network (BA44, BA46, and IPS) showed greater neural response to violations to orderedness. Of the three clusters, the anterior IFG (BA46) demonstrated the encoding of consecutiveness. Interestingly, the bilateral STS, which showed a robust effect to violations in voice identity, also demonstrated the encoding of consecutiveness. These results indicate that a right-lateralized fronto-parietal network activity can differentiate between a count list and random numbers, while BA46 and bilateral STS respond specifically to violations of the count sequence, suggesting specific mechanisms in the brain for processing consecutive numbers in both the perceptual and cognitive levels.

Topic Area: OTHER

C102 Mind the gap: Differences in sensory memory throughout development in individuals with Cystinosis

Alaina S. Berruti[1], Ana A. Francisco[1], Douwe J. Horsthuis[1], John J. Foxe[1, 2], Sophie Molholm[1, 2], [1]Albert Einstein College of Medicine, [2]University of Rochester

Cystinosis, a genetic rare disease characterized by cystine accumulation and crystallization, results in significant damage in a multitude of tissues and organs. While Cystinosis' impact on brain function is relatively mild compared to its effects on other organs, the increased lifespan of this population and thus potential for productive societal contributions have led to increased interest in the effects on brain function. Nevertheless, and despite some evidence of structural differences, the neural impact of the mutation is still not well characterized. We tested basic auditory processing in a group of 36 individuals with Cystinosis (6-38 years old) and in neurotypical age-matched controls (n=39). High-density electrophysiology was recorded while participants were presented with a passive duration oddball paradigm using three different presentation rates (stimulus onset asynchrony: SOAs). We examined whether the N1 (basic auditory processing) and mismatch negativity (MMN; sensory memory) significantly differed between groups, and characterized the developmental trajectory of these processes in Cystinosis. Individuals with Cystinosis presented similar N1 responses to their age-matched peers, indicating typical basic auditory processing in this population. The MMN response, however, was clearly reduced in the longer SOAs in the children and adolescents, whereas the adults presented similar responses to the neurotypical controls. These findings suggest shorter lasting auditory sensory memory traces, and thus a sensory memory impairment in younger patients, which seems to be resolved by adulthood. Future work addressing other aspects of sensory and working memory is needed to understand the bases of the differences described here and their implications.

Topic Area: PERCEPTION & ACTION: Audition

C103 Do you hear that? Individual Differences in Alpha-Frequency Connectivity Predict Hyperacusis in Anxiety

Jessica Simon[1], Nika Kartvelishvili[1], Kevin Clancy[1], Wen Li[1], [1]Florida State University

Alpha oscillations (8-12 Hz range) act as an inhibitory mechanism of sensory activity, mediating sensory gating and sensory cortical inhibition. Attenuated alpha oscillations have been implicated in key anxiety symptoms such as hypervigilance. In parallel, impaired sensory gating and heightened sensory responses, especially in the auditory modality, have been reliably observed in anxiety. Relatedly, symptoms of auditory hypersensitivity (aka, hyperacusis) are disproportionately represented in individuals with anxiety. Here, we tested the hypothesis that attenuated alpha oscillations can contribute to hyperacusis

in anxiety. Participants (N = 94) underwent a 3-minute resting-state electroencephalogram (EEG) recording, followed by an anxiety induction manipulation. Before and after anxiety induction, participants also performed intensity ratings to a set of sounds varying in Valence (Fear, Disgust, Neutral) and Loudness (Loud, Medium, Quiet). In support of anxiety-induced hyperacusis, we observed an increase in perceived intensity of loud sounds after anxiety induction [Meanpost-pre(SD)= 2.68 (9.8), p = .01], which was marginally correlated with the magnitude of anxiety induction (r = .182, p = .085). Baseline alpha-frequency connectivity (posterior ï? frontal) marginally correlated with baseline perceived intensity of loud sounds (r = -.177, p = .095). Critically, baseline alpha connectivity predicted the increase in sound intensity following anxiety induction (r = -.264, p = .012) such that individuals with weaker alpha connectivity demonstrated greater levels of anxiety-induced hyperacusis. These results thus implicate an alpha oscillatory mechanism underlying hyperacusis in anxiety where alpha activity attenuation heightens hyperacusis, facilitating and perpetuating sensory hypervigilance in anxiety.

Topic Area: PERCEPTION & ACTION: Audition

C104 Non-specific impact of Transcranial Magnetic Stimulation sound patterns on cortical oscillations and visual detection

Chloé Stengel[1], Adrien Martel[1], Julian Amengual[2], Antoni Valero-Cabre[1], [1]Institut du Cerveau de la Moelle epiniere (ICM), [2]Institut des Sciences Cognitives Marc Jeannerod

The delivery of active pulses of Transcranial Magnetic Stimulation (TMS) generates a brief but loud clicking sound. To cancel the influence of this auditory stimulation, experimental designs contrast active TMS with a sham control condition that mimics this sound. But what is the impact of auditory stimulation associated to sham TMS on brain activity and behavioral performance, and may this impact interact with the effect of active TMS pulses? Here we recorded EEG activity from healthy participants performing a near-threshold visual detection task while they received, pre-target onset, either single pulses or short rhythmic or random bursts of sham TMS. We show that the delivery of sham TMS did not significantly modulate visual sensitivity (d'). However, sham stimulation, either in single pulses or in bursts, modulated the decision criterion of participants, leading them to show a more liberal decision making. In parallel, we found no signs of oscillatory entrainment following the delivery of rhythmic bursts of sham TMS. Nonetheless, single pulses or bursts of sham stimulation induced broadband phase-locking in the auditory cortex. These results strengthen the use of sham control designs in TMS entrainment experiments. Moreover, here we bring evidence that sham TMS does not induce states of neural activity (namely increased fronto-parietal high-beta oscillatory activity) reported elsewhere as contributing to the facilitation of visual perception. Nonetheless, the non-specific effects on perceptual decision-making processes and oscillatory phase-locking here reported call for a better understanding of the effects of sham TMS on brain activity.

Topic Area: PERCEPTION & ACTION: Audition

C105 Effects of musical training on processing speech envelope and temporal fine structure

Lidongsheng Xing[1], Yi Du[1], [1]Institute of Psychology, Chinese Academy of Sciences

A speech waveform could be decomposed into a slowly varying envelope (ENV) and a rapidly varying temporal fine structure (TFS), which contributes to speech intelligibility and noise resistance, respectively. Although the musician advantage in identifying speech in noise has been repetitively found, no study has investigated the musical training effects on perceiving different speech components, namely, the ENV and TFS. Here, repetition accuracy and EEG were recorded in 24 musicians and 24 non-musicians when they listened to speech sentences or 40-s segments containing speech TFS only, ENV only or both (natural speech) in either quiet or noise (SNR: 0dB and 5dB). Consistent with previous findings, musicians and non-musicians did not differ in identifying natural speech sentences in noise, but musicians had higher recognition of TFS speech and lower recognition of ENV speech than non-musicians. EEG inter-trial correlation, cerebro-acoustic coherence and reconstruction accuracy from neural temporal response function consistently found stronger entrainment to speech envelope at delta and theta frequencies in non-musicians than musicians even when it was absent in TFS speech. In comparison, musicians had higher coupling between delta phase and theta amplitude when processing natural speech in noise and TFS speech than non-musicians. Additional brainstem frequency-following response to syllable /da/ showed higher inter-trial phase locking of h1 component in musicians than non-musicians. Our findings suggest that musicians may exhibit higher weighting and better encoding of speech TFS than envelope in chunking and parsing speech, while non-musicians rely more on speech envelope tracking and reconstruction in comprehending speech.

Topic Area: PERCEPTION & ACTION: Audition

C106 An EEG Study Testing the Role of Infants' Motor Experience in the Development of Action Understanding

Bennett Bertenthal[1], Rebecca Hailperin-Lausch[1], Lauren Wade[1], [1]Indiana University

Neural oscillations in the alpha frequency band (i.e., alpha desynchronization) observed over sensorimotor areas of the scalp are associated with both the observation as well as the execution of actions in infants as well as adults. Recent electroencephalographic (EEG) studies suggest a link between infants' motor experience and the development of their action understanding. Nevertheless, the EEG evidence is confounded because the observation of the object during the reach also results in alpha desynchronization as a function of the object's affordance. Moreover, action experience in most previous studies is limited to very brief short-term experiences introduced prior to the testing phase of the study. The current study was designed to control for these problems by testing 6- to 9-month-old infants while they observed an adult reaching for an occluded object with either an ipsilateral or a contralateral reach. Infants begin reaching ipsilaterally approximately 2 to 3 months earlier than they begin reaching contralaterally; thus, this comparison enables a direct test of the contributions of motor experience over developmental time on infants' EEG responses to the observation of goal-directed reaching. EEG was recorded using a 64-channel Geodesic Sensor Net and sampled at 1,000 Hz. The results revealed event related desynchronization during observation of the ipsilateral reach, but not during observation of the contralateral reach. Critically, this effect was observed over the central, but not the occipital scalp area. This condition effect thus provides more definitive evidence supporting the role of motor experience.

Topic Area: PERCEPTION & ACTION: Development & aging

C107 Color and Intensity of flickering light to enhance gamma entrainment and networking

Kanghee Lee[1,2], Yeseung Park[1], Seung Wan Suh[1,2], Ji Won Han[1,2], Jaeho Lee[3], Jaehyeok Park[3], Seunghyup Yoo[3], Ki Woong Kim[1,2], [1]Seoul National University, [2]Bundang Hospital, [3]School of Electrical Engineering, KAIST

Sensory stimulation with 40Hz flickering light could entrain gamma oscillations leading to decreased amyloid ? burden. However, the optimum parameters of a light source to promote brain gamma activity in humans have not suggested yet. For developing a standardized protocol to enhance the synchronization of brain gamma activities in humans, we performed the study to investigate the

optimal intensity and frequency of the flickering light stimulus (FLS) in healthy young adults. We measured electroencephalography (EEG) during the FLS presented. In experiment 1, we applied 10 cd/m2 light with four different colors (white, red, green, and blue). In experiment 2, we applied white light with four different light intensities (10, 100, 400, and 700 cd/m2). Each FLS condition consists of 10 different flickering frequencies from 32Hz to 50Hz with an interval of 2Hz in both experiments. We configured each frequency condition with ten repetitions of 2-sec FLS. Entrained gamma activity started after the FLS onset, lasted during the FLS, and diminished after the FLS offset, which was observed profoundly at the parietal area and steadily decreased from the parietal to the frontal area. Red or white entrains gamma entrainment more effectively than green or blue. The stronger FLS of 400 and 700 cd/m2 entrained higher event-related synchronization (ERS) with stronger functional connectivity. FLS with the lower frequencies than 40Hz entrained significantly higher ERS than the others. Applying the optimal parameters of the FLS validated in this study could accelerate the development of Alzheimer's disease therapies.

Topic Area: PERCEPTION & ACTION: Development & aging

C108 Positive expectation improves perception of mental and physical fatigue in a sequence learning task

Mirta Fiorio[1], Mehran Emadi Andani[1], Paola Cesari[1], Bernardo Villa-Sanchez[1], [1]University of Verona

Learning to perform precise movement sequences underlies many daily-life functions. As many other processes, sequence learning goes through repeated practice sessions until automation is achieved. Intensive repetition induces mental and physical fatigue that in turn cause individuals to give up the training sessions. In this study, we investigated the effects of positive expectations, induced through placebo procedures, in influencing implicit sequence learning and perception of mental and physical fatigue. Ninety healthy volunteers performed a serial reaction time task in three sessions (baseline, training, final). Two placebo procedures were applied in two different experimental groups: a motor placebo procedure consisted in the application of transcutaneous electrical nerve stimulation, TENS (inert), over the hand executing the task; a cognitive placebo procedure consisted in the application of sham transcranial direct current stimulation, tDCS (inert), over the supraorbital area. In both cases, participants received specific verbal information about the positive effects of the treatment (i.e., TENS in increasing muscle activity or tDCS in increasing attention). A control group performed the same task without treatment. Reaction times were measured as index of performance and perception of mental and physical fatigue was measured by means of visual analogue scales. While performance improved independently of the adopted placebo procedure, perception of fatigue was differently modulated by the type of placebo: placebo-TENS reduced only perception of physical fatigue, whereas placebo-tDCS reduced perception of both mental and physical fatigue.

Positive expectation can reduce the perception of mental and physical fatigue, with potential implications to foster sequence skill learning.

Topic Area: PERCEPTION & ACTION: Motor control

C109 Prior Exposure Enhances Cortical Entrainment to Unheard Speech during Silent Lip-reading

Zhewei Cao[1], Aisling O'Sullivan[2], Lauren Szymula[1], Aaron Nidiffer[1], Edmund Lalor[1], [1]University of Rochester, [2]Trinity College Dublin

Neuroimaging research has demonstrated that observing visual speech in the absence of auditory speech activates primary auditory cortex. However, it remains unclear what this activation precisely reflects. It is established that, during continuous auditory speech, neural activity in auditory cortex tracks the temporal envelope of the speech signal. Recently, it has been suggested that this process may reflect a synthesis of the speech stream rather than the encoding of the envelope. In the current study, we look into whether silent lip-reading can elicit a similar 'entrainment' to the envelope in the absence of auditory speech. We trained subjects on 5 audiovisual videos of a speaker, and then asked them to perform a target word detection task to the silent version of the trained videos, as well as 5 novel silent videos of the same speaker. We tracked both behavioral performance and recorded electroencephalography (EEG) data during testing. Results showed that subjects exhibited higher accuracy in trained over novel ones in the target word detection task. Additionally, by reconstructing an estimate of the silent audio speech envelope from the EEG signal, we find that when the speech could be accurately lip-read, the speech envelope can be more accurately reconstructed. Preliminary analysis suggests that this improved envelope tracking was driven by greater encoding of phonetic features of the unheard speech in the case of the trained videos. With these results, we show supporting evidence that silent lip-reading does activate auditory cortex in a way that is meaningfully related to the speech stimulus.

Topic Area: PERCEPTION & ACTION: Multisensory

C110 Assessing and Predicting Efficacy of Dance Intervention for Parkinson's Disease

Anna Krotinger[1, 2], Psyche Loui[1, 3], [1]Wesleyan University, [2]Harvard Medical School, [3]Northeastern University

Parkinson's disease (PD) is associated with a loss of internal cueing systems, affecting rhythmic motor tasks such as walking and entrainment. Music and dance encourage spontaneous rhythmic coupling between sensory and motor systems; this has inspired the development of dance programs for PD. Here we assessed the therapeutic outcome of dance classes for PD, as measured by neuropsychological assessments of disease severity as well as quantitative assessments of sensorimotor experience. We assessed prior music and dance experience, beat perception (Beat Alignment Test), sensorimotor coupling (tapping to high- and low-groove songs), and disease severity (Unified Parkinson's Disease Rating Scale in PD individuals) before and after four months of weekly dance classes. PD individuals performed better on UPDRS after four months of weekly dance classes, suggesting efficacy of dance therapy. Greater post-intervention improvements in UPDRS were associated with the presence of prior dance experience and with more accurate sensorimotor coupling, especially as assessed by tapping to low-groove songs. Prior dance experience was additionally associated with enhanced sensorimotor coupling during tapping to both high-groove and low-groove songs. These data suggest that dance classes for PD improve both qualitative and quantitative assessments of disease symptomology. The association between these improvements and dance experience suggests that rhythmic motor training, a mechanism underlying dance training, impacts the therapeutic outcome of dance classes for PD.

Topic Area: PERCEPTION & ACTION: Multisensory

C111 The relationship between sign language fluency and mental rotation: An EEG study

Emily Kubicek[1], David Thornton[1], Lorna Quandt[1], [1]Gallaudet University

Past work investigating spatial cognition suggests better mental rotation abilities for those who are fluent in a signed language. However, no prior work has investigated if fluency is needed to achieve this performance benefit and what it may look like on the neurobiological level. We used EEG to examine deaf fluent signers (n=18), hearing fluent signers (n=16), hearing non-fluent signers (n=17), and hearing non-signers' (n=15) performance on a classic

mental rotation task. We hypothesized that mental rotation abilities are enhanced only when sign language fluency is attained, most notably for deaf fluent signers. In line with our behavioral prediction, deaf fluent signers and hearing fluent signers scored significantly better than hearing non-fluent signers and hearing non-signers (p=.02), suggesting a high level of sign language comprehension is needed for significant performance enhancements in mental rotation abilities. In a correlation analysis, we discovered that as sign language skills increase, mental rotation improves, regardless of hearing status (p=.001). We further hypothesized that this behavioral enhancement can be seen through differential responses of sensorimotor system EEG activity. Time-frequency activity in alpha and beta ranges were computed for each condition at frontal and central sites overlying the sensorimotor cortex. Contrary to our prediction, results show similar activity across groups in response to stimuli, suggesting similar strategies are being used regardless of sign language knowledge or mental rotation abilities. We also conducted multiple exploratory analyses on mental rotation abilities, sign language knowledge, and past spatial experiences.

Topic Area: PERCEPTION & ACTION: Other

C112 Formation of face-related predictions: An interplay of prestimulus ?/? enhancement and peristimulus N170 diminution

Marlen A. Roehe[1], Daniel S. Kluger[1], Svea C. Y. Schroeder[1], Lena M. Schliephake[1], Jens Bölte[1], Axel Kohler[2], Ricarda I. Schubotz[1], [1]University of Muenster, [2]University of Frankfurt

Our environment confronts us with a highly dynamic nature, veiling a cascade of statistical regularities. Explicitly, these regularities often go unnoticed whilst traces of implicit learning are evident in neural activity. Recent perspectives have offered convincing evidence that both prestimulus oscillations and peristimulus event-related potentials are reliable biomarkers of implicit anticipation during statistical learning. What remains ambiguous, however, are temporal aspects underlying the genesis of predictions. To address this issue and determine a timeframe confining the formation of predictions, prestimulus increases in alpha and beta power were examined in relation to a reduction of the early N170 face-sensitive component. EEG was acquired from naive participants (n=35) who engaged in a 'cover-up' gender discrimination task. Participants were unaware, however, that eight face images were sorted into four reoccurring pairs - the first image invariably preceded the second image - and were pseudorandomly hidden amongst sequences of arbitrary face images. As hypothesized, we found a reduced N170 amplitude for anticipated compared to unanticipated images over temporal and temporo-parietal electrodes. Furthermore, enhanced alpha and beta power was evident prestimulus for anticipated in comparison to unanticipated faces. Of particular interest, however, was the early onset of alpha/beta power enhancement which commenced as early as -1.75 seconds prior to onset of the anticipated faces. Our findings thus provide evidence of a systematic correspondence between prestimulus alpha/beta enhancement and peristimulus N170 diminution, suggesting an approximate timeframe in which the formation of face-related predictions can be observed.

Topic Area: PERCEPTION & ACTION: Other

C113 Male Observers use Facial Sexual Dimorphism to make Physical Dominance Assessments Following Brief Exposure

Graham Albert[1], Erika Wells[1], Steven A. Arnocky[2], Changhong Liu[3], Carolyn R., Hodges-Simeon[1], [1]Boston University, [2]Nipissing University, [3]Bournemouth University

Research on facial dominance perceptions has consistently demonstrated the faces manipulated to appear more masculine (i.e., masculinized) are rated as more dominant than those manipulated to appear more feminine (feminized). However, these studies have relied on forced-choice paradigms, which are susceptible to demand characteristics. To circumvent these problems, we test if manipulating the sexual dimorphism of faces effects men's dominance perceptions when these faces are presented individually, and for one-hundred milliseconds, reducing the time available to assess facial features. We predicted that men would assign higher dominance ratings to masculinized faces, and that they would remember these faces better in a follow up recognition memory test. In two experiments 46 men were presented with masculinized and feminized facial photographs and rated physical dominance. In Experiment 2, the facial photographs were set to an oval shape, to control for the effects that face outline may have had on dominance ratings. Men assigned significantly higher dominance ratings to masculinized faces, suggesting that they can appraise differences in facial sexual dimorphism following brief exposure. This effect occurred regardless of whether men were presented with complete facial photographs or photographs set to an oval, suggesting that observers were relying on internal facial features. The rating phase was followed by a surprise recognition memory test where participants classified faces as either old or new. Men correctly classified more masculinized men's faces as old, providing evidence that facial sexual dimorphism is a salient feature that men attend to during dominance assessments.

Topic Area: PERCEPTION & ACTION: Vision

C114 MRI structural analysis of cortical thickness and tissue integrity in developmental prosopagnosia

Joseph DeGutis[1,2], Jirapat Likitlersuang[1,2], David Salat[1], [1]VA Boston Healthcare System, [2]Harvard Medical School

Face recognition is crucial to social functioning and is severely impaired in developmental prosopagnosics (DPs), individuals with lifelong face recognition deficits. DPs have shown to have reduced face-selective responses in the fusiform face area (FFA), a key face processing node in the ventral temporal cortex, as well as decreased white matter integrity in tracts originating from the FFA. However, studies have yet to investigate cortical thickness and macromolecular tissue differences in the FFA between DPs and controls. In this study, we examined the T1-weighted magnetic resonance imaging (MRI) scans as well as collected T1 quantitative MRI scans of 25 developmental prosopagnosics and 24 healthy controls. The statistical group difference of the cortical thickness were computed using General Linear Model (Freesurfer's mri_glmfit) followed by permutation clusterwise analysis (mri_glmfit-sim).The region of interest generated within the right FFA was selected for mean cortical thickness calculation. The result revealed a significantly thicker cerebral cortex among individual with DP compared to control in the FFA sub-region. Furthermore, a preliminary quantitative MRI results also showed shorter proton relaxation time (T1) in controls compared to DPs within FFA, indicative of reduced macromolecular tissue integrity in DPs. These results reinforce that structural integrity and functioning of the right FFA is crucial for successful face recognition and suggests that DPs' thicker and less marcomolecularly rich FFA is consistent with poor or incomplete development of this region.

Topic Area: PERCEPTION & ACTION: Vision

C115 Action Associations Bias Perception

Dick Dubbelde[1], Sarah Shomstein[1], [1]The George Washington University

Neuroimaging studies of object recognition have revealed that object processing is largely a result of computations within the dorsal and ventral visual streams. Each stream is differentially recruited depending on object identity. Objects with strong action associations (e.g., tools) recruit dorsal regions more than non-tool objects, which are more reliant on ventral

processing. We hypothesized that if this differential functional recruitment is indeed meaningful, it should have behavioral consequences. Due to the relative proportions of magno- and parvo-cellular input to each stream, processing along the dorsal stream, such as when a tool is seen, should have higher temporal sensitivity, while processing along the ventral stream, such as when a non-tool is seen, should have higher spatial sensitivity. We test this hypothesis using two tasks: gap detection, testing the spatial resolution of the ventral parvocellular processing, and object flicker discrimination, testing the temporal resolution of the dorsal magnocellular processing. Across four experiments we show (1) a non-tool advantage in spatial resolution, (2) a tool advantage in temporal discrimination, (3) that this advantage is reduced by impeding object recognition through inversion, and (4) that this advantage diminishes when suppressing magnocellular processing with red light. These results demonstrate perceptual differences in object processing arising from differential recruitment of the two processing streams, such that tools, which recruit the more magnocellular dorsal stream regions have higher temporal resolution, and non-tools, which are reliant on the more parvocellular ventral stream regions, have higher spatial resolution.

Topic Area: PERCEPTION & ACTION: Vision

C116 Representation of visual information for rapid motor responses

Rajendran Pottayil[1], Marjan Persuh[1], [1]Borough of Manhattan Community College

Visual perception has limited capacity. We can attend only to a limited amount of information and we can track only few objects at a time. It is conceivable that visual information is represented differently for different tasks; however, capacity limitations might affect all visual pathways at the encoding stage of the visual system. We tested our prediction in a paradigm that differs substantially from attentional and object tracking tasks and requires rapid motor responses: a response priming, in which a preceding prime activates or inhibits response to a target. In a set of three experiments, participants responded to stimuli of different orientations, shapes, or colors. A single prime together with a varying number of distractors was presented in a circular arrangement while targets were presented at the center. Participants made speeded responses to the targets. Our results show that priming decreased as the number of distractors increased, suggesting that capacity for simultaneous representation of visual information is limited for rapid motor responses. However, all features were not represented with equal efficiency. We found that as the number of distractors increased, priming dropped faster for orientation and for a set size of six was practically eliminated. Priming for shape and orientation was stronger and still detectable at the highest set sizes. Our results demonstrate that visual information representation is limited in capacity even for response priming, suggesting a general limitation for all visual pathways. Furthermore, capacity limitations are feature specific and color, in particular, shows higher representational capacity than other features.

Topic Area: PERCEPTION & ACTION: Vision

C117 A brief period of postnatal visual deprivation permanently alters visual motion processing in early visual regions

Mohamed Rezk[1], Stefania Mattioni[1], Junghyun Nam[2], Zhong-Xu Liu[3], Xiaoqing Gao[4], Terri Lewis[5], Daphne Maurer[5], Olivier Collignon[1], [1]Université Catholique de Louvain (UCLouvain), [2]University of Toronto, [3]University of Michigan-Dearborn, [4]Zhejiang University, [5]McMaster University

How does early visual experience shape the development of the visual motion network? To address this question, we used functional magnetic resonance imaging to characterize the brain response elicited by visual motion in adults born with dense bilateral cataract that was treated early in life. Our results suggest that early cataract patients showed reduced recruitment of the early visual areas while processing motion information when compared to matched controls with typical visual development. Interestingly, no alterations were observed in the higher-order visual motion area hMT+/V5. Psychophysiological interaction analyses demonstrated reduced interhemispheric connectivity in V1, and reduced connectivity between bilateral hMT+/V5 and V1 during visual motion processing. The altered connectivity profile of V1, but not hMT+/V5, in cataract-reversal patients was confirmed using independent data collected without the subjects being involved in a specific task (resting-state). Altogether these results suggest that a brief and transient period of visual deprivation early in life has a region-specific impact on the visual motion network with V1 being permanently affected while hMT+/V5 shows resilience to deprivation.

Topic Area: PERCEPTION & ACTION: Vision

C118 Fast periodic visual stimulation marker of face identity impairment in developmental prosopagnosia

Kevin Spencer[1], Elyana Saad[1], Maruti Mishra[1], Joseph DeGutis[1], [1]Harvard Medical School

Developmental prosopagnosia (DP) is characterized by severe lifelong face recognition deficits. Researchers have sought to identify an objective neural marker to better understand and diagnose DP. Fast periodic visual stimulation (FPVS) EEG is one potentially efficient method to reliably identify dysfunctional face processing. Here we used FPVS in 30 individuals with DP and 25 matched control participants to determine which aspects of face processing might be dysfunctional in DP. In our FPVS paradigms, participants performed a color change-detection task at fixation while in the background, an image category was repeated at 6 Hz while an oddball image was presented every 5th image (1.2 Hz). The signal-to-noise ratio (SNRs) of the oddball frequency and its harmonics were computed in the frequency domain at occipito-temporal electrodes sensitive to face processing (PO7/8, P9/10). The tasks were upright face identity (novel face oddball amongst presentations of the same repeated face), inverted face identity (inverted novel face amongst same inverted face), face vs. object (face oddball amongst objects), famous face identity (famous face oddball amongst non-famous faces). We found a significant reduction of SNR for the oddball frequency and harmonics in DPs compared to controls in the upright face identity task. No significant differences between DPs and controls were found in the other tasks. These FPVS results are consistent with DPs' pronounced difficulties in matching novel face identities and recognizing newly learning faces. The FSVP method may be useful as a rapid means to test face perception mechanisms in DP.

Topic Area: PERCEPTION & ACTION: Vision

C119 Putting visual object recognition in context

Mengmi Zhang[1, 2], Claire Tseng[2], Gabriel Kreiman[2], [1]Boston children's hospital, [2]Harvard College

Context plays an important role in visual recognition. Recent studies have shown that visual recognition networks can be fooled by placing objects in inconsistent contexts (e.g. a cow in the ocean). To understand and model the role of contextual information in visual recognition, we systematically and quantitatively investigated ten critical properties of where, when, and how context modulates recognition including amount of context, context and object resolution, geometrical structure of context, context congruence, time required to incorporate contextual information, and temporal dynamics of contextual modulation. The tasks involve recognizing a target object surrounded with context in a natural image. As an essential benchmark, we first describe a series of psychophysics experiments, where we alter one aspect of context at a time, and quantify human recognition accuracy. To computationally assess

performance on the same tasks, we propose a biologically inspired context aware object recognition model consisting of a two-stream architecture. The model processes visual information at the fovea and periphery in parallel, dynamically incorporates both object and contextual information, and sequentially reasons about the class label for the target object. Across a wide range of behavioural tasks, the model approximates human level performance without retraining for each task, captures the dependence of context enhancement on image properties, and provides initial steps towards integrating scene and object information for visual recognition.

Topic Area: PERCEPTION & ACTION: Vision

C120 Catching the Visual System in Action: A Modified Event-Related Potential Paradigm for Dynamic Stimuli

Shan Zhang[1], Ayse P. Saygin[1], [1]University of California, San Diego

Perceiving biological motion (BM), the movements and actions of other living entities, is critical for human behavior and social interaction. Despite the inherently dynamic nature of these stimuli, much remains to be understood about the temporal aspects of BM processing. The event-related potential (ERP) technique provides excellent temporal resolution, but typically involves time-locking to overall stimulus onset, which can make it difficult to explore subtler and ongoing aspects of processing for dynamic stimuli. We developed a variant of the ERP method, to apply sparse visual events onto continuously presented, dynamic stimuli. Subjects viewed point-light walkers (PLWs) depicting BM with black dots corresponding to the joints of a moving body. A contrast reversal (i.e., change to white dots), aimed to induce a feed-forward wave of processing, was applied to individual frames at an average rate of 3/s, without disturbing the continuity of motion. Each trial featured either an intact or a spatially-scrambled PLW matched for local motion and motion energy. Responses to the contrast-reversal frames showed the expected visual ERP componentry and distribution, indicating the feasibility of our approach. Furthermore, the occipital P1 (90-110ms) and parietooccipital N1 (150-170ms) components were enhanced for intact vs. scrambled PLWs. Further frame-level analyses showed that while the response to the stimulus onset can dominate evoked potentials to dynamic stimuli, our ERP paradigm provides a promising approach to study the temporal aspects of BM processing by acting as a probe to 'catch the visual system in action'.

Topic Area: PERCEPTION & ACTION: Vision

C121 Clarifying the Role of the Medial Prefrontal Cortex During Metacognition: Revelations from a 'Maybe' Judgment

Hillary Erwin[1], Tasnuva Enam[1], Deborah Eakin[2], Ian McDonough[1], [1]The University of Alabama, [2]Mississippi State University

Metacognition refers to an awareness of one's knowledge and ability to understand, control, and manipulate their own cognitive processes. A common way to measure metacognition is to directly ask people to predict their current learning state via judgments of learning (JOLs), which are subjective ratings concerning whether information will be remembered later. Prior research suggests that brain regions within the Default Mode Network (DMN), especially the medial prefrontal cortex (mPFC), are involved in making JOLs, but its computational role has yet to be identified. In a preregistered study (https://osf.io/sp5hn), we attempted to adjudicate between three theoretical perspectives about the bases of JOLs: Somatic Marker (emotionally guided), Feeling of Rightness (contextually appropriate), and Task Engagement (self-referential processing) Hypotheses. Twenty participants made JOLs on a 1-3 scale (Likely, Maybe, Unlikely) after viewing picture pairs during fMRI scanning. All hypotheses predicted that mPFC activity would be greater for Likely than Unlikely judgments, which was found. Each hypothesis made different predictions regarding the Maybe judgment, either higher than both Likely and Unlikely or mid-way between the two; however, brain activity was lowest for Maybe judgments. Rather than create emotional sensation or elicit more self-referential processing, the uncertainty of Maybe judgments might shut down pathways associated with ongoing decision making. Only the Feeling of Rightness hypothesis predicted higher mPFC activation for Likely over Maybe judgments. The unexpected decrease in mPFC activity relative to Unlikely judgments might then be due to the continuing unresolved uncertainty relative to the other two judgments.

Topic Area: THINKING: Decision making

C122 Differential Striatal Responses During Moral and Economic Value-Based Decision-Making

Yu-Hsuan Kao[1], Chi-Chuan Chen[1], Yu-Shiang Su[1], Chien-Te Wu[1], Joshua Oon Soo Goh[1], [1]National Taiwan University

In this study, we investigated neurobehavioral processes underlying value-based decisions over variable amounts of money or human lives. We hypothesized that decisions involving monetary and human life forfeiture would reflect utilitarian and non-utilitarian strategies, respectively. We scanned 29 participants (mean age(SD)= 24.1(3.1) years; 16 females) in a functional magnetic resonance imaging (fMRI) moral choice task (MCT) experiment. Participants underwent four blocked conditions each consisting first of text describing a hypothetical scenario followed by 10 associated choice trials. In Cash-Cash blocks, scenarios described cash stakes. For each following choice trial, participants saw different initial cash expected values (EV), defined by varying probabilities and amounts, as well as an alternative cash EVs. Participants either accepted the initial EV or forfeited NT$10 million in exchange for the alternative, which could yield better or worse overall outcomes. Cash-Life blocks involved saving or sacrificing human lives with cash forfeit option to alter expected number of lives. Life-Cash blocks involved money with option to forfeit one life to alter cash EVs. Life-Life blocks involved human lives with one-life forfeit option to alter expected number of lives. Forfeiture rates over expected loss to gains and reaction time remained low for Life-Cash. For all other conditions, forfeiture rates were low for expected losses and switched to high for expected gains, reflecting utilitarian behavior. Critically, neural responses in the striatal areas were higher for Life-Cash and Life-Life than Cash-Life and Cash-Cash conditions. Our findings reveal differential involvement of striatal processes when deliberating moral and economic values in decision behavior.

Topic Area: THINKING: Decision making

C123 Classifying individuals into 'info types' based on information-seeking motives

Christopher Kelly[1], Tali Sharot[1], [1]UCL

The human pursuit for information drives intellectual development and social engagement. Here, we test whether individuals can be categorized into 'info-types' according to their motives for seeking knowledge expressed in information-seeking decisions. We further test if this classification provides clues about latent psychiatric conditions. Participants indicated whether they wanted to receive 40 different pieces of information related to themselves. They also rated (i) how useful each piece of information will be, (ii) its likely impact on their affective state, and (iii) how often they think about it. Cluster analysis revealed three well-defined 'info-types'. The first type included participants that made information-seeking decisions based predominately on whether information was useful ('Action Group'). The second included participants who primarily took into account the expected influence of information on their affect ('Affect Group'). The third type consisted of participants who predominately made information-seeking decisions based on the frequency in which they think about the information in question ('Cognitive

Group'). The 'Affect group' reported the most trans-diagnostic psychopathology symptoms and the 'Cognitive group' the least. The data suggests that information-seeking behavior can be indicative of mental health. Thus, the research may inform the development of new screening tools based on information-seeking patterns.

Topic Area: THINKING: Decision making

C124 Disentangling the influences of positive and negative incentives on cognitive effort

Xiamin Leng[1], Debbie Yee[1], Amitai Shenhav[1], [1]Brown University

When deciding how much effort to invest in a given task, people weigh both potential positive outcomes that one would accrue (e.g., praise) as well as potential negative outcomes such efforts would avoid (e.g., admonishment). Yet research into the basis of cognitive effort has largely focused on how people respond to positive incentives. Here, we sought to distinguish adjustments of cognitive effort motivated by positive versus negative incentives, and to further dissociate between different kinds of effort adjustments that can result under threat of a negative outcome -- namely, the choice to work more vigorously or more cautiously. To quantify these incentive effects, we developed a novel Incentivized Cognitive Effort Task, in which participants are given fixed time intervals to complete as many trials as they want of a Stroop task. We vary the positive incentives for performance (monetary gain for each correct response; Studies 1-3) and two forms of negative incentives: monetary loss avoidance for responding correctly (negative reinforcement; Study 2) vs. penalty for responding incorrectly (punishment; Study 3). Participants correctly completed more trials with increasing reinforcement, and even more so under negative vs. positive reinforcement, whereas they completed fewer trials (but were more accurate) with increasing potential punishment. Drift diffusion models revealed that this dissociation between cognitive effort strategies could be accounted for by reinforcement vs. punishment differentially increasing evidence accumulation (drift rates) vs. response thresholds. These findings provide an important foundation for a better understanding of the mechanisms driving individual differences in real-world cognitive effort investment.

Topic Area: THINKING: Decision making

C125 Navigational Agency Modulates Neural Representations of Spatial Environments

Yi-Chaung Lin[1], Ya-Ting Chang[1], Charlotte Maschke[2], Joshua Oon Soo Goh[1], [1]National Taiwan University, [2]Technical University Dresden

Spatial navigation (SN) involves forming accurate neural representations of the environment usually with movement actions that involve making navigational decisions. However, how navigational agency in SN modulates neural spatial representations remains unclear. We evaluated the effects of navigational decision-making on SN-related neural responses under conditions of internally (Free) vs. externally (Tour) generated navigational steps. 17 participants (23.7±2.5 yrs old, 7 females) underwent a SN functional magnetic resonance imaging (fMRI) experiment in virtual mazes consisting of 12 landmarks. In the Free condition, participants first freely navigated a maze in the first person to learn landmark locations. During testing, participants started at various locations, and determined distances then navigated to target landmarks. In the Tour condition, participants viewed first-person videos guiding them through the landmarks and then did the same spatial retrieval test. All participants underwent both learning conditions in different mazes in counterbalanced order. Direction judgement errors were greater ($t(16) = 2.29$, $p < .05$) and navigational time to targets were longer ($t(16) = 2.36$, $p < .05$) for the Tour than Free condition. During maze learning, brain responses were generally higher for Free than Tour in anterior cingulate cortex (ACC) and thalamus, but higher for Tour than Free in orbitofrontal cortex. Comparing maze junction to traversing periods, brain responses were higher for Free than Tour in hippocampus and thalamus during maze learning, but in ACC during retrieval navigation. Our findings demonstrate more accurate spatial representations under navigational agency that implicate neural processes in the ACC, thalamus, and hippocampal areas.

Topic Area: THINKING: Decision making

C126 The Effect of Phasic Arousal on Risky Choice in Younger and Older Adults

Margot Sullivan[1], Ringo Huang[2], Joseph Rovetti[1], Erika Sparrow[1], Julia Spaniol[1], [1]Ryerson University, [2]Davis School of Gerontology, USC

Anecdotal evidence suggests that choices we make 'in the heat of the moment' are often different from those we make while 'cool and collected'. In younger adults, arousal has been shown to promote simple decision strategies and preference for low-risk options, but little is known about the influence of arousal on decision making in older adults. In light of recent evidence of age-related declines in the locus coeruleus-norepinephrine system, we predicted a reduced influence of arousal on risky choice in older adults. Healthy younger and older participants made a series of choices between smaller-safer and larger-riskier financial gains. Each choice was preceded by a high-arousal or a low-arousal sound clip. Three conditions were compared within subjects: low-arousal baseline trials, low-arousal trials embedded in mixed blocks, and high-arousal trials embedded in mixed blocks. Pupil dilation was continuously recorded as an index of task-evoked arousal. Both age groups showed significant modulation of pupil dilation as a function of the arousal manipulation, but behavioral results offered only partial support for the hypothesized effects of arousal on choice. Arousal produced shorter decision times in both age groups, consistent with an effect of arousal on decision thresholds. Furthermore, younger adults were more risk-averse, and showed greater sensitivity to expected value, compared with older adults. However, these patterns were not significantly modulated by arousal. Jointly, these findings help inform current theories of the effects of arousal on information processing in younger and older adults.

Topic Area: THINKING: Decision making

C127 Understanding brain pattern complexity and interactivity in naturalistic processing

Lucy L. Owen[1], Jeremy Manning[1], [1]Dartmouth College

Naturalistic processing requires coordinated activity patterns across our brain. In order to understand the dimensionality of neural activity patterns, and changes in the complexity of brain activity patterns over time, we used an fMRI dataset collected by Simony et al. (2016) in which cognitive richness was manipulated. Specifically, participants listened to an audio recording of a story, as well as scrambled versions of the same story (where the scrambling was applied at different temporal scales). We applied dimensionality reduction algorithms to the activity patterns in each experimental condition. We sought to understand the 'dimensionality' of the neural patterns that were sufficient to decode participants' listening times (or approach was similar to that of Mack et al. 2017). We trained classifiers with the same neuroimaging dataset using more and more principle components to decode the precise time when a given neural patterns was recorded. We found that even low-dimensional embeddings of the data were sufficient to accurately decode listening times from the intact story recording, whereas finer temporal scramblings of the story required higher-dimensional embeddings of the data to reach peak decoding accuracy.

Topic Area: THINKING: Other

C128 Computer code comprehension shares neural resources with formal logic and math

Yun-Fei Liu[1], Marina Bedny[1], Colin Wilson[1], [1]Johns Hopkins University

Computer programming is a recent cultural invention that makes use of neural circuits evolved for other cognitive domains. We investigated which neural mechanisms are 'recycled' to support code comprehension. While undergoing fMRI, eleven expert-programmers (>5 years of experience) performed a code comprehension task and four non-programming tasks previously hypothesized to share neural resources with coding: language comprehension ('The lawyer that the banker irritated ...'), symbolic math (e.g., 17-3=X), formal logic (If X and Y, then Zâ?¦), and executive control (multisource interference task MSIT) (Monti et al., 2009, PNAS & Kanjlia et al., 2016, PNAS). In the code-comprehension task, participant saw trials with real or fake code. Real code trials began with a Python function implementing character manipulations (24 seconds), followed by an input string (6 seconds), and then a possible output (6 seconds). Participants judged whether the output was correct. On analogous fake code trials, participants saw a word-level scrambled version of a Python function, followed by a fake input and fake output. They judged whether the fake output string had appeared in the fake function. The real vs. fake code contrast revealed a consistent left-lateralized network of regions across individuals: dorsal and ventral lateral frontal cortex, intra-parietal sulcus, and posterior temporal cortex. A high degree of overlap was observed among neural responses to code comprehension, formal logic, and math. However, there was little overlap with language. These results suggest that the domain general executive network is crucial for expertise in culturally derived symbol manipulation.

Topic Area: THINKING: Problem solving

C129 Neural Correlates Underlying Passive and Active Abstract Rule Inferencing

Wan-Rue Lin[1], Yu-Shiang Su[2], Joshua Oon Soo Goh[1], [1]National Taiwan University, [2]Academia Sinica

Forming inferences about the environment can be an active process, whereby hypotheses drive actions to modify inferences, or passive, whereby inferences are modified based only on observation data. This study evaluated neural correlates underlying the engagement of active relative to passive inference processing. 20 participants (23.8±5.1 yrs old, 7 females) underwent a rule-learning task functional magnetic resonance imaging (fMRI) experiment. In the Active condition, participants first observed three blank circles in triangular arrangement and then chose to fill each with either red, yellow, or blue colors for the cue phase. Participants then answered whether the color cue configuration they chose was classified as a red, yellow, or blue color category. Feedback was then provided based on predetermined cue-category association rules. The Passive condition was similar except that color cue configurations were predetermined. Behavioral performance times and tries-to-criterion were similar for both inference types. Nevertheless, Active neural responses were higher than Passive during observation in bilateral superior frontal areas. Cue phase Active responses increased but Passive responses decreased in the left inferior parietal region and were higher than Active across bilateral visual, superior parietal, striatal, and orbitofrontal, and left thalamus, precentral, and supplementary motor areas. Answer phase responses across bilateral inferior temporal, insula, putamen, and medial frontal and supplementary motor areas decreased for Passive but increased for Active conditions. Feedback responses in left putamen and insula, and right parahippocampal areas decreased for Active but increase for Passive conditions. These findings characterize progressive neural processing stages involved during generation of hypothesis-driven actions.

Topic Area: THINKING: Reasoning

C130 Decoding Pre-trial Pupil Diameter from EEG dynamics in an Auditory Oddball Task

Blake L. Elliott[1], Deanna L. Strayer[1], Matthew K. Robison[1], Chris Blais[1], Samuel M. McClure[1], Gene A. Brewer[1], [1]Arizona State University

The adaptive gain theory posits that the locus coeruleus-norepinephrine (LC-NE) system is crucial in regulating arousal and task-engagement. Importantly, this theory hypothesizes that tonic activation of the LC-NE system has an inverted U-shaped relationship with task engagement and performance. The current study is direct replication and extension of Murphy et al. (2011) which investigated two proposed psychophysiological biomarkers of the LC-NE system: pupil diameter and the P3 event-related potential (ERP). Data was collected during a two-stimulus auditory oddball task. We replicate the results from Murphy et al. (2011). Pre-trial pupil diameter exhibited and inverted U-shaped relationship with P3 amplitude. Furthermore, decoding methods were used to predict pre-trial pupil diameter from ERP scalp topographies and oscillatory activity. The results provide evidence for the adaptive gain theory, as well extend our understanding of different ERP and oscillatory dynamics that may underlie arousal and task-engagement.

Topic Area: ATTENTION: Auditory

Session D

Monday, March 16, 8:00–10:00 am, Exhibit Hall C

D1 Evoked responses to auditory vs. visual attentional cues in auditory spatial discrimination

Norbert Kopco[1, 2], Rene Sebena[1], [1]Safarik University, Kosice, [2]Boston University

A spatial attention task using the Posner paradigm was employed to examine whether directing automatic auditory spatial attention affects listeners' performance and how neuronal activity changes during task performance. In a previous study (Kop?o et al, 2018, 'Visual vs. auditory attentional cueing and auditory spatial discrimination', Cognitive Neuroscience Society, 2018, Poster E3), we found 1) better performance following a visual cue vs. auditory cue, mainly driven by a decrease in performance when the auditory cue was presented from an incongruent location; and 2) that target-elicited ERP amplitudes of the late auditory components covaried with the observed behavioral performance. The current study focused on the ERPs elicited by the auditory cues, while also considering the effect of the visual cues. Auditory-evoked N1 component varied for different combinations of hemispheric laterality and cue position, but not as a function of cue validity. Analysis of responses in the 100-400ms interval did not find clear evidence of auditory-evoked occipital potential contralateral to an auditory cue (ACOP), previously reported as a correlate of attentional processing. However, later components (400-700ms) varied for different combinations of hemispheric laterality, cue position, and cue validity. These results suggest that an automatic auditory spatial cue can cause attentional modulation in the primarily visual occipital areas at delays larger than those previously reported for ACOP. [Work supported by EU H2020-MSCA-RISE-2015 grant 691229, VEGA 1/0355/20]

Topic Area: ATTENTION: Auditory

D2 Differential brain functional network topology disruptions in children with ADHD, ASD and ASD comorbid with ADHD

Shih-Jen weng[1], Xing Qian[1], Min Sung[1], Beatrice Rui Yi Loo[2], Juan Helen Zhou[3], [1]Institute of Mental Health, Singapore, [2]Duke-National University of Singapore Medical School, [3]National University of Singapore

Attention deficit hyperactive disorder (ADHD) and autism spectrum disorder (ASD) are two of the most common neurodevelopmental disorders and frequently occur together. Although the two disorders share many behavioral and neuropsychological characteristics, most functional magnetic resonance imaging (fMRI) studies examined only one of the disorders at a time and few studies investigated the comorbid of the two disorders. This study aimed to compare brain functional network changes derived from task-free fMRI data in children with ADHD, ASD, comorbid of ASD and ADHD (ASD+ADHD) with healthy controls (HC). Functional connectivity (FC) within and between brain networks at the individual level were derived based on a whole-brain functional parcellation containing 144-region-of-interest (ROIs). We found both ADHD and ASD+ADHD groups exhibited reduced anti-correlation between default mode network and attention networks, and increased FC between subcortical and task-positive networks compared with HC. In contrast, children with ASD did not have functional segregation loss and showed a trend of reduced FC between subcortical and task-positive networks and within subcortical network compared to HC. Moreover, the revealed between-network segregation reduction was more severe in ASD+ADHD group than ADHD or ASD groups. Importantly, the reduced functional segregation was associated with more severe behavioral problems including internalizing problems, attention problems, and social problems across all the patients. These results indicated divergent patterns of functional brain network topology disruptions across the three groups and highlighted reduced functional segregation between the default and attention networks in children with ADHD symptoms regardless whether it is co-occurred with ASD.

Topic Area: ATTENTION: Development & aging

D3 Disentangling top-down and bottom-up influences on blinks in the visual and auditory domain

Mareike Brych[1], Supriya Murali[1], Liyu Cao[1], Barbara Haendel[1], [1]University of Wuerzburg

Sensory input can drive the modulation of blinking, but also cognitive factors were suggested to have an effect. We aimed to dissociate bottom-up from top-down influences on blink probability and timing. Participants performed a detection task (without immediate response) including frequent standards, and infrequent distractors and targets in different modalities. Our data (n = 28) revealed that visual input leads to stronger blink modulation than auditory input. Nevertheless, if the input is associated with a task, the modulation is significantly increased, similarly in the two domains. In contrast, during bimodal input a mere shift of attention to visual or auditory input did not lead to a changed modulation after stimulus onset. However, when assessing the time before stimulus onset, we found a significant pre-stimulus decrease in blink probability, but only if attention was on the visual input. This matched the finding during the unimodal visual condition. Interestingly, blink latency was significantly higher for target vs. standard and distractor. A follow-up experiment (n = 18) further revealed that when the distractor consisted of a stimulus omission, latencies were shifted and comparable to those after a target stimulus. Our data suggests that two independent processes have an effect on our blinking. One suppresses blinks before sensory input whenever attention is turned to a visual task, the other increases blink probability after sensory input, no matter if the task is in the visual or auditory domain. The time point of this increase might be a possible marker to disentangle top-down vs bottom-up influences.

Topic Area: ATTENTION: Multisensory

D4 Transcranial direct current stimulation improves sustained attention in breast cancer survivors

Alexandra M. Gaynor[1], Denise Pergolizzi[2], Yesne Alici[3], Elizabeth Ryan[3], Katrazyna McNeal[3], Tim Ahles[3], James Root[3], [1]Memorial Sloan Kettering Cancer Center, [2]Universitat Internacional de Catalunya, [3]Memorial Sloan Kettering Cancer Center

Transcranial direct current stimulation (tDCS) has been shown to alter attention performance in healthy individuals and some clinical populations, but no studies to date have tested whether tDCS may improve attention difficulties in cancer survivors with cancer-related cognitive dysfunction. In a within-subjects study of 16 breast cancer survivors, we compared the effects of 2 consecutive days of active tDCS over the dorsolateral prefrontal cortex to 2 days of sham tDCS on performance during a continuous performance test of attention. Results of mixed linear models controlling for age and individual differences in stimulation-related sensations showed that during active stimulation, participants had significantly lower standard errors of reaction times, indicating better sustained attention ability, as compared to during sham stimulation. Furthermore, because participants are expected to have longer and more variable reaction times with longer inter-stimulus intervals (ISIs), we analyzed effects of tDCS on mean reaction times and standard errors of reaction times within task blocks of 1-second, 2-second, and 4-second ISIs. We found no significant difference in performance between sham and active tDCS for 1- and 2-second ISIs, but for 4-second ISIs, stimulation reduced mean reaction times and variability in reaction times relative to sham. Taken together, results suggest tDCS over the prefrontal cortex may be an effective intervention to improve sustained attention in survivors with cancer-related cognitive dysfunction. Further research is needed to test whether repeated stimulation sessions can produce long-lasting benefits to attention, and identify individual differences that may mediate effects of tDCS on cognition.

Topic Area: ATTENTION: Nonspatial

D5 Simultaneous EEG-fMRI-tES reveals a visual-cortex-DMN system of sustained vigilance via alpha oscillations

Kevin Clancy[1], Melissa Meynadasy[1], Jessica Simon[1], Wen Li[1], [1]Florida State University

Alpha (8-12 Hz) oscillations are highly implicated in both sensory (i.e., visual) systems and the default mode network (DMN). Relatedly, the DMN is believed to support broad, low-level vigilance to the external environment under the 'sentinel hypothesis'. Here, by causally manipulating alpha oscillations via high-definition alpha-frequency transcranial alternating current stimulation (hd-tACS) at the occipitoparietal midline we sought to understand the role of alpha oscillations in integrating the visual cortex and the DMN at rest. Towards that end, we developed a novel neuroimaging methodology utilizing simultaneous EEG-fMRI combined with tACS (fMET), whereby resting-state EEG-fMRI recordings were acquired before and after either active (n = 18) or sham (n = 19) tACS during a continuous performance task (CPT). rsEEG validated the effect of alpha-tACS in an MR environment, with the active (but not sham) group demonstrating post-stimulation increases in occipitoparietal alpha power ($t = 2.37$, $p = 0.030$) and posterior-to-frontal alpha connectivity ($t = 2.36$, $p = 0.031$). Behaviorally, reaction times on the CPT became faster in the active (but not sham) condition ($t = 3.31$, $p = 0.005$), suggesting improvements in low-level sustained vigilance via alpha enhancement. Importantly, rsfMRI revealed post-stimulation connectivity increases within the DMN (Precun/PCC and mPFC) as well as between DMN and dorsal/ventral visual cortex (including the cuneus and middle/superior occipital gyrus) in the active condition alone. These findings provide preliminary evidence for an intrinsic visual-cortex-DMN circuit mediated by alpha oscillations, which could underpin passive, sustained vigilance and the 'sentinel' function during an idling resting state.

Topic Area: ATTENTION: Other

D6 Consumer-Based EEG Devices-Are They Mind-Wandering?

Shenyang Huang[1], Claire Simmons[1], William Krenzer[1], Nita Farahany[1], [1]Duke University

Mind-wandering occurs when one's attention drifts away from the immediate task at hand. While consumer-based electroencephalography (EEG) headsets have been used by professional athletes to monitor concentration during training and by schools to detect students' mind-wandering during classes, how these one-size-fits-all devices with sparse semi-dry electrodes compare to conventional scalp EEG caps in terms of efficacy remains unclear. In our study, participants (N = 15 after exclusion; aiming for 50-60) wore the EMOTIV Insight EEG headset when they completed a continuous performance test that measures one's attentional level (i.e., CPT-AX task). In addition, participants self-reported their mind-wandering state in response to probe questions inserted randomly in between letter presentations. Past studies using conventional EEG have found that mind-wandering, relative to attention on the task at hand, is associated with higher frontal Theta/Beta Ratio (TBR). Preliminary results from a Repeated Measures ANOVA with variables Mind-Wandering response (Yes/No) and Electrode (AF3, T7, Pz, T8, AF4) showed an interaction between the two was trending towards significance, $F(4, 56) = 2.277$, $p = .13$. Surprisingly, summing across all electrodes there was a lower TBR when participants said they were mind-wandering than when they said they paid attention. Our results raise the questions of whether the EMOTIV Insight EEG headset acquires the same brain activity patterns as those collected from conventional scalp EEG caps. Further research should investigate other consumer-based EEG devices' ability to detect mind-wandering and other brain states.

Topic Area: ATTENTION: Other

D7 Delineating the impact of mind wandering on event-based prospective memories with varying error-related consequences

Kristina Krasich[1], Eva Gjorgieva[1], Samuel Murray[1], Felipe De Brigard[1], Marty G. Woldorff[1], [1]Duke University

People sometimes forget to execute an intended task. These errors in prospective memory (PM) can result in consequences that may range in severity depending on the forgotten task. We tested the behavioral and neural impact of mind wandering (MW)-a shift in attention from task-related to task-unrelated thoughts-on event-based PM, while varying the PM error-related consequences. Participants completed a computer task serving lunches to virtual students, adjusting responses for rare-target students (PM cues) with dietary restrictions, where failure to serve the correct lunch (PM errors) could have either moderate or severe consequences. We found that self-reported mind wandering was associated with more frequent PM errors than focused attention, an effect equal in magnitude across the PM error-related consequences. The simultaneously recorded EEG showed a positive-polarity deflection between 200-400 ms after PM-cue onset that reflected the initial neural indication of the detection/recognition of a previously learned PM cue. This positivity was attenuated on trials preceding self-reported MW, suggesting this effect is related to the impaired PM performance associated with MW. MW was also associated with speeded response times-an effect of equivalent magnitude across consequences. Intriguingly, response times were slowest for the PM cues linked to severe consequences even though the P3 ERP component was the earliest and largest for these cues. These collective findings suggest that although MW impacts behavior similarly across consequences, it may have very specific impacts on the neurocognitive stages that support PM, including whether the error-related consequences are severe or moderate.

Topic Area: ATTENTION: Other

D8 Individual Differences in Self-Reported Autistic Traits and the N2pc

Jane Couperus[1], Juniper Hollis[2], Jess Roy[2], Amy Lowe[2], Cathy Reed[3], Cindy Bukach[4], [1]Mt. Holyoke College, [2]Hampshire College, [3]Claremont McKenna College, [4]University of Richmond

The N2pc has been shown to be an effective marker of attentional object selection when presented with a visual search task, reflecting selection of a target item among distractors (Eimer, Kiss, & Nicholas, 2011). Research also suggests that those with autism spectrum conditions have atypical selective attention when compared to typically developing populations (Burack, 1994). Moreover, recent research suggests that the N2pc may also reflect such atypical selective attention, specifically spatial selective attention (Dunn et al., 2016). This study further investigated this relationship by examining individual differences in autistic traits in relation to the N2pc. Here, 187 adults (ages 18-30) completed a visual search task designed to elicit the N2pc. Participants were asked to search for either a pink or blue vertical U among lateral facing U's and indicate if the gap was at the top or bottom of the U. Participants also completed the Autism Quotient (AQ) Questionnaire (Baron-Cohen, 2001). A Linear Regression of the overall N2pc at electrodes P07/P08 showed a significant relationship between AQ score and the N2pc ($F(1,185)=4.10$, $p=.044$). Results suggest that participants with higher AQ scores show a reduced N2pc, contrary to previous research by Dunn et al. (2016). Findings are discussed in light of differences between the studies in regards to tasks and populations as well as how the N2pc may index alterations of spatial selective attention in those with autism spectrum conditions.

Topic Area: ATTENTION: Spatial

D9 Influence of reward on attention selectivity in Parkinson's disease

Matthew Pilgrim[1], Zhen Ou[1], Madeleine Sharp[1], [1]McGill University

Attention deficits are common from the earliest stages of Parkinson's disease. Though evidence broadly points to dopamine dysfunction as a neural substrate for these deficits, a specific mechanistic understanding is lacking. Recent research suggests that dopamine-dependent reward signals help guide attentional resources, but whether this contributes to the attentional deficits in Parkinson's patients is not known. The goal of this study was to investigate whether attention deficits in Parkinson's patients are caused by an inability to use reward signals to triage and prioritize incoming information for further processing. We compared Parkinson's patients On and Off their dopaminergic medication in a within-subject design. Participants (patients On/Off and healthy controls) performed an attention task in which reward information was provided to guide attentional resources. Stimuli, which had been previously associated with different levels of reward, acted as task-irrelevant distractors while subjects performed a visual search for a distinct target. We predicted that dopamine medications would selectively enhance attention for the reward-related information thereby drawing it away from the targets. We found that patients were overall slower to respond to targets when a distractor was present than healthy controls. Additionally, patients On made more errors in the presence of previously rewarded distracting information than patients Off medication but the magnitude of reward did not additionally influence attention. This suggests that dopamine state plays a role in the overall process of allocating attentional resources but that this selectivity may not be specifically reward-dependent.

Topic Area: ATTENTION: Spatial

D10 Probing the properties of priority maps in visual working memory

Jiangang Shan[1], Bradley Postle[1], [1]University of Wisconsin, Madison

With fMRI and EEG, evidence for an active representation of an unprioritized memory item (UMI) often drops to baseline levels, in a manner indistinguishable from that of an 'irrelevant memory item' (IMI) presumably dropped from working memory. One theoretical model proposes that the difference between the UMI and IMI is that the binding between the content of the IMI and its trial-specific context has been removed (Lewis-Peacock, Kessler, and Oberauer, 2018). We explored this model with a task in which two samples (oriented gratings) were presented sequentially, followed by a retrocue designating the uncued item an IMI, followed by the presentation of a third sample that could appear at the location of the cued item, of the IMI, or a neutral location. Finally, a dial cued the recall of either sample with equal probability. For the third sample, precision was highest and guessing lowest for recall of the orientation when it had appeared at the initially cued location (i.e., at a 'prioritized context'), and precision was lowest and guessing highest when it had appeared at the same location as the IMI. The absence of swap errors to the IMI suggested that it had indeed been dropped. These results suggest two properties of priority maps in visual working memory. First, binding multiple items to the same spatial context may, paradoxically, improve their retention. Second, there may be a refractory period after removing a content-to-context binding (i.e., after dropping an item) that disrupts binding new content to the same spatial location.

Topic Area: ATTENTION: Spatial

D11 An Event-Related Potential Study on Emotional Face Processing, Temperament, and Internalizing Traits in Three-Year-Olds

Finola Kane-Grade, Halie Olson[1], Wanze Xie[2], Michelle Bosquet Enlow[2, 3], Charles Nelson[2, 3], [1]Massachusetts Institute of Technology, [2]Boston Children's Hospital, [3]Harvard Medical School

Face-sensitive components of the event-related potential (ERP), including the P1 and N170, are reliably elicited from young children. ERPs may be a useful tool in understanding how individual differences in neural responses relate to emotional difficulties, including anxiety. Early temperament also has been associated with later anxiety. The purpose of the current study was to examine whether ERP responses to emotional faces and temperamental characteristics are associated with anxiety symptoms in preschool-aged children. Typically developing 3-year-olds (n=61) viewed female faces displaying happy, fearful, angry, and neutral expressions during ERP recordings. Mothers completed the Early Childhood Behavior Questionnaire (ECBQ) to assess temperament and the Infant-Toddler Social and Emotional Assessment (ITSEA) to assess emotional problems, including internalizing symptoms such as anxiety. Analyses revealed negative associations of ITSEA Internalizing T-scores with (a) P1 latency to angry faces in the left occipital region (?=-.151, p=.017) and (b) N170 latency to angry faces in the right occipital region (? =-.127, p=.048). Additionally, Internalizing T-scores were moderately associated with the ECBQ scale scores of Fear (r=.452, p

Topic Area: EMOTION & SOCIAL: Development & aging

D12 Fear of Negative Evaluation is associated with Connectivity Strength within Dorsomedial Default Mode Network

Ji Soo Lee[1], Hairin Kim[1], Seyul Kwak[1], Jeanyung Chey[1], [1]Seoul National University

Increase in fear of getting negative evaluation is frequently observed in social anxiety disorder (SAD) and it is accompanied by an altered brain functional connectivity pattern. Considering that the symptoms of SAD can develop on a spectrum ranging from mild non-clinical behavior to severe clinical manifestation, investigating the underlying neural mechanism of fear of negative evaluation in non-clinical sample is important. This study aimed to investigate an association between the fear of negative evaluation and dorsomedial default mode network (dDMN) connectivity, which has been known for its association with the ability to understand others. Ninety healthy older adults (Mage = 71.74, SDage = 6.67), participating in the Korean Social life, Health, Aging Project (KSHAP), were included in the current study. They completed 12-item Brief Fear of Negative Evaluation scale (K-BFNE II) and underwent a 10-minute resting-state fMRI acquisition in a 3T MRI scanner with eyes open. dDMN connectivity strength was calculated as mean connectivity value within dDMN ROIs, such as medial prefrontal cortex (MPFC) and posterior cingulate cortex (PCC). Then we examined the association between dDMN connectivity strength and the fear of negative evaluation, using a linear regression analysis. Our results showed that K-BFNE II score was negatively associated with dDMN connectivity strength in rsfMRI after controlling for the effect of age, sex, and education (r = -0.294, p = 0.006). It suggests that the weakened dDMN connectivity may be an underlying neural mechanism of fear of negative evaluation or the response to significant negative evaluation from the past.

Topic Area: EMOTION & SOCIAL: Development & aging

D13 The Link Between Sleep Quality and Stress Reactivity

Harlan Fichtenholtz[1], Emily Whitman[1], [1]Keene State College

Poor sleep quality has been associated with increased levels of stress and suicide risk (Mullan, 2014; Nadorff et. al, 2013). The purpose of this study is to understand the association between sleep quality and acute stress reactivity. Participants completed assessments of sleep quality (overall sleep quality, insomnia, dream anxiety, and nightmare experiences), anxiety, and depression. Following these assessments participants were exposed to a brief acute stress, the cold pressor task. During the cold pressor task, participants had their ECG recorded during three 2-minute phases (1) at rest, (2) while their hand is submerged in ice water, and (3) rest again. Inter-beat interval (time between heart beats, IBI) and heart-rate variability (HRV) measures were calculated from the ECG data. HRV from the 2-minute baseline period was used as a predictor variable. IBI data showed that there was a significant difference in stress reactivity for participants with moderate to severe insomnia compared to those with little to no insomnia. Additionally, cardiac stress reactivity was significantly larger for participants with moderate to severe anxiety compared to those with low anxiety. While the complexities of the relationship are still to be determined, this suggests that sleep quality, anxiety and depression all play a role in an individuals' cardiac response during an acutely stressful situation.

Topic Area: EMOTION & SOCIAL: Emotional responding

D14 Enhanced Emotional Responses to Live Facial Expressions

Chun-Ting Hsu[1], Wataru Sato[1], Sakiko Yoshikawa[1], [1]Kyoto University

Facial expressions of emotion are indispensable communicative signals to create and maintain social relationships in real-life. Previous psychological studies have shown that the observation of emotional facial expressions automatically induce subjective and physiological responses (e.g., mimicking facial muscle activation and autonomic arousal). However, majority of the research presented pre-recorded photos or videos of facial expressions, which lacked the potential for 'live' interactions with stimulus models, and compromised the generalizability and ecological validity of results to real-life facial expression processing. To investigate this issue, we asked participants to interact with the stimulus model at the beginning of the experiment. Participants then observed live dynamic facial expressions of the stimulus

model showing angry and happy emotions, as well as pre-recorded videos randomly. We recorded the facial electromyogram (EMG) of the corrugator superciili and zygomaticus major muscles and pupil sizes. We also collected participants' subjective ratings of valence and arousal for the facial expressions. Subjective rating showed that live, compared with video, happy expressions were more positive and arousing, while live angry expressions were more arousing than video angry expressions. EMG data showed that live happy expressions caused more corrugator relaxation and zygomaticus activation than video happy expressions. Pupils dilated more when viewing live expressions of anger and happiness than video expressions. These data showed that real-life expressions have stronger impact on subjective, facial, and autonomic emotional responses than previously assumed based on the data with pre-recorded static or dynamic stimuli. This paradigm has proved to be valuable for future neuroimaging studies.

Topic Area: EMOTION & SOCIAL: Emotional responding

D15 Stress Alters Within-Network and Between-Network Connectivity for Default Mode Network - A Simultaneous EEG-fMRI Study

Jeremy Andrzejewski[1], Kevin Clancy[1], Wen Li[1], [1]Florida State University

The resting-state neural activity is dominated spatially by the Default Mode Network (DMN) and temporally by alpha oscillations (8-12 Hz), both of which can be disrupted by anxiety and stress. Combining simultaneous EEG-fMRI resting-state (RS) recordings (12 minutes; eyes open) and stress induction, we examined the coupling between DMN and alpha activity in response to stress. Behavioral testing of stress induction confirmed significant increases anxiety and stress post-induction (N = 10), M (SE) = 39.28 (6.35) and M (SE) = 38.38 (7.47) on a 0-100 visual analog scale, respectively. Using the bilateral posterior cingulate cortex (PCC, a posterior DMN hub) as a seed, we observed decreases in RS connectivity between the PCC and right mPFC (peak voxel in MNI: 10, 34, -8; Z = 4.47) following induction. Stress also increased cross-network connectivity between the DMN and the dorsal attention network (i.e., frontal parietal network; FPN), as evinced by increases in connectivity between the PCC and the right dorsolateral prefrontal cortex (42, 42, 18; Z = 3.82), the PCC and the inferior parietal gyrus (42 ,-52, 46; Z = 3.73), and the medial prefrontal cortex (mPFC; an anterior DMN hub) and lateral PFC (40, 54, 8; Z = 3.66). Current results suggest that stress induction disrupts RS DMN connectivity while enhancing crosstalk between FPN and DMN networks. Ongoing analyses of alpha oscillations will provide electrophysiological insights into the DMN disconnectivity and between-network hyper connectivity in anxiety and stress.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

D16 Reinforcement Learning and Rock, Paper, Scissors

Gregory Gagliardi[1], Chad Williams[1], Cam Hassall[1], Olave E. Krigolson[1],[1]University of Victoria

Reward processing, from the perspectives of brain activity and behaviour, is often studied using explicit rewards and punishments. However, predictive neutral cues can also acquire value and be processed as rewards or punishments themselves, based on how reliably they predict future outcomes. The present study investigates whether facing an opponent would be processed as a reward or punishment depending on the level of difficulty the opponent poses. Participants played Rock, Paper, Scissors against three computer opponents while electroencephalographic (EEG) data were recorded. In a key manipulation, one opponent was programmed to win most of the time, another was made to lose, and the third was set to tie with the player. Through practice, participants learned to anticipate the outcome of a game based on the opponent they were facing that round. An analysis of our EEG data revealed that winning outcomes elicited a reward positivity relative to losing outcomes. Interestingly, our analysis of the predictive cues (i.e., the opponents' faces) demonstrated that the face of a learned 'hard' opponent elicited a reward positivity relative to the face of a learned 'easy' opponent. As such, our results for the predictive cue are contrary to what one might expect, but in this case demonstrate that the neural response to the predictive cue was encoding actual value of the opponent as opposed to value relative to the anticipated outcome. These findings are interesting and important because they show a novel reward feedback event related potential evoked by a non-reward outcome predictive cue.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

D17 Inferring meaning from variably intense emotion expressions

Natalie Holz[1], Pauline Larrouy-Maestri[1], David Poeppel[1, 2], [1]Max Planck Institute for Empirical Aesthetics, [2]NYU

A crucial aspect of understanding others' thoughts and feelings is to infer meaning from rich sensory signals, such as the human voice. Vocalizations (e.g., laughter, cries, moans, or screams) constitute a potent source of information through which affective states of others are sensed and categorized. Yet, the nature of this categorization process is debated, as is the informational content of such emotion expressions. One commonplace assumption, plausibly, is that the ability to infer expressed meaning increases the stronger the underlying affective state. Whether such a generalization is correct, however, is not clear. In fact, the empirical basis of emotion intensity remains rather underdetermined and problematic. A more comprehensive and parametrically varied study of vocal emotion can disambiguate some foundational questions on emotion communication. Here we show a new, ecologically valid database of non-speech expressions of various affective states, ranging from low to peak emotional intensity, to be able to address the influence of intensity on perceptual evaluation. Next, capitalizing on different designs, we demonstrate in three experiments (n = 30 participants each) the interaction between emotional intensity, emotion judgements, affective ratings of valence and arousal, and perceived authenticity. Finally, informed by robust effects of intensity on perceptual and acoustic properties, we challenge the notion of diagnostic emotion expression and demonstrate how, amongst all, especially peak emotion is not the easiest human experience to be inferred.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

D18 Abnormal Attention and Memory Bias to Facial Expressions in Individuals with High Social Anxiety

So-Yeon Kim[1], Jin-Ah Park[1], [1]Duksung Women's University

Recently, we demonstrated that patients with social anxiety disorder showed prolonged attentional bias by task-irrelevant angry faces at both behavioral and neural levels. Here, we expanded our findings to incidental memory formation of emotional faces in people with high social anxiety (HSA). We hypothesized that HSA would show both prolonged attentional bias and stronger incidental memory of emotional faces compared to individuals with low social anxiety (LSA). Eight HSA and nine LSA participated. Participants performed an attention task where they detected the orientation of a letter 'T' rotating every second whilst distractors (angry or happy faces) appeared or disappeared. Attentional bias effects were defined by comparing RT differences between targets with or without distractors. After the attention task, participants performed an unexpected memory task to recognize face stimuli seen in the attention task. Results showed significant Emotion X Group interaction effects on attentional bias ($F(1,15)=4.55$, p

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

D19 Representation of Valence Across Studies

Svetlana Shinkareva[1], Chuanji Gao[1], Douglas Wedell[1], [1]University of South Carolina

Hedonic valence describes the pleasantness or unpleasantness of psychological states elicited by stimuli and is conceived as a fundamental building block of emotional experience. Multivariate pattern analysis (MVPA) approaches contribute to the study of valence representation by allowing identification of valence on a trial-by-trial basis. However, the issue of construct validity arises in that there is always the possibility that classification results from a single study are driven by factors other than valence, such as the idiosyncrasies of the stimuli. In this work we address this issue by identifying valence across participants from five different fMRI studies, thus increasing the likelihood that classification is driven by valence and not by the specifics of the experimental paradigm of a particular study. The studies included a total of 73 participants and differed on materials, task, trial duration, number of participants, as well as scanner parameters. In a leave-one-study-out cross validation procedure we trained the classifiers on fMRI data from four studies and predicted valence, positive or negative, for each of the participants in the left-out study. In cross-participant classification, we have demonstrated a reliable distinction between positive and negative valence states (77% correct, $p < .001$). The demonstrated cross-study classification of valence enhances the construct validity and generalizability of the findings from the combined studies.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

D20 Impact of Perceived Stress on Brain Network Activation During Memory Retrieval in Adolescents

Jennifer Sneider[1,2], Julia Cohen-Gilbert[1,2], Emily Oot[1,3], Anna Seraikas[1], Eleanor Schuttenberg[1], Derek Hamilton[4], Sion Harris[2,5], Lisa Nickerson[1,2], 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 characterized by substantial structural and functional brain remodeling, particularly in memory-processing regions influenced by stress. This study evaluated network activation during spatial memory performance using a virtual Morris water task (MWT), and associations between network activation, memory and stress (perceived stress and rejection, peer emotional abuse). Functional magnetic resonance imaging data were acquired at 3Tesla from 58 (34 female) adolescents (13-14yrs). We used NIH Emotion Toolbox to measure perceived stress and rejection and the pediatric Maltreatment and Abuse Chronology of Exposure (MACE) to assess peer emotional abuse. Network template spatial activation maps were derived from HCP maps and projected onto brain activation maps to create a subject-series of activation strengths for each network for each participant. Hippocampal and prefrontal cortex networks were significantly activated during task performance (retrieval>motor), as were central executive, salience, dorsal attention and default mode (DMN) networks. Worse MWT performance (longer path to reach platform quadrant) was associated with higher perceived stress ($p=.017$) and rejection ($p=.004$), and greater peer emotional abuse (p

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

D21 Dynamic brain response to acute stress in children and adolescents: It's all about age

Andrea Pelletier-Baldelli[1], Alana Campbell[1], Rachel Corr[1], Sarah Glier[1], Josh Bizzell[1], Ayse Belger[1], [1]University of North Carolina at Chapel Hill

The goal of this study was to investigate neural circuitry and dynamic connectivity underlying the acute stress response in children and adolescents. 98 youth aged 9-16 ($M = 13.28$, $SD = 2.32$) underwent an fMRI scanning session where they were exposed to ~18 minutes of cognitive and psychosocial stress using the Montreal Imaging Stress Task (MIST). Using a unified structural equation modeling and community detection algorithm through GIMME (Group Iterative Multiple Model Estimation), we defined dynamic network connections and specific sub-group response to the stress task. Acute stress elicited an overall network involving directional effects of the amygdala ($B = 0.54$ and $B = 0.42$, bilateral) and anterior cingulate cortex (ACC) ($B = 0.38$) on the hippocampus, insula impacting the ACC ($B = 0.53$), and orbitofrontal cortex (OFC) affecting insula activation ($B = 0.44$). Data-driven sub-groups during stress were differentiated based on a 1) nucleus accumbens (NAcc) -> OFC circuit ($B = 0.37$) and a 2) NAcc -> amygdala ($B = 0.41$) & hippocampus -> OFC ($B = 0.47$) circuit. Logistic regression showed that age significantly predicted subgroup status ($B = -0.27$, $p = 0.03$) such that older adolescents were more likely to be in subgroup 1. Including sex, clinical symptoms, and cortisol response did not significantly improve the model. Results are the first to present dynamic network modeling of the MIST in children and adolescents, showing unique brain responses to stress in this important developmental and transitional period of life.

Topic Area: EMOTION & SOCIAL: Other

D22 Insula Connectivity during Narratives Predicts Willingness to Donate to a Cause

Anthony Vaccaro[1], Brandon Scott[1], Sarah Gimbel[1], Antonio Damasio[1], Jonas Kaplan[1], [1]University of Southern California

Engaging with narratives involves a complex array of cognitive and affective processes, and can influence pro-social decision-making. The insula may play an important role in pro-sociality given its function in processing feelings from the body, and thus, may participate in narrative influence on prosocial behavior. In this study, using personal stories obtained from podcasts as stimuli, we aimed to explore the insula's role in narrative processing and in how stories affect prosocial decisions. Forty-five right-handed subjects were recruited. Each participant listened to two stories inside the fMRI scanner. In one story the protagonist watched a neighbor die of cancer, and in the other, two children experience a dangerous situation while hitchhiking. After the scan, subjects were asked a series of questions, including how likely they would be to donate $5 to a cancer charity and to a public awareness campaign for children on the dangers of hitchhiking. Searchlight multivariate pattern analyses of insula connectivity found that during both stories, individuals with high versus low willingness to donate to cancer was predicted by insula connectivity to precuneus (~.77 during both stories). Willingness to donate to hitchhiking awareness was predicted by insula connectivity to right anterior prefrontal cortex during both stories (~.75 during cancer story, ~.80 during hitchhiking story). In summary, insula connectivity with regions implicated in moral processing was predictive of how people answered questions on willingness to help causes. However, since results were similar across two stories, these data do not show the relevance of story content to predictiveness.

Topic Area: EMOTION & SOCIAL: Other

D23 Empathy influences behavioral perceptions and eye movements in non-literal language processing

Gitte Joergensen[1], Lauren Benson[2], Pavitra Makarla[1], Hana Kim[3], Kathrin Rothermich[3], [1]University of Connecticut, [2]Indiana University, [3]East Carolina University

Recognizing nonliteral language is a crucial part of communicative functioning and involves complex social-cognitive skills such as the inference of mental states and empathy. To study the influence of empathy on processing literal

positive, blunt, sarcastic, and jocular dynamic social interactions, we tracked healthy adults' eye movements while they watched video vignettes (N = 40). Participants were asked to evaluate speaker intention and friendliness, and we measured their empathy levels using the Interpersonal Reactivity Index (Davis, 1980). Behavioral results showed that participants with higher levels of empathic concern rated blunt interactions as less friendly compared to literal positive interactions, while participants with low empathic concern levels showed the opposite pattern. The eye-tracking analysis revealed that all participants spent significantly more time looking at faces when scanning literal versus nonliteral vignettes. Moreover, participants with higher empathic concern showed significantly more fixations to faces when viewing jocular interactions compared to participants with lower empathic concern scores. Our findings will be discussed not only in the context of interactive versus modular nonliteral language processing theories but also in relation to clinical populations who exhibit difficulties with empathy and nonliteral language understanding, (e.g. Autism Spectrum Disorders or Parkinson's Disease).

Topic Area: EMOTION & SOCIAL: Person perception

D24 The time course of processing authentic and fake emotional vocalisations

Maciej Kosilo[1, 2], Mónica Costa[2], César Lima[2], Ana Pinheiro[2], Diana Prata[2], [1]fciencias.id-Associacao para a investigacao e desenvolviment, [2]University of Lisbon

The same emotion will evoke a different meaning and social response depending on its perceived authenticity. However, few studies investigated the time course of authenticity processing in emotional expressions, and no studies have looked into this process in the auditory domain. To address this gap, we measured event-related potentials (ERPs) while 32 participants listened to authentic and fake negative (crying) and positive (laughing) vocalisations in a within-subject study. The vocalisations were rated on a scale from 1 (authentic-sounding) to 7 (fake-sounding) after each stimulus presentation.We show that two early ERP components (N100, measured between 80 and 200ms, and P200, measured between 180 and 350ms) were both modulated by the authenticity of the stimuli. The main effect of authenticity on the N100 component was driven by a larger amplitude in response to authentic negative vocalisations. On the other hand, the main effect of authenticity on the P200 amplitude was mostly driven by a larger response to fake laughing.These results point to two different mechanisms. A larger N100 amplitude in response to real vocalisations is consistent with literature showing the component to be sensitive to emotional content. On the other hand, a higher P200 amplitude in response to fake emotional vocalisations is consistent with studies linking this component to motivational significance of events. Together, these results suggest that the processing of emotional content is shortly followed by an assessment of its authenticity. Importantly, the authentic/fake distinction appears to be achieved rapidly, and earlier than previously shown using photographs of emotional faces.

Topic Area: EMOTION & SOCIAL: Person perception

D25 Association between actions and personality traits for modeling of the social knowledge

Masahiro Okamoto[1], Satoshi Eifuku[1], [1]Fukushima Medical University

We make predictions about others' behaviors based on what we know about their personality traits. Conversely, we also make inferences about personality traits of others based on their behaviors. In the present study, we examined what kind of actions could lead us to a specific personality trait (study1) and evaluated relationships between actions and personality traits (study 2). In study 1, we focused on verbs and extracted verbs from descriptions of impressions on others. Participants were asked to rate others close to them on 20 personality traits and to provide reasons for rating each personality trait, with concrete episodes. Principle component analysis on the ratings revealed three components ('approachableness,' 'extraversion,' and 'gentleness') and correspondence analysis identified verbs characterizing each category. Next, in study 2, we examined the relationship between the personality traits and the extracted verbs. Participants asked to rate how likely a person who did some action has a personality trait and how likely a person with a personality does an action. This revealed a selective association between personality traits and verbs: for instance, a person with traits categorized as 'approachableness' tends to be judged to do actions categorized as 'approachableness.' Furthermore, we found stronger effects of traits on the judgment of actions than those of actions on the judgement of traits. This result indicates that the association of traits and actions is asymmetry and the possibility that more information could be collected to personality traits than actions.

Topic Area: EMOTION & SOCIAL: Person perception

D26 Investigating the emergence of expression representations in a neural network trained to discriminate identities

Emily Schwartz[1], Kathryn O'Nell[2], Stefano Anzellotti[1], [1]Boston College, [2]University of Oxford

A picture of a face provides information about both someone's identity and their facial expression. According to traditional view, identity and expression recognition are performed by separate neural mechanisms. However, recent studies show that recognition of identity and expressions may not be as disjointed as originally thought: face identity can be decoded from response patterns in pSTS (Anzellotti et al. 2017, Dobs et al. 2018), a brain region previously implicated in expression recognition. Joint processing of expressions and identity might be driven by computational efficiency. In support of this hypothesis, O'Nell et al. 2019, found that artificial neural networks (ANNs) trained to recognize expressions spontaneously learn features that support identity recognition. Here, we investigate transfer learning in the reverse direction, testing whether ANNs trained to distinguish between identities learn features that support recognition of facial expressions. We trained a siamese architecture without handcrafted features on a face verification task. The network achieved 77.22% accuracy. To see if the network spontaneously learns features that support expression recognition, we froze its weights and used features in its hidden layers as inputs to a linear-layer trained to label expressions. Our current results indicate that the accuracy at labeling expressions was at chance, failing to provide evidence for transfer learning from identity verification to expression recognition. Taken together with the successful transfer from expressions to identity, the results suggest that transfer learning in face processing is asymmetrical. We also discuss possible alternative accounts of our results.

Topic Area: EMOTION & SOCIAL: Person perception

D27 The Self-enhancement Effect at Implicit and Explicit Levels: Their Complementary Relationship and Cultural Difference

Yi Ding[1], [1]Tohoku University

In western culture, it has been established that people tend to evaluate the self better than average and remember self-relevant items better than irrelevant items. This self-enhancement effect has, however, poorly been examined at the implicit perceptual level and less consistently reported in the eastern culture. In this study, we assessed the self-enhancement effect at the perceptual level and examined its relationship with the effect on the evaluation or memory level in Chinese students. The perceptual-level effect was assessed using two tasks. The implicit association task measured the reaction-time advantage at the semantic decision task when the same key was assigned to the self and positive trait. The associative learning task measured

the accuracy advantage at the recognition task when a geometric shape was learned is associated with 'good self.' The evaluation-level and memory-level effects were assessed in terms of the self-positivity bias in the trait-evaluation task and better performance at the surprising recognition task on the trait words that were previously used for the self-evaluation, respectively. The self-enhancement effects were significant in both the perceptual-level tasks, but not in the evaluation-level or memory-level tasks. The individual degree of the perceptual-level effect in the associative learning task was, however, negatively correlated with the degree of the evaluation-level effect. The results may suggest the complementary relationship between the implicit perceptual-level and explicit evaluation-level self-enhancement effects and the dominance of the former in the eastern culture.

Topic Area: EMOTION & SOCIAL: Self perception

D28 A fNIRS investigation of event-related, Go-No-Go task in children

Soyong Eom[1], Jongkwan Choi[2], Jae-Myung Kim[2], Jaehyun Lim[2], Do-Joon Yi[1], [1]Yonsei University College of Medicine, [2]Optical Brain Electronics Laboratory

Near-infrared spectroscopy (NIRS) can be applied in the natural setting in children of any age. The present study investigated functional brain activation patterns in children using functional Near Infrared Spectroscopy (fNIRS) during an event-related, Go-No-Go task and neuropsychological tests as a more cost-effective tool measuring cortical hemodynamics and a behavioral paradigm. This study enrolled 148 healthy normal participants (age range of 7.0?12.4 years old, 8.9 ± 1.5 years; 72 boys). Measurements were performed by NIRSIT-Lite (OBELAB Inc, Korea) which utilizes 5 LED sources and 7 photo detectors and it can measure 15 channels at prefrontal area. We adapted Go-No-Go task in an event-related version which might suggest executive processes, and measured prefrontal activity during task performance. Wechsler Intelligence Scale for Children ?Fifth Ed. (WISC-?) were also performed. fNIRS density, GLM, and task parameters are calculated after applying threshold value at the distance matrix. fNIRS data and behavioral measure were analyzed with repeated measure ANOVA as a within-subjects and an inter-group factor. And correlation analysis was conducted among fNIRS, behavioral and neuropsychological data. In terms of development, no significant differences on fNIRS density, GLM, task parameters were shown, suggesting no prominent discrimination. However, the accuracy level of Go-No-Go test showed comparatively high correlation with density from fNIRS and showed high correlation with Processing Speed and Working Memery from WISC-?.Our results suggest that fNIRS parameters are associated with different functional activation patterns in the frontal subregions based on the characteristics of each task besides developmental aspects.

Topic Area: EXECUTIVE PROCESSES: Development &aging

D29 Exploring Cognitive Flexibility Deficits Using Behavioral and EEG Tasks in Individuals with Fragile X Syndrome

Joy Li[1], Megan Rogers[2], Nicole Friedman[2], Danielle Chin[2], Ellen Russo[3], Craig Erickson[2], Ernest Pedapati[2], Lauren Schmitt[2], [1]University of Oklahoma, [2]Cincinnati Children's Hospital Medical Center, [3]University of Cincinnati

Fragile X Syndrome (FXS) is the leading inherited cause of autism spectrum disorder and intellectual disability. To better understand cognitive flexibility deficits in FXS, we administered a behavioral and electroencephalogram (EEG) task of reversal learning. Briefly, participants were instructed to choose the correct location (i.e., initial learning), which randomly changed following 8 (behavioral) or 3-5 (EEG) consecutive correct trials (i.e., reversal learning). The behavioral task varied level of uncertainty based on number of choices (2 vs. 4) and probability of reward rate (100% vs 80%). We calculated number of trials during initial and reversal learning phases and error rate during the behavior task. We analyzed event-related potentials (ERPs) following reward feedback during the EEG task. During the behavior task, results show that FXS individuals demonstrate an initial learning deficit in high compared to low uncertainty situations and difficulty switching to and maintaining new behaviors relative to controls. During the EEG task, results show greater amplitudes of ERPs related to sensory processing (N1, P3a) and greater amplitude and longer latency of ERP related to task-switching (P3b) in FXS. These findings suggest FXS individuals are hypersensitive to feedback stimuli and may require a longer processing time to determine whether a behavioral change is needed. In the first study of its kind with FXS, our findings add important insights into inflexible behavior and suggest this task may be an appropriate proxy of rigid behavior in FXS, implicating its potential use in future preclinical models and cross-species drug studies.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

D30 Real World Multitasking Experience Interferes with Lab-Based Volitional Multitasking

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

Media multitasking (e.g., listening to podcasts while studying) has been linked to decreased executive functioning. However, the tasks used to establish this finding do not approximate a real-world volitional multitasking environment. A novel experimental framework was designed to mimic a desktop computer environment where a 'popup' associated with a secondary task would occasionally appear. Participants could select the popup and perform a difficult word stem completion trial, or ignore the popup and continue performing the primary task which consisted of math problems. We predicted that frequent media multitaskers (quantified with a self-report questionnaire) would be more distracted by the popups, choose to perform the secondary task more often, and be slower to return to the primary task compared to infrequent media multitaskers. In line with these predictions, frequent multitaskers were slower to perform the primary task when a popup was presented and were slower to return to the primary task. Interestingly, frequent multitaskers were also found to be slower on primary tasks even when the pop-up was presented. However, frequent multitaskers did not choose to perform the secondary task more than loss frequent multitaskers. These findings suggest that frequent multitasking in day-to-day life is associated with increased distractibility in a controlled lab environment, supporting previous evidence for an impact of daily multitasking exposure on executive function. To examine which component(s) of processing are most impacted by media multitasking (e.g., task set preparation, attentional biasing), we are currently analyzing EEG data and conducting computational modeling.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

D31 The Hidden Cost of a Cell Phone: Behavioral and Neural Correlates of Attention and Cognitive Control Related to Smartphone

Joshua Upshaw[1], Carl Stevens[1], Giorgio Ganis[2], Darya Zabelina[1], [1]University of Arkansas, [2]University of Plymouth

Frequent smartphone use is associated with detriments to attention and cognitive control. The present study examined the impact of smartphone notifications on attention for people with high and low smartphone addiction proneness (SAP). Participants (n = 69) completed a Navon letter task where they indicated the presence of a frequent or rare target letter, with each trial preceded by a smartphone or a control sound. We predicted that participants high (vs. low) in SAP would exhibit worse cognitive control, indicated by reaction times (RT) and N2 event related potential (ERP) oddball effect (rare?frequent trials) on trials preceded by smartphone (vs. control) sounds. Interestingly, on smartphone trials, people high (vs. low) in SAP showed better

cognitive control, indicated by a smaller N2 oddball effect. The two groups did not differ in cognitive control on the control sound trials. The cognitive control effect was specific to N2 ERP, while there was no effect for RT. People high (vs. low) in SAP, however, were slower overall on trials preceded by the smartphone (vs. control) sounds (and this effect holds controlling for time). Results suggest that people who are addicted to their smartphones show a tradeoff: They slow down after hearing smartphone notifications, while also showing better upregulation of cognitive control in such circumstances. Future investigations will seek to further investigate attention and cognitive control processes that are linked with smartphone use, particularly in people with smartphone addiction.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

D32 Effects of Transcranial Direct Current Stimulation (tDCS) on Operator Vigilance: A Double-blind, Sham-controlled Study

E. Susan Duncan[1], Surani G. Nakkawita[1], Heather D. Lucas[1], Owen T. Carmichael[2], Marcio de Queiroz[1], [1]Louisiana State University, [2]Pennington Biomedical Research Center

With increasing automatization of essential systems, human operators need to maintain appropriate levels of vigilance to monitor and swiftly intervene when necessary. We investigated whether anodal transcranial direct current stimulation (tDCS) targeting left dorsolateral prefrontal cortex (F3) modulates performance on a tedious go/no-go task. Twenty-one healthy young adults completed two 30-minute sessions of a computerized Mackworth Clock, randomly allocated to receive either active or sham tDCS first. Active tDCS was delivered at 2mA for the first 20 minutes of the task, with cathode placed on contralateral forehead (Fp2); sham lasted 30 seconds. Stimuli requiring response occurred on ~8% of 3600 trials, evenly distributed across three 10-minute blocks (occurrence randomized within). We used a linear mixed effects model (subjects as random factors) to assess correct and incorrect responses. Results indicated significant main effects for session (first or second) and block (first, second, or third 10-minute interval). Participants produced more correct ($p=0.022$) and incorrect ($p=0.004$) responses during the first session vs. second. Participants produced fewer correct ($p=0.015$) and more incorrect ($p=0.003$) responses at the end vs. beginning of the session. For correct responses, there was a significant interaction ($p=0.049$); performance consistently decreased across blocks with sham but increased with active tDCS during the first session only. For incorrect responses, there was a significant main effect of stimulation ($p=0.009$), with active tDCS yielding consistently fewer errors than sham. Results suggest that tDCS holds future promise for enhancing operator vigilance. Moreover, adaptively modulating the stimulation via real-time feedback may yield consistent, optimal vigilance.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

D33 Incidental encoding reveals the time-varying nature of post-error adjustments in cognitive processing

Eva Gjorgieva[1], Tobias Egner[1], [1]Duke University

Post-error slowing (PES) of reaction time (RT) is a common finding in cognitive control tasks. However, it remains contested whether PES reflects adaptive or maladaptive cognitive processing adjustments, in part because mean post-error RT and accuracy rates are insensitive tools for understanding how post-error stimuli are processed. To overcome this limitation, we devised a novel object flanker task that employed trial-unique target and distractor stimuli, which was followed by a surprise recognition memory test. This allowed us to determine how errors influence incidental target and distractor encoding in a trial-specific manner. We used this approach to test Wessel's (2017) integrative 'adaptive orienting theory' of post-error processing, which proposes that an error triggers an initial inhibition of task processing and orienting to the error source, followed by a controlled reinforcement of the current task set. To characterize the time-course of the post-error processing cascade, we combined our task with a manipulation of the response-stimulus interval (RSI), across three experiments (RSIs: 300ms, 650ms, 1000ms; N = 96-100 per experiment). We observed classic flanker and PES effects for all three experiments. Crucially, we also found ? for the first time ? a substantial (~10%) post-error enhancement of target (but not distractor) memory, and this boost to target encoding interacted with RSI: in line with the adaptive orienting account, post-error targets were remembered better than post-correct targets at the long (650ms, 1000ms) but not at the short (300ms) RSIs. These findings provide clear support for a time-dependent adaptive (target boosting) adjustment in post-error processing.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

D34 The Relation between Inhibitory Control and Neural Patterns of Reactivity to Craved Items

Melissa Moss[1], Krista Destasio[1], Brendan Cullen[1], Elliot Berkman[1], [1]University of Oregon

In addiction research, cue-induced reactivity to a substance strongly predicts later use of that substance. In contrast, people who perform better on tasks assessing the executive process of inhibitory control are less likely to use health-risking substances and relapse when they try to quit. Though there is extensive scientific knowledge about the neural and behavioral properties of cue-induced reactivity, on the one hand, and inhibitory control, on the other, these two processes have been studied in isolation of each other despite their strong overlapping relevance to addictive behavior. Here, we directly examined the interrelation between cue-induced reactivity and inhibitory control in a large sample of individuals struggling with the use of one or more risky substances. Our research question crosses disciplines that use different methods, so we deployed a multimethod approach that integrated data from neural recordings, self-report measures, and behavioral tests. We measured neural activation while participants viewed personalized images of the risky substances they had endorsed as craved substances. Participants also completed a variation of the standard stop signal task that incorporated personalized cues of their craved substances, and provided self-reports on craving, risk behaviors, and impulse control. Results indicate that self-reported craving was inversely associated with the degree of activity in the inhibitory control network during the cue reactivity task. This work provides a link between inhibitory control and cue reactivity that could be used to help people self-regulate their cravings for problematic substances.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

D35 Frontoparietal Connectivity During Cognitive Control in Autism Spectrum Disorder

Rachel Wulff[1], Marie Krug[1], Andrew Gordon[1], Cory Coleman[1], Tara Niendam[1], Tyler Lesh[1], Cameron Carter[1], Marjorie Solomon[1], 1University of California, Davis

Initial studies suggest individuals with autism spectrum disorder (ASD) exhibit less frontoparietal connectivity during cognitive control than those with typical development (TD) (Solomon, et. al. 2009, 2014). To further characterize the nature of (possibly compensatory) control connections in ASD, 116 IQ-matched participants (58 ASD; 58 TD) completed the rapid Preparing to Overcome Prepotency task during fMRI scanning, in which a green cue (50% trials) signals a button press on the same side as a subsequent arrow probe and a red cue signals a press in the opposite direction. Accounting for a potential speed-accuracy tradeoff, the dependent measure was inverse efficiency (IES), calculated as response time / accuracy. There was a significant interaction between cue color and diagnosis ($p < .01$, $BF\neg10 =$

7.120), such that ASD participants were less efficient than TD only on red trials. Neuroimaging analyses examined associations between IES and functional connectivity between nodes of the cognitive control, salience, and default networks. During the cue phase, increased connectivity between ventrolateral prefrontal and inferior parietal regions on red trials was associated with better behavioral performance for ASD but worse performance for TD. During the probe phase, increased connectivity between the retrosplenial cortex and insula related to better performance in ASD, but worse performance for TD. Increased medial prefrontal cortex - parietal operculum connectivity related to poorer performance in ASD on red probes but was not associated with task performance in TD. Taken together, these results suggest that some, but not all, frontoparietal connectivity can be beneficial in ASD.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

D36 Examining Prefrontal Cortex Contributions to Cognitive Flexibility With Noninvasive Electric Brain Stimulation

Kent Hubert[1], Maria Mukhanova[1], Evangelia G. Chrysikou[1], [1]Drexel University

Cognitive neuroscience studies of cognitive flexibility typically employ divergent thinking tasks that prioritize bottom-up processes to generate novel responses. However, real-world creative problem solving is also guided by top-down thinking that puts an emphasis on the goal to be achieved. Here, we introduce the Alternative Objects Task (AOT)-a novel task that incorporates both bottom-up and top-down thought during problem solving. Guided by functional neuroimaging findings, we employed transcranial direct current stimulation (tDCS) over the left frontopolar cortex to investigate causally the impact of transient changes in activity in this region for problem solving performance on the AOT. Participants were presented with a series of goals and generated either a common or an uncommon object that could satisfy each, while undergoing either excitatory (anodal), inhibitory (cathodal), or sham 4 x 1 high-definition tDCS at 1.5 mA over the left frontopolar cortex. Analyses of variance on the effect of tDCS on response fluency, reaction times, and semantic distance revealed significant interactions between task and stimulation type across measures and highlight how goal-orientation during cognitive flexibility may differentially prefrontal cortex contributions to creative thinking.

Topic Area: EXECUTIVE PROCESSES: Other

D37 Cerebello-Striatal Resting-State Network Efficiency and Cortical Network Coherence

T. Bryan Jackson[1], Jessica Bernard[1], [1]TEXAS A&M UNIVERSITY

The cerebellum (CB) and basal ganglia (BG) each have distinct functional subregions that interact with functionally connected cortical regions through discrete thalamic loops. Previous work suggests subcortical interconnectedness may be especially important for cognition (Bostan & Strick, 2018) and our lab has previously shown CB-BG functional connectivity moves from synchrony to asynchrony in older adulthood, helping to clarify age-related performance decline (Hausmann, Jackson, Goen, & Bernard, 2018). Functional networks spanning cortical and subcortical regions contribute to overt behavior and overall cognition, but it is currently unknown how differences in functional connectivity within subcortical regions relate to differences in cortical regions. Here, rsfMRI data from 238 non-related participants (Human Connectome Project-1200) were selected for graph theory analyses designed to test whether within-region subcortical network connectivity predicted between-region network connectivity. Sixty regions comprising canonical cortical (default mode, fronto-parietal, and cingulo-opercular) resting-state networks were defined based on previous work. Preliminary imaging results (n = 30) showed negative correlations in network-level clustering coefficients and local efficiency between the cerebello-striatal network and the default mode network, $r(30) = -.49$, $p < .01$, $r(30) = -.48$, $p < .01$, supporting our general hypothesis that subcortical regions provide a foundation for cortical processing. No significant correlations between subcortical and task-positive networks were found (for all networks $p > .62$). Subcortical network efficiency potentially mitigates the change from default mode to task-positive networks as needed for processing. This work has implications for understanding cortical network organization, as well as cortical-subcortical interactions in both health and disease.

Topic Area: EXECUTIVE PROCESSES: Other

D38 Neurofunctional Indices of Executive Functioning in Autism Spectrum Disorder

Kaitlyn May[1], Rajesh Kana[1], [1]University of Alabama

Autism spectrum disorder (ASD) is characterized by impairments in executive function (EF) (Hill, 2004). While some research attributes this to an overreliance of the prefrontal cortex (PFC), others demonstrate poor recruitment of the PFC in individuals with ASD (Gilbert et al., 2008). In order to assess the emerging consensus across neuroimaging studies of EF in ASD, the current study used coordinate-based anatomical likelihood estimation (ALE) analysis of 18 functional magnetic resonance imaging (MRI) studies. This resulted in a meta-analysis of 900 participants (408 ASD, 492 typically developing (TD) individuals) ranging from 7 to 52 years of age. Within-group analysis (EF task vs. Control Task) revealed that both TD and ASD participants had significant activity in PFC regions. Analysis of group differences indicated greater activation ins ASD, relative to TD participants, in the right middle frontal gyrus (MFG) and the anterior cingulate cortex (ACC), and lesser activation in the bilateral middle frontal, left inferior frontal gyrus (LIFG), right inferior parietal lobule (RIPL), and precuneus. Although both ASD and TD participants showed similar PFC activation, results indicate differential recruitment of wider EF regions such as the IPL in ASD participants ($p = .001$; $k=50$). The absence of parietal activation may be due to a lack of connectivity between frontoparietal networks with other regions during EF tasks (Lynch et al., 2017). These results support the executive dysfunction theory of ASD and suggests that the lack of activation within frontoparietal circuits may be related to some of the EF difficulties individuals with ASD experience.

Topic: EXECUTIVE PROCESSES: Other

D39 Dissociated neural representations of content and structure in auditory sequence memory

Ying Fan[1], Qiming Han[1], Simeng Guo[1], Huan Luo[1], [1]Peking University

When retaining a sequence of auditory tones in working memory, two forms of information - the content and structure - have to be encoded and maintained in the brain. Here we used Electroencephalography(EEG) recordings in combination with a time-resolved decoding approach to examine how the content and structure information are encoded, maintained and retrieved in an auditory working memory task. Specifically, in each trial, subjects were instructed to memorize a list of three pure tones that have different frequencies, and during the delay period, a retrocue instructed subject the position on which the tone frequency would be tested later. In the retrieval phase, a target tone was presented and participants needed to compare its frequency with that of the cued memorized tone. Behavioral performance showed that the memory performance is modulated by the position of both cued and non-cued tones, suggesting the influence of structure information on content representation in auditory working memory. Importantly, EEG results further demonstrate that retaining content (i.e., frequency) and structure (i.e., position in the list) information in working memory relies on largely distinct neural mechanisms in both encoding and maintenance period. Taken

together, our results support dissociated representations of content and structure in auditory working memory.

Topic Area: EXECUTIVE PROCESSES: Working memory

D40 Frequent longitudinal sampling reveals learning-related changes in working memory substrates

Jacob Miller[1], Anastasia Kiyonaga[1], Arielle Tambini[1], Mark D'Esposito[1], [1]UC Berkeley

The neural substrates for working memory (WM) are inconsistent across studies and species. For instance, non-human primate (NHP) electrophysiology studies often conclude that fronto-parietal cortex stores WM representations, while human brain imaging studies find that such content is stored in sensory cortex instead. Yet the fact that NHPs undergo prolonged training on specific tasks and stimuli clouds comparisons to human studies. To address this confound, we collected over 16 sessions of whole-brain functional MRI (fMRI) in each of three human participants while they performed a set of tasks. Across three months, each participant was trained on (1) a serial reaction time (SRT) task, wherein complex fractal stimuli were associated with arbitrary response mappings and embedded within probabilistic sequences, and (2) a delayed recognition task that probed WM for the trained stimuli. All participants showed strong sequence learning effects, with faster RTs for items in sequences across training. Participants also became progressively faster and more accurate during the WM task, and these effects were amplified for trained compared to novel stimuli. Neurally, activity during WM encoding decreased across fronto-parietal and visual cortex with training, suggesting less reliance on these regions for transforming better-learned stimuli into WM representations. However, during the WM delay, activity in the intraparietal sulcus increased across training, suggesting that association cortex may shift from supporting encoding to maintenance. This unique sampling of changing memory function may reconcile disparate WM findings across species, showing that fronto-parietal and visual areas change their process selectivity across an extended training period.

Topic Area: EXECUTIVE PROCESSES: Working memory

D41 An EEG study of the role of executive control in individual differences in working memory

Yuri G. Pavlov[1], [1]University of Tuebingen

Working memory (WM) is a complex phenomenon and it is not a uniform psychological construct. It is unclear what contribution different components of WM make to establish individual differences in WM. To address this issue we recorded EEG from a large sample of human subjects while performing WM tasks. We used a verbal WM paradigm where the participants (N = 156) had to memorize sets of letters and maintain them in WM. We used two types of tasks, which required either only retention of stimulus set (Retention task) or retention and manipulation of the content (mental recombination to the alphabetical order, Manipulation task). The main difference between Manipulation and Retention tasks was the level of involvement of central executive component of WM. Subtraction of activity in Retention task from activity in Manipulation task would reveal 'pure' representation of the central executive on neuronal level. We found that difference power (Manipulation minus Retention) in theta and lower beta are significantly correlated with performance (r=0.24, p=.003 and r=-0.24, p=.003, respectively). The difference between magnitude of theta synchronization and lower beta desynchronization in Manipulation and Retention conditions may serve as an indicator of the effective allocation of neural resources between temporary storage and central executive WM systems. We conclude that successful maintenance and manipulation of information in WM strongly depends on the individual differences in executive functions.

Topic Area: EXECUTIVE PROCESSES: Working memory

D42 Events structure information accessibility less in children than adults

Jie Ren, Katherine Duncan[1], Amy Finn[1], [1]University of Toronto

We parse experience into manageable events in everyday experience (Zacks, Tversky & Iyer, 2001). Importantly, content within an event has been shown to have a privileged state of accessibility for adults, which is quickly lost after entering the next event; these event segments can, therefore, shape our memory and experience in significant ways. However, little is known about whether event structure impacts information accessibility in children, especially given their reduced experience with events. We explored the possible differential impact of event segmentation on children's and adults' information accessibility. Fifty-seven children (7-9 years) and sixty adults (17-38 years) were presented with two cartoons, which were interrupted at points either within or across an event boundary. During these interruptions, participants selected objects that recently appeared in a forced-choice task. Adults and children were both more accurate (ßadult = 0.91, $p < 0.001$; ßchild = 1.15, $p < 0.001$) and faster (ßadult = -0.19, $p < 0.001$; ßchild= -0.10, $p < 0.001$) to remember objects that occurred within vs. across an event boundary. Therefore, both children and adults segment events in a structured manner. Additionally, an interaction between age and event type was observed in reaction times (ßevent*age = 0.07, $p < 0.05$): children's responses differed less for objects that occurred within vs. after event boundaries than adults'. Thus, while the automatic segmentation of complex events emerges by middle childhood, children are less affected by event structures in their information accessibility than adults.

Topic Area: EXECUTIVE PROCESSES: Working memory

D43 Effects of attentional prioritization on the representation of content and of context in visual working memory

Chunyue Teng[1], Qing Yu[1], Bradley Postle[1], [1]University of Wisconsin-Madison

Rapid and flexible prioritization among the contents of working memory is important for adaptive control behavior. Although it has been suggested that the same stimulus information might be represented in different, possibly rotated, representational formats depending on whether it corresponds to a prioritized memory item (PMI) or an unprioritized memory item (UMI; van Loon et al., 2018; Yu & Postle, 2018), interpretation of these results is complicated by negative correlation between the two items held in working memory. The current study was designed to provide an unconfounded assessment of the effects of prioritization on working memory content and context. During fMRI scanning, subjects first viewed the sequential presentation of two oriented gratings ('content') that could appear at any of nine locations ('context'), then, on two occasions, digit retrocues indicated the item to be recalled. Multivariate inverted encoding model (IEM) reconstructions of stimulus orientation indicated that, in early visual cortex, stimulus content was represented in rotated formats depending on priority status (i.e., reconstructions of the UMI were flipped relative to the PMI). For stimulus location, in contrast, it was in IPS that IEM reconstructions revealed rotated representational formats as a function of priority. Thus, a similar active mechanism may be engaged to transform the working memory representation of both stimulus content and its context when that item is not needed to guide an impending decision or action.

Topic Area: EXECUTIVE PROCESSES: Working memory

D44 Rotational remapping between 'decision-potent' and 'decision-null' representations in visual working memory

Quan Wan[1], Ying Cai[2], Jason Samaha[3], Bradley Postle[1], [1]University of Wisconsin-Madison, [2]Zhejiang University, [3]University of California, Santa Cruz

In previous work, we trained a 3-layer fully-recurrent neural network (RNN) to perform a 2-back task to study the transitions in stimulus representation as an item (n) transitioned from memory probe (for comparison vs. n - 2) to unprioritized memory item (UMI; while n + 1 was compared to n - 1), and then to prioritized memory item (PMI; for comparison with n + 2). We tracked stimulus representation by projecting activity patterns of the hidden layer into a 2D space with Principal Component Analysis (PCA). These simulations revealed a decision axis, whereby, on trials requiring a 'match' response, representations of n clustered along a manifold in the center of this 2D space, and on 'nonmatch' trials, representations of n clustered in one of two discrete clouds that flanked the 'match' manifold. While a UMI, the representation of item n rotated to an axis orthogonal to the decision axis, and when a PMI it rotated into alignment with the decision axis. In this study, to see whether the brain implements a similar mechanism, we conducted PCA on EEG data recorded while subjects performed 2-back for oriented gratings. Consistent with RNN results, the EEG representation of n when a UMI was rotated by 177 degrees relative to when a PMI. Moreover, this PMI representation closely resembled the delay-period representational structure of the same stimuli when tested with a 1-item delayed recognition task. Priority in working memory may be implemented by representing information in decision-potent versus decision-null formats.

Topic Area: EXECUTIVE PROCESSES: Working memory

D45 Relationship of atrophy to task-related activity in the language network for different PPA clinical phenotypes

Rania Ezzo[1,2], Jeanne Gallée[1,2], Megan Quimby[1,2], Bradford Dickerson[1,2], Jessica Collins[1,2], [1]Massachusetts General Hospital, [2]Harvard Medical School

Numerous studies have identified a network of brain regions that are selectively engaged during linguistic processing in the healthy brain. The subcomponents of this language network are differentially vulnerable to neurodegeneration in distinct clinical phenotypes of primary progressive aphasia (PPA), a condition characterized by progressive language impairment. In this study we investigated the effects of PPA on the functional integrity of the language network during linguistic processing. A language-localizer fMRI task was administered to patients with a clinical diagnosis of semantic (svPPA, N=8), logopenic (lvPPA, N=11), or nonfluent (nvPPA, N=8) variant PPA, and age-matched older healthy controls (CN, N=8). Functional ROIs (fROIs) were defined including the top 10% of voxels responding to a sentence > non-words contrast, within six brain parcels: anterior temporal (AT), posterior temporal (PT), angular gyrus (AG), inferior frontal orbital (IFGORB), inferior frontal (IFG), and middle frontal gyrus (MFG). Relative to CNs, significantly decreased activation was observed for svPPA patients in AT [t(14)=2.47, p=0.01], and for lvPPA patients in AG [t(17)=2.08, p=0.03] and PT [t(17)= 1.78, p=0.05]. In svPPA a positive relationship between cortical thickness and activity was observed in IFG (r = 0.082, p=0.01). In lvPPA a negative relationship between cortical thickness and activity was observed in AT (r = -0.60, p=0.05) and IFGORB (r = -0.60, p=0.05); and a positive relationship was observed in MFG (r = 0.63, p=0.04). Our results show that linguistic task-related activity is altered in PPA and demonstrates a nuanced relationship to atrophy within the language network in different PPA phenotypes.

Topic Area: LANGUAGE: Development & aging

D46 Examining Relationships between Home Literacy Environment, Language and White Matter Tracts from Infancy to Toddlerhood

Ally Lee[1, 2], Jolijn Vanderauwera[3], Ted Turesky[1,2], Joseph Sanfilippo[1], Jennifer Zuk[1,2], Ellen Grant[1], Nadine Gaab[1,2], [1]Boston Children's Hospital, [2]Harvard Medical School, [3]Universite Catholique de Louvain

Early language abilities are related to the white matter fractional anisotropy (FA) of corresponding neural pathways, most prominently the arcuate fasiculus (AF). Home literacy environment (HLE) has also been shown to be related to reading and language abilities in children. Yet, it remains unclear how HLE is related to language abilities and AF in the earliest stages of language development. The present study investigates the relationship between HLE, early language skills and the structural organization of the left and right AF from infancy to toddlerhood. As part of a larger longitudinal investigation on early language skills, diffusion-weighted MRI and Mullen receptive and expressive language scores were acquired in 26 participants when they were infants (4 ? 12 mo.) and toddlers (18 ? 24 mo.). Automated Fiber Quantification was employed to estimate white matter FA in the AF. StimQ, a questionnaire designed to quantify HLE, was administered to parents at the infant timepoint. Preliminary analyses confirmed a significant correlation between FA of left AF and language abilities at both infant and toddler timepoints, but not with the right AF. Interestingly, while StimQ did not correlate with children's language abilities in infancy, this HLE measure did correlate with the developmental increase in receptive language abilities from infancy to toddlerhood. Furthermore, StimQ in infancy correlated with toddler receptive and expressive language abilities and FA of left AF. This research suggests that HLE sets an important foundation from as early as infancy in shaping early language development and relates to language-related white matter organization.

Topic Area: LANGUAGE: Development & aging

D47 Semantic substitution errors in Chinese reading aloud

Catherine Caldwell-Harris[1], Jiajun Zhu[1], [1]Boston University

Surprisingly, Chinese readers make semantic substitution errors while reading out loud. In a prior study, 90% of Chinese native speakers made errors, such as pronouncing ? 'say' instead of ? 'ask.' Goals. To determine if readers can be constrained to make errors on specific words, and to determine if semantic context is necessary for producing errors. Method. Native Chinese speakers were residents of Shanghai or international students in Boston. Experiment 1 used passages containing two-character words which had a synonym; the synonym had more or less phonetic information. Readers read out loud from a computer screen. In Experiment 2 words belonging to the synonym pairs were used in a lateralized single word naming task. Results. During the passage reading, readers infrequently made errors on the synonym pairs we had inserted, indicating that creating errors is idiosyncratic and cannot easily be manufactured. Error analysis across the whole passage confirmed our hypothesis that lower frequency words were replaced by higher frequency words. In the single word naming task, semantic errors were 33% of all naming errors. Semantic priming, amount of phonetic information, and visual field did not influence errors. Lower frequency words were the stimuli which were most likely to elicit a semantic substitution. Conclusion. Semantic substitutions occur even when semantic context is absent. Low frequency words lose the competition to be named in favor of higher frequency words. In sentence contexts, these are semantically appropriate words, thus providing no error signal to readers that they have read the incorrect word.

Topic Area: LANGUAGE: Lexicon

D48 NSF Funding Opportunities for Cognitive Neuroscience

Kurt Thoroughman, NSF

D49 Spatiotemporal dynamics of left Inferior Frontal Gyrus recruitment during spontaneous and cued speech production

Nikita Agrawal[1], Werner Doyle[1], Orrin Devinsky[1], Adeen Flinker[1], [1]NYU

A variety of speech production tasks are used to localize language for surgical planning to avoid postoperative language deficits. Neuroimaging studies in fMRI and PET have shown that overlearned speech production, such as number counting, does not reliably activate left hemisphere language cortex. Similarly, electrical stimulation of cortex during counting does not reliably produce a speech deficit. While prior studies have linked left inferior frontal gyrus (IFG) activation to pre-articulatory stages of speech production, the timing and degree of IFG recruitment during spontaneous speech remains underspecified. Here, we draw on the high spatial and temporal resolution offered by electrocorticographic (ECoG) data recorded in neurosurgical patients to examine the degree and timing of left IFG recruitment. We measured high gamma (70-150 Hz) power responses time-locked to speech production for several spontaneous and cued speech production tasks: number counting, months recitation, sentence repetition and word reading. We cross-correlated the neural activity with the amplitude of the patient's speech in order to measure the degree of correlation as well as the latency between neural activity and actual speech produced. Preliminary data (N=3) demonstrates that IFG recruitment preceded speech production across tasks but the degree of IFG recruitment increased as the tasks became effortful and utterances less overlearned. Furthermore, adjacent frontal regions were recruited during the spontaneous tasks, including anterior and middle frontal gyri, post speech production. This activity was not seen during cued visual word reading and most likely reflects speech monitoring processes.

Topic Area: LANGUAGE: Other

D50 The Relationship between White Matter Structural Integrity and Language Performance in Individuals with Aphasia

Emily Braun[1], Anne Billot[1], Ajay Kurani[2], Todd Parrish[2], Swathi Kiran[1], [1]Boston University, [2]Northwestern University

This study aimed to evaluate white matter structural integrity and its relationship to measurements of naming and severity in individuals with aphasia. Participants were 34 individuals with chronic post-stroke aphasia who underwent T1-weighted scans and diffusion tensor imaging (DTI) and completed various behavioral measures, including the Boston Naming Test and Western Aphasia Battery ? Revised. T1 and diffusion-weighted images were pre-processed and tractography was completed through Automated Fiber Quantification (AFQ), a method which computes diffusion metrics along white matter tracts binned into segments (Yeatman et al, 2012). Average fractional anisotropy (FA) values for five left-hemisphere tracts of interest and their right-hemisphere homologues as well as the corpus callosum forceps major and minor were determined and related to language measures. Due to stroke lesions, left hemisphere fiber tracts were not able to be rendered in 46% of potential left-hemisphere tracts, ranging from 6% to 74% depending on the tract. For rendered tracts, average FA values were significantly lower for left vs. right inferior fronto-occipital fasciculi (p

Topic Area: LANGUAGE: Other

D51 Alpha suppression increases during situation model construction: Neural evidence for the structure building framework

Emily Coderre[1], Neil Cohn[2], [1]University of Vermont, [2]Tilburg University

To understand a narrative, comprehenders build a mental representation of the story called a 'situation model'. According to the structure building framework, constructing a situation model involves a process called shifting, in which new substructures are created when incoming information coheres less with previous information. Shifting is proposed to require a mechanism called suppression which inhibits information that is irrelevant to the story. In the attentional and executive control literature, EEG power in the alpha frequency band (~7-12 Hz) typically decreases following stimulus onset; this 'alpha suppression' is thought to reflect the suppression of irrelevant information to attend to a salient stimulus. Here we ask whether alpha suppression can serve as a neural measure of suppression during narrative comprehension. Twenty-two neurotypical adults viewed 6-panel visual narrative sequences one panel at a time (1350 ms duration, 350 ms ISI) during concurrent EEG recording. EEG power in the alpha frequency band was calculated from 400-800 ms after presentation of each panel. At the first panel in a sequence, alpha suppression was minimal, but increased as subsequent panels appeared. This aligns with the structure building framework: at the initial panel it is unclear what information is relevant to the story, so alpha suppression is minimal because all details are considered important. As the narrative unfolds the comprehender learns what is relevant and begins to suppress irrelevant details, reflected as increasing alpha suppression. Alpha power can thus serve as a neural measure of suppression during narrative comprehension.

Topic Area: LANGUAGE: Other

D52 Musical Training is Associated with Better Reading and Differences in Resting State Functional Connectivity in Adults

Steven Meisler[1], Ola Ozernov-Palchik[2], Rola Farah[3], Sara Beach[2], Tzipi Horowitz-Kraus[3], John Gabrieli[2], [1]Harvard University, [2]Massachusetts Institute of Technology, [3]Technion - Israel Institute of Technology

Musical training has been linked to better language and reading performance. This has been demonstrated in both correlational and interventional studies. Few studies to date, however, have examined the neural networks supporting these cognitive advantages. Here, we compared the performance of typical adults (mean age: 26 years) with (MUS, N=11, mean years of musical training: 7.65) and without (NMUS, N=25) musical training on multiple reading and language measures. We conducted a whole-brain seed-to-voxel resting state functional connectivity (RsFc) analysis to compare intrinsic differences in language and reading (i.e. left ventral occipitotemporal-vOT seed region) networks between MUS and NMUS. All results were thresholded at a voxel-wise $p < 0.001$ and a cluster extent $p < 0.05$ FWE corrected. MUS performed significantly better than NMUS across language and reading measures ($p < 0.05$). There was greater RsFc in MUS between the right posterior superior temporal gyrus (rPSTG) and the right hemispheric superior parietal, inferior frontal, and supramarginal regions. This network of regions has been shown to support syntactic processing in both language and music. There was a weaker RsFc of the rPTSG to the left cuneus in MUS as compared to that in NMUS. There was also stronger RsFc between the vOT region, a key region for letter/word identification, and the right angular gyrus, a region important for visual-auditory integration. These findings provide some insights into the neural mechanisms underlying the increasingly well-documented positive effects of musical training on language and reading skills.

Topic Area: LANGUAGE: Other

D53 Learning Swedish Predictive Tones Correlates with Grey and White Matter Reorganization

Mikael Novén[1], Merle Horne[1], Markus Nilsson[1], Mikael Roll[1], [1]Lund University

Swedish contains an interesting tone on word stems that can cue inflectional suffixes. This tone aids listeners in speech processing, possibly by pre-activating morphological structures as suggested by results from ERP and fMRI studies. As part of a study of acquisition of the tone-suffix association by second language learners of Swedish, this work investigates the effects of learning on participants' cortical thickness within and diffusion properties between speech processing cortical areas. Subjects were German second language learners of Swedish who got extra tutoring in either tone-suffix association ('melody group') or Swedish morphology ('morphology group)' for four weeks. Before and after training, subjects were scanned in a 7T Philips Achieva scanner to obtain high-resolution T1-weighted and diffusion-weighted images. Rate of increase in cortical thickness correlated with learning outcome in the melody group in a left inferior frontal cluster (r=0.527, t(14)=2.16, cluster-wise corrected p (cwp)=0.0001). The melody group atrophied significantly more than the morphology group in the left inferor parietal cortex (t(23=-3.20, MMelody=-0.0141mm/week, MMorphology=0.0139 mm/week, cwp=0.001) as well as in right temporal (t(23)=-4.22 ,MMelody=-0.0293 mm/week, MMorphology=0.0418 mm/week, cwp=0.001) and inferior parietal areas (t(23)=-3.25, MMelody=-0.0177mm/week, MMorphology=0.0173 mm/week, cwp=0.0319). Change in fractional anisotropy in tracts between the left inferior frontal gyrus and planum temporale correlated with learning outcome in the melody (r= -0.710, t(10)= -3.19, p= 0.00963) The results indicate a process of cortical and white-matter reorganization to possibly integrate and streamline processing of tonal predictive information.

Topic Area: LANGUAGE: Other

D54 Neuronal Activity Reveal Region-Specific Functionality for Language Perception and Production

Leyao Yu[1], Doyle Werner[1], Orrin Devinsky[1], Adeen Flinker[1], [1]NYU

Speech production critically depends on frontal cortex activity to retrieve, plan, and execute speech utterances, but the extent to which the regions are involved across different task demands, modalities, and articulatory loads remains unknown. To investigate this, we employed a battery of five functional tasks including word reading, picture naming, auditory naming, auditory word repetition, and auditory sentence completion in a cohort of 12 neurosurgical patients undergoing treatment for refractory epilepsy while intracranial EEG data was acquired. Neuronal activity from both regular and high-density arrays were collected and epoched locked to stimulus or speech onset. We focused on high gamma (70 ~ 150 Hz) spectral responses shown to correlate with the spiking rate of underlying neuronal populations. Results across patients showed robust STG homogenous responses across the three auditory tasks locked to perception. Responses locked to production showed homogenous responses across the five tasks within pre-central gyrus. In the posterior IFG (pars opercularis), a premotor response profile was evident with significant activity prior to speech onset for all five production tasks. Portions of the anterior IFG (including pars triangularis) showed early activity locked to stimulus onset which was selective to one task or a subset of tasks. A similar profile of task-selective pre-articulatory responses was seen in the posterior MFG adjacent to precentral gyrus locked to both stimulus and speech onset. These data suggest two speech production components in IFG and MFG, a motor-related component shared across tasks, and a task-selective component reflecting task demands and route of word retrieval.

Topic Area: LANGUAGE: Other

D55 Event-related brain potent effects of actions and role relations during second language picture-sentence verification

Pia Knoeferle[1], Katja Maquate[1], Jennifer Lewendon[2], Carsten Schliewe[1], [1]Humboldt-University zu Berlin, [2]Bangor University

Previous ERP research suggests that native language processing mechanisms for role-relation versus verb-action congruence differ. In a picture-sentence verification task, Knoeferle et al. (2014) asked participants to first inspect a clipart scene with for instance a gymnast punching a journalist. Subsequently, a sentence about these characters was presented word by word. The scene either matched the sentence completely (e.g., The gymnast punches the journalist), mismatched in action depiction (e.g., The gymnast applauds the journalist), mismatched in role relations (e.g., The journalist punches the gymnast), or mismatched in both action and role (e.g., The journalist applauds the gymnast). Participants verified picture-sentence congruence. The present study investigated the functional brain responses associated with these world-language relations in L2 comprehenders (16 German natives, pilot study). The materials and setup were identical to Knoeferle et al. (2014). Similar to the original study, including only correctly answered trials, the analyses revealed reliably larger mean amplitude negativities to role mismatches vs. matches during the first noun (gymnast) and the first 100ms of the verb. Action mismatches yielded larger mean amplitude negativities than matches in the N400 verb time window, replicating the effects of the original study. Between study differences emerged in the relativity of the effect and in that an additional mean amplitude difference emerged between role mismatches versus matches in the verb N400 time window.

Topic Area: LANGUAGE: Semantic

D56 A comparison of three vector space models of word meaning for mapping the semantic system

Deborah Levy[1], Stephen Wilson[1], [1]Vanderbilt University Medical Center

What are the relative utilities of different vector space models of word meaning for mapping the semantic system in the brain? In this preliminary study, we investigated the neural correlates of three models of word meaning, using fMRI and representational similarity analysis (RSA). Ten neurologically normal participants were scanned with 3 Tesla fMRI as they processed single words in an event-related paradigm. Semantic similarities between all pairs of words were calculated using three distinct models of word meaning: the experiential attributes model (Binder et al., 2016), fastText (Bojanowski et al., 2016), and GloVe (Pennington et al., 2014). A searchlight approach was then used to calculate correlations between patterns of semantic similarity and patterns of neural similarity centered at each voxel in the brain. Voxelwise t-tests across participants were performed on the resulting correlation maps to identify regions where model-based semantic similarity and neural similarity were reliably correlated. Group maps based on each of the three models revealed a left-lateralized semantic network including the angular gyrus, middle temporal gyrus and inferior frontal gyrus, consistent with prior characterizations of the semantic network (Binder et al., 2009). A series of paired-sample t-tests revealed no significant differences between maps based on the three different models of word meaning, although this may reflect our limited sample size (c.f., Abnar et al., 2018). In sum, our findings suggest that diverse models of word meaning can be used to identify brain regions that encode semantic representations.

Topic Area: LANGUAGE: Semantic

D57 Hemispheric asymmetries in processing semantic relationships during reading

Melissa Troyer[1], Marta Kutas[2], [1]University of Western Ontario, [2]University of California San Diego

Though each cerebral hemisphere is sensitive to sentence-level context, studies of how they jointly contribute to real-time language processing suggest asymmetries. We used event-related brain potentials (ERPs) combined with lateralized visual presentations of critical words to examine hemispheric processing of two types of semantic relationships (categorical, event-based) in sentences about the fictional world of Harry Potter (HP). Participants who varied in their HP knowledge read sentences ending in a word which was variously contextually supported (appropriately completed an HP 'fact'); unsupported/unrelated to the sentence context; or a 'related anomaly' that was unsupported but from the same category as the supported word or related to the overall event/episode described by the sentence. Replicating previous results using central visual presentation, we observed effects of contextual support (unrelated minus supported words) and related anomaly (unrelated minus related words) on ERPs in the N400 time period (250-500 ms), with effects being larger for individuals with greater knowledge. To examine hemispheric asymmetries, we focused on HP 'experts' (N=20). The two hemispheres were similarly sensitive to effects of contextual support, but only the right hemisphere was sensitive to the related anomaly manipulations. The exact pattern of results depended on the nature of the relationship (category, event).

Topic Area: LANGUAGE: Semantic

D58 Humor modulates prediction error updating in first and second language reading comprehension

Megan Zirnstein[1], Rhonda Mudry[2], Sybrine Bultena[3], Dorothee Chwilla[4], Judith Kroll[5], [1]Pomona College, [2]Pennsylvania State University College of Medicine, [3]Radboud University, [4]Donderst Institute for Brain, Cognition, and Behavior, [5]University of California, Irvine

Monolinguals, as well as bilingual L2 readers who are highly proficient and skilled at regulating the dominant L1, typically show the same pattern of brain responses when engaged in predictive reading: smaller N400 effects for predicted words, and larger frontal positive effects for plausible prediction errors (Zirnstein et al., 2018). However, studies that use pragmatic cues to guide expectations (e.g., a child speaker is less likely to talk about her forthcoming retirement; van Berkum et al., 2008; Foucart et al., 2015), generally do not elicit the same prediction error responses. One possibility is that stimuli in these studies were unintentionally humorous, and that humor may indicate to readers that prediction errors need not be resolved or learned from. In two ERP experiments, monolingual English and Dutch-English bilingual speakers viewed pictures and read sentences in their L1 and L2 (e.g., the Queen of England; 'Every morning, I drink...'). Target words were predictable (tea), plausible prediction errors (juice), humorous prediction errors (gin), or implausible (paper). Robust N400 effects were observed for all unexpected words. Attempts to resolve and learn from prediction errors, indicated by frontal positive responses, were reduced for monolinguals with higher self-reported sense of humor. For bilinguals, higher L2 proficiency led to better discrimination between conditions, with a frontal positive response for plausible prediction errors, but not for humorous words. Humor, pragmatic knowledge, and L2 proficiency all appear to play an important role in determining how L1 and L2 readers treat the prediction errors they encounter during comprehension.

Topic Area: LANGUAGE: Semantic

D59 Lists with and without syntax: Neural correlates of syntactic structure

Ryan Law[1], Abu Dhabi Liina Pylkkänen[1], [1]New York University

A fundamental challenge for the neurobiology of syntax is de-confounding syntax from semantics. Recent magnetoencephalographic (MEG) findings implicate the left posterior temporal lobe (PTL) for syntactic composition, evidenced by cases in which two words semantically combine in two conditions but syntactically combine only in one (Flick & Pylkkänen, 2018). Here we used lists as both test and control conditions as a novel approach to controlling semantics to examine neural effects of syntactic structure. Three-noun lists (pianos, violins, guitars) were embedded in sentences (The music store sells pianos, violins, guitars?) and in longer lists (theater, graves, drums, mulch, pianos, violins, guitars?). These list items were matched in both their lexical characteristics and local combinatorics across conditions: in neither case do these words semantically nor syntactically compose with one another (e.g. 'pianos violins' does not form a phrase). We also varied the semantic association levels of the list items to contrast syntax with associative semantics. In a memory-probe task, the presence of structure resulted in increased source-localized MEG activity for lists-inside-sentences over lists-inside-lists in left inferior frontal cortex (242-273ms post-stimulus-onset), left (310-331ms) and right (465-499ms) anterior temporal lobes, and left PTL (344-368ms). Association effects were observed in the left temporo-parietal cortex, with higher activity elicited by high than low associative words (353-419ms). While explanations in terms of the global sentential semantics cannot yet be ruled out, our approach in using lists allows us to rule out explanations in terms of lexical semantics and local semantic composition.

Topic Area: LANGUAGE: Syntax

D60 Attention! Behavioral evidence of distinct contributions of attention and working memory to speech comprehension

Corianne Rogalsky[1], Arianna LaCroix[2], Cassandra Rehwalt[1], Estefania Ordaz[1], [1]Arizona State University, [2]Midwestern University

The relationship between working memory and sentence comprehension is well-studied, yet the role of attention, a precursor to working memory, remains largely unexplored. The present experiment explores the relative contributions of attention and working memory to sentence comprehension in 39 neurotypical adults (18-30 years old, all right-handed native speakers of American English). Participants completed an auditory Attention Network Test to provide measures of three different types of attention: alerting, orienting and executive control. Working memory was measured using the Wechsler Adult Intelligence Scale-IV's Working Memory Index subtests. Auditory sentence comprehension was measured with a sentence-picture matching task, presented in three conditions: (1) with a 15-second delay between sentence and picture to tax working memory, (2) in multi-talker babble to tax attention, and (3) in silence, i.e., a typical listening control condition. Linear regression models indicate no significant relationships between any cognitive measure and sentence comprehension accuracy in the control condition- as expected in young adult neurotypical participants. But notably, better executive control attention performance predicted higher sentence comprehension accuracy when working memory resources were taxed in the working memory load condition, and better working memory performance predicted higher sentence comprehension accuracy in the attention-taxing condition. These preliminary findings suggest that while there is known to be close interactions between working memory and attention processes, attention and working memory may support sentence comprehension in dissociable ways. Thus, further investigation into the role of attention in speech comprehension, independent of working memory, is warranted.

Topic Area: LANGUAGE: Syntax

D61 WITHDRAWN

D62 CSF tau levels correlate with age but not sex or MOCA in a memory clinic population

Syra Mehdi[1], Shreya Nair[1], Anil Nair[1], [1]Alzheimer Disease Center

Background: The Montreal Cognitive Assessment (MOCA) score declines with the severity of a patient's dementia. Mutated tau proteins cause microtubules to fall apart and release an aggregation of hyperphosphorylated tau. This process can lead to neurodegeneration and is a potential explanation for Alzheimer's Disease. The findings of this paper will be useful in better understanding how phosphorylated tau can affect one's memory. Objectives: To analyze the cerebrospinal fluid (CSF) tau proteins among patients attending a memory clinic. Method: Memory clinic patients from July 2010 to July 2019 with available CSF tau results were analyzed retrospectively. Univariate and multivariate analyses of tau with sex, age, race, and education were performed. After normality we analyzed the effect of t-tau on sex and MOCA scores after adjusting for age and race among memory clinic patients. Results: Univariate analyses indicated tau levels were significantly associated with age (r = -0.108, p0.05), MOCA scores (r = -0.108, p>0.05) or race (r = -0.00912, p>0.05). Multivariate analyses confirmed the association of age to CSF total tau levels (p

Topic Area: LONG-TERM MEMORY: Development & aging

D63 Mindfulness training improves cognition and resting-state connectivity between the hippocampus and posteromedial cortex

Gunes Sevinc[1, 2], Johann Rusche[1, 2], Bonnie Wong[1, 2], Bradford Dickerson[1, 2], Sara Lazar[1, 2], [1]Massachusetts General Hospital, [2]Harvard Medical School

Several training programs have been proposed in order to slow or reverse age-related decline in cognitively intact older adults, however intervention-induced increases in cognitive function and their neural correlates remain to be investigated. In this study, we examined common and dissociable correlates of intervention induced changes in brain morphology and resting state neural oscillations following mindfulness (MT, n=45) or cognitive fitness training (CFT, n=50) programs. We hypothesized that the repeated practice of heightened attention to and awareness of present moment sensory experience during mindfulness training will counteract age-related decline in cognitive function through changes in the large-scale memory network. We tested this hypothesis in a randomized controlled longitudinal study design in older adults between 65 and 85 years of age. Preclinical Alzheimer Cognitive Composite (PACC) was used as the cognitive outcome measure. Gray matter volume, resting-state functional connectivity and activity were assessed. We show that while both interventions result in increases in PACC scores, MT is differentially associated with enhanced connectivity between the right precuneus/posterior cingulate and the right hippocampus. We also report an association between connectivity change between these regions and changes in PACC scores. While voxel-based morphometry analyses did not reveal any differences between the two interventions, there was a significant increase in the amplitude of regional neuronal activity in right caudate nucleus following MT compared to the CFT. These findings suggest that mindfulness-based interventions can help maintain optimal neurocognitive functioning through changes in the large-scale memory network and promote successful neurocognitive aging.

Topic Area: LONG-TERM MEMORY: Development & aging

D64 Signed Reward Prediction Errors in the Ventral Striatum Drive Episodic Memory

Cristian Buc Calderon[1], Esther De Loof[1], Kate Ergo[1], Anna Snoeck[1], Nico Boehler[1], Tom Verguts[1], [1]Ghent University

A traditional memory-systems view imposes a rigid distinction between procedural and declarative memory: Whereas procedural memory is shaped and consolidated by dopaminergic reward prediction errors (RPEs), declarative memory is considered to be stored in hippocampal-(neo)cortical patterns of activation. Using fMRI, we demonstrate that, declarative memory also emerges from experiencing RPEs. Using a novel variable-choice task, we experimentally manipulated RPEs. We demonstrate that RPE responses in the ventral striatum predict the strength of subsequent declarative memory. Furthermore, functional connectivity of task-relevant processing areas, hippocampus, VTA, and ventral striatum increases as a function of RPE value during declarative learning, suggesting a central role for these (traditionally procedural memory assigned) areas in episodic memory formation. Our results suggest that RPEs also play a key role in declarative learning.

Topic Area: LONG-TERM MEMORY: Episodic

D65 Neural correlates of emotional episodic memory encoding and retrieval: Neuroimaging meta-analyses using seed-based d map

Kristina Dahlgren[1], Charles Ferris[1], Stephan Hamann[1], [1]Emory University

Neuroimaging meta-analysis methods can summarize the brain regions associated with a cognitive function that are consistently activated across multiple studies. We previously reported activation likelihood estimation (ALE) meta-analyses of episodic emotional memory encoding and retrieval. Seed-based d Mapping (SDM) is an improved method that considers the effect sizes associated with the coordinates of reported activation maxima to produce a more representative summary than other coordinate-only based approaches. SDM also uses threshold free cluster enhancement (TFCE) statistics and permutation tests to better control for false positives. We included 22 encoding studies and 13 retrieval studies that contained successful emotional vs neutral episodic memory contrasts. For successful emotional memory encoding, we found activations in regions associated with episodic memory (bilateral hippocampus and parahippocampal gyrus), emotion processing (bilateral amygdala, insula, basal ganglia temporal pole, and orbitofrontal cortex), and visual processing (bilateral fusiform cortex and right lateral occipital cortex). For successful emotional memory retrieval, we found activation in left hemisphere regions associated with episodic memory (hippocampus, parahippocampal gyrus, and inferior frontal gyrus) and emotion processing (amygdala, insula, basal ganglia, superior temporal gyrus, temporal pole, and orbitofrontal cortex). These findings overlap substantially with our previous ALE meta-analyses but also differ significantly, with SDM revealing larger clusters of activations and additional regions. These findings further clarify the role of the amygdala, hippocampus, and neocortical regions in successful encoding and retrieval of emotional episodic memory and provide an important summary of the current literature in this area.

Topic Area: LONG-TERM MEMORY: Episodic

D66 Item-specific activity immediately preceding a memory-retrieval cue predicts memory retrieval success

Benjamin R. Geib[1], Roberto Cabeza[1], Marty Woldorff[1], [1]Duke University

When successfully remembering an item, stimulus-specific regions reactivate as a function of the identity of the retrieved stimulus. The stimulus-specific characteristic of memory reactivation has been shown with functional magnetic resonance imaging (fMRI); however the associated temporal dynamics are unclear. Research utilizing electroencephalogram (EEG) and

lateralized stimuli at encoding have suggested that reactivation can be observed as early as 100 ms following the presentation of the retrieval cue. However, this latency precedes hippocampal activation (~250 ms), which is thought to mediate the reactivation process and memory retrieval in general. Here we demonstrate that pre-stimulus lateralized activity prior to the presentation of an item cue for memory retrieval (occurring in the same cortical regions that exhibited attention-related subsequent memory effects during encoding) predicts the memory-retrieval success. Our interpretation of this prestimulus effect is that, if an individual's attention randomly happened to be oriented toward one side of space prior to the presentation of a retrieval cue stimulus, and that stimulus item was originally presented on that same side at encoding, the subject will be more likely to be able to correctly report having seen that particular item. As such, we suggest that this is a key example of an individual's pre-stimulus attentional and/or contextual state influencing their memory retrieval success. Moreover, it indicates that pre-stimulus stimulus-specific activity can precede and perhaps even engender later reactivation.

Topic Area: LONG-TERM MEMORY: Episodic

D67 Multi-unit activity in human MTL reflects retrieval of spatial and temporal context

Nora A Herweg[1], Paul A Wanda[1], Lukas Kunz[2], Armin Brandt[2], Michael R Sperlin[3], Ashwini D Sharan[3], Andreas Schulze Bonhage[2], Michael J Kahana[1], [1]University of Pennsylvania, [2]University Medical Center Freiburg, [3]Thomas Jefferson University

Cell-populations in the medial temporal lobe (MTL) represent an animal's trajectory through space as well as the passing of time. These representations support navigation, but they may also play a role for remembering the spatio-temporal contexts associated with specific events. We recorded multi-unit activity (MUA) from micro-wires implanted in the MTL of 19 patients undergoing monitoring for the treatment of drug-resistant epilepsy. Subjects navigated through a virtual town to deliver objects to a sequence of target stores, followed by free recall of the delivered objects. We used subjects' recall transitions to infer the retrieval of spatio-temporal context: if context is retrieved along with an item's identity, it should cue the recall of other items that were encoded in spatial or temporal proximity. We find that MUA in the hippocampus decreases during recalls followed by temporally or spatially close transitions, indicating that a reduction in hippocampal firing rates accompanies contextual retrieval. Firing rates in the parahippocampal gyrus, in contrast, increase during temporal context retrieval. These results indicate that distinct changes in population activity in hippocampus and surrounding parahippocampal gyrus support the retrieval of spatio-temporal context. As such, they provide new insights into the cellular basis of episodic memory retrieval in the human MTL.

Topic Area: LONG-TERM MEMORY: Episodic

D68 Warning eyewitnesses about misinformation influences sensory reactivation during memory retrieval

Jessica M. Karanian[1], Nathaniel Rabb[2], Alia N. Wulff[2], Ayanna K. Thomas[2], Elizabeth Race[2], [1]Fairfield University,[2]Tufts University

Memory for an event can be distorted when eyewitnesses are exposed to misleading post-event information. However, memory performance improves if participants are warned about the veracity of the post-event information. Using fMRI, we investigated the neural mechanisms mediating the effect of warning on eyewitness memory. Specifically, we tested the hypothesis that warning influences sensory reactivation during memory retrieval. Sixty-five participants viewed a silent film depicting a crime and were then exposed to misleading, control, and consistent post-event information via an audio narrative. Participants then took a test during fMRI that probed their memory of the original crime. Critically, some participants received a warning about the veracity of the post-event information whereas others did not. We predicted that warned participants would demonstrate increased reactivation of sensory areas associated with the modality of the original event (visual), while unwarned participants would demonstrate increased sensory reactivation of sensory areas associated with the modality of the misleading information (auditory). Behaviorally, we found that participants in the warning group performed significantly better on misleading trials at test compared to the no-warning group. Warning was also associated with increased visual cortex (BA18) activity during memory retrieval when memory was accurate, which is consistent with the hypothesis that warning encourages retrieval of the original event. In contrast, increased auditory cortex (BA41) activity was observed in unwarned participants when memory was inaccurate, suggesting that memory errors result from reactivation of misleading information. Together, these results suggest that warning improves memory accuracy by influencing sensory reactivation during memory retrieval.

Topic Area: LONG-TERM MEMORY: Episodic

D69 Fitness and Stress as Modulators of Hippocampal Subfield Structure and Function in Aging

Kathryn Kern[1], Rachel Nauer Wehr[1], Thomas Storer[2], Karin Schon[1], [1]Boston University School of Medicine, [2]Brigham and Women's Hospital

A key facet of episodic memory that demonstrates behavioral impairment in aging is pattern separation (PS), or the ability to disambiguate similar stimuli during neural encoding. PS is supported by the dentate gyrus (DG), a hippocampal subfield that demonstrates striking plasticity in response to exercise. In young adults, increasing cardiorespiratory fitness (CRF) is associated with increased left anterior DG/CA3 volume and improved PS task performance. However, how these variables interact in aging is unknown, yet critical, given aging has known effects on hippocampal plasticity. To examine these relationships, 64 participants aged 55-85 years underwent a submaximal treadmill test to estimate CRF, high-resolution MRI to determine hippocampal subfield volumes, and a behavioral PS task with varying levels of stimulus similarity (10, 30, 50%). Inventories of stress, depressive symptoms, and anxiety were collected to include as covariates in analyses. Participants demonstrated significantly impaired performance in the condition with the greatest PS requirement (50%), and left DG/CA3 body volume significantly predicted performance in this condition. However, there was no relationship between CRF and PS task performance. Furthermore, although CRF did not predict DG/CA3 volume, it did significantly predict bilateral subiculum volume, which was statistically driven by female sex. Additionally, perceived stress negatively predicted right DG/CA3 body volume. Altogether, these findings provide support for a role of the DG in PS and suggest that distinct modulators of the hippocampal memory system, such as fitness and stress, may differentially affect hippocampal subfields in older adults.

Topic Area: LONG-TERM MEMORY: Episodic

D70 Reinstated episodic context guides visual exploration during scene recognition

James Kragel[1], Joel Voss[1], [1]Northwestern University

Memories for episodes are temporally structured. Cognitive models derived from list-learning experiments attribute this structure to the retrieval of temporal context information that indicates when a memory occurred. These models predict key features of memory recall, such as the strong tendency to retrieve studied items in the order in which they were first encountered. Can such models explain ecological memory behaviors, such as eye movements during encoding and retrieval of complex visual stimuli? We tested predictions from retrieved-context models using three datasets involving recognition

memory and free viewing of complex scenes. Subjects (N=120) reinstated previously encoded sequences of eye movements during retrieval. Moreover, successful memory involved greater sequence reinstatement, which decayed over time. We observed memory-driven reinstatement even after accounting for intrinsic scene properties that produced consistent eye movements across individuals. These findings confirm predictions of retrieved-context models, suggesting retrieval of temporal context influences complex behaviors generated during naturalistic memory experiences. As recollection of episodic context is mediated by the hippocampus, these results suggest a mechanism by which hippocampal-dependent processes influence visual exploration. We relate these findings to recent and ongoing studies from our group linking memory-guided eye movements to direct recordings of theta oscillations from the human hippocampus.

Topic Area: LONG-TERM MEMORY: Episodic

D71 Cortisol-Testosterone Interactions on Approach/Avoid Behaviors and Emotional Memory Consolidation

Antonio Martinez Tlatenchi[1], Jessica Payne[1], [1]University of Notre Dame

Memory for emotionally salient information is often preserved at the expense of less salient information. Stress related hormones (e.g. cortisol) have been shown to modulate emotional memory effects. Critically, cortisol may interact with other hormones, such as testosterone, to influence behavior and memory. Additionally, increases in testosterone concentrations can impair identification of emotionally salient cues and increase approach behavior towards threatening stimuli, but only when concurrent cortisol levels are low. The aim of the present study was to examine cortisol-testosterone interactions in relation to approach/avoid behaviors and emotional memory performance. Participants (N=143; women=89; control=68) completed an encoding task in the afternoon, provided saliva samples prior to and after a stressor or matched control condition, and were tested for memory performance the following morning. Reactivity measures for cortisol and testosterone were utilized. A hierarchical regression and subsequent simple slope analysis revealed a significant cortisol-testosterone interaction effect on approach/avoid behavior (B=-0.360,t=-2.635,p=0.009), such that participants who rated themselves as more likely to approach negatively valenced scenes also had higher levels of testosterone in relation to lower co-occurring levels of cortisol. Additionally, approach behavior with regard to negatively valenced scenes was negatively correlated with emotional tradeoff scores (p=0.013), such that approaching negatively valenced scenes was associated with a decrease in preservation of the emotional aspects of scenes compared to its associated neutral background. Our results, in conjunction with previous research, suggest a need to consider cortisol-testosterone interactions to understand emotional episodic memory performance.

Topic Area: LONG-TERM MEMORY: Episodic

D72 WITHDRAWN

D73 Neural mechanisms underlying face memories modulated by context-dependent impressions of trustworthiness for others

Taiki Nishioka[1], Saeko Iwata[1], Takashi Tsukiura[1], [1]Kyoto University

The first impression of face-dependent trustworthiness is updated by a social context. Previous studies have demonstrated that the temporo-parietal junction (TPJ), dorsomedial prefrontal cortex (dmPFC) and inferior frontal gyrus (IFG) are associated with the updating of trustworthiness for others. In addition, the importance of the anterior temporal lobe (ATL) in social knowledge of persons has been identified in fMRI studies. However, little is known about the neural mechanisms underlying the effects of context-dependent trustworthiness on memory for others. The present fMRI study investigated this issue. Healthy young adult females performed the encoding and retrieval tasks. In an encoding trial with fMRI, participants were initially presented with an unfamiliar face and rated the first impression of face-dependent trustworthiness (1st phase). After the 1st phase, participants were presented with the face paired with a sentence describing the hypothetical action, and rated the overall impression of trustworthiness modulated contextually by the sentence (2nd phase). During retrieval, participants recognized target faces. Behavioral results showed that low trustworthy faces in the 2nd phase were remembered more accurately than the other faces. In fMRI, activation in the 2nd vs. 1st phase was inclusively masked with linearly increasing activation from trustworthy to untrustworthy faces in the 2nd phase. This analysis yielded significant activation in the left dmPFC, IFG, TPJ, and bilateral ATL. Successful encoding activation was identified in the bilateral hippocampi. These findings suggest that the network including the dmPFC, TPJ, IFG, ATL and hippocampus could contribute to the memory enhancement for faces with context-dependent untrustworthy impression.

Topic Area: LONG-TERM MEMORY: Episodic

D74 Pattern Separation Deficits in Multidimensional Schizotypy Consistent with Findings in Schizophrenia

Lili Sahakyan[1], Chris Wahlheim[2], Thomas Kwapil[1], [1]UIUC, [2]University of North Carolina

Current models suggest that schizophrenia is understood as the most extreme expression of a multidimensional continuum of symptoms and impairment referred to as schizotypy. Schizotypy in non-disordered adults predicts heightened risk for developing schizophrenia-spectrum disorders. Schizophrenia is associated with disruptions in detecting subtle differences between objects, which is linked to hippocampal dysfunction. In Mnemonic Separation Task, patients are less likely to recognize similar lures as 'similar' (pattern separation deficits), along with propensity to mistake similar lures for old items (enhanced generalization). However, studies have not examined whether schizotypy is associated with these deficits in non-disordered adults. We examined 230 young adults assessed for positive, negative, and disorganized schizotypy. To examine whether schizotypy predicted pattern separation (proportion of similar lures called 'similar'), we computed a linear regression entering the schizotypy dimensions and their interactions. The negative x disorganized schizotypy interaction was significant. Simple slopes indicated that negative schizotypy was associated with pattern separation deficits only at high levels of disorganized schizotypy. The effect remained after partialling out bias for calling new items 'similar'. Furthermore, the negative x disorganized schizotypy interaction predicted the proportion of similar lures called 'old' (increased generalization). Simple slopes indicated that negative schizotypy was associated with increased generalization only at high levels of disorganized schizotypy. While negative schizotypy was associated with impaired pattern separation and increased generalization at high levels of disorganized schizotypy, there was not a comparable relationship with overall recognition accuracy, suggesting that the effect was specific to pattern separation, consistent with findings with schizophrenia patients.

Topic Area: LONG-TERM MEMORY: Episodic

D75 Differential effects of reappraisal- and suppression-based regulation during retrieval of episodic memories

Rosalie Samide[1], Maureen Ritchey[1], [1]Boston College

Regulating negative emotions that arise while remembering an unpleasant event (retrospective emotion regulation) presents a persistent challenge. Cognitive and clinical research suggests that reappraisal-based emotion regulation strategies, which involve deliberately reframing an event to render

it less negative, tend to be more effective at reducing negative affect than suppression-based strategies, such as deliberately avoiding remembering. Little is known, however, about how these strategies affect objective memory detail or long-term emotion regulation success when employed during remembering. To address this issue, participants in the current study (n = 47) watched real-life news broadcast videos with emotionally negative content and rated the emotionality of each video. In a within-subjects design, they then reappraised or suppressed their memory for each event, compared to baseline retrieval-alone and no-retrieval conditions. The next day, they completed a cued recall task in which they described each video and rated the emotionality and vividness of their memory. Compared to retrieval-alone, reappraisal was associated with decreased negative valence from encoding to cued recall. However, reappraised videos were remembered at the same rate as retrieval-alone videos and more frequently than suppressed videos. There were no differences in memory vividness or number of total or correct details remembered across strategies. Together, these findings suggest that reappraisal is effective at reducing negative affect associated with complex emotional memories while maintaining memory accessibility and accuracy. Future work will explore the role of hippocampal memory reactivation in mediating reappraisal-related memory changes.

Topic Area: LONG-TERM MEMORY: Episodic

D76 Frontoparietal contributions to strategic criterion shifts during recognition memory

Tyler Santander[1], Elissa Aminoff[2], Michael Miller[1], [1]University of California, Santa Barbara, [2]Fordham University

Memories are often imperfect representations of the past. When faced with uncertainty in the available evidence, strategic use of contextual cues can support optimal performance through the adaptation of appropriate decision criteria. Here, 100 healthy adults performed a recognition memory task during fMRI scanning. At encoding, participants first studied three lists of 51 words each; subsequent tests required 'Old' or 'New' memory judgments across blocks of alternating target prevalence. In one condition, participants were informed target probability was high (70% old, encouraging 'Liberal' decision criteria); in the other condition, target probability was low (30%, encouraging 'Conservative' criteria). Behavioral analysis using signal detection theory confirmed the efficacy of this manipulation: on average, participants adopted Liberal criteria when target probability was high and Conservative criteria when target probability was low. We then assessed general differences in task-related activity between trials requiring a criterion shift ('Switch' events) and trials requiring the maintenance of a criterion ('Same' events). This analysis revealed recruitment of a vast, bilateral frontoparietal network for Switch > Same, spanning wide swaths of posterior parietal and dorsolateral prefrontal cortex. Zooming in on specific shifts (i.e. Liberal to Conservative vs. Conservative to Liberal) revealed significant bilateral activity in the supramarginal gyrus (SMG), driven by Liberal to Conservative switches. At large, these findings are consistent with previous research on strategic criterion shifts during recognition memory, implicating a broad network of frontoparietal control regions. A particular role for the SMG in Liberal to Conservative shifts has not yet been identified and warrants further consideration.

Topic Area: LONG-TERM MEMORY: Episodic

D77 Neural Correlates of Autobiographical Memory Retrieval: A Meta-Analysis Using Seed-based d Mapping

Susie Shepardson[1], Kristina Dahlgren[1], Stephan Hamann[1], [1]Emory University

Autobiographical memory (AM) is a type of episodic memory that involves the recollection and re-experiencing of personal life events. A large number of neuroimaging studies have investigated AM retrieval, a complex process involving the coordination of multiple regions across the brain. Neuroimaging meta-analyses can summarize the brain regions associated with AM retrieval and reveal consistent patterns across multiple studies. Here we used a recently developed meta-analysis technique, seed-based d mapping (SDM), to summarize the findings from a large number of AM retrieval studies. A major advantage of SDM over similar methods is that it takes into account the effect sizes associated with the activation coordinates from studies, producing a more representative summary of activations. Studies were included if they elicited AM retrieval during scanning and used a matched active control task (perceptual-motor, semantic, or imagery), yielding 48 studies. The SDM analysis identified clusters of activation in several regions that have been implicated in AM retrieval: bilateral medial temporal lobe regions including the amygdala, hippocampus, entorhinal cortex, perirhinal cortex, and parahippocampal cortex as well as other neocortical regions including the anterior and posterior cingulate cortex, prefrontal cortex, bilateral angular gyrus, bilateral middle temporal gyrus, bilateral fusiform cortex, and the left and right lateral occipital cortex. Although the areas of activation identified in the SDM meta-analysis differed from those reported in previous meta-analyses, there were also areas of substantial overlap. These meta-analytic findings further clarify and refine knowledge regarding the regions typically involved in autobiographical memory retrieval.

Topic Area: LONG-TERM MEMORY: Episodic

D78 Neural representations of structured semantic knowledge mediate variability in episodic memory

Shao-Fang Wang[1], Jiefeng Jiang[1], Tyler Bonnen[1], Chris Iyer[1], Anthony Wagner[1], [1]Stanford University

Computational models and behavioral evidence indicate that semantic similarity has a powerful effect on episodic memory. Emerging neural data suggest that similarity in cortical activity patterns reflects, in part, similarity of semantic knowledge and relates to episodic memory decisions. Here, we sought to further delineate (a) how semantic similarity influences the similarity of cortical and hippocampal encoding patterns, and (b) how model-based and neural measures of similarity predict later recognition memory. We first quantified the similarity of semantic knowledge using word embeddings (cosine similarity; cs) from a Natural Language Processing model (GloVe). Leveraging these model-based metrics, we selected 80 target words; for each, we identified five semantically similar words (mean cs = 0.52, SD = 0.06) and five control-level similarity words (mean cs = 0.34, SD = 0.01). In a behavioral experiment, participants studied the five words from each of 20 semantically similar and 20 control lists, and later made recognition memory decisions on studied words, unpresented target words for studied lists (critical lures), and unpresented target and list words for unstudied lists. Behavioral results (N=33) validated that model-derived cs predicts the hit rate to studied words and false alarm rate to critical lures. In an fMRI experiment, independent participants viewed all words, yielding the similarity of cortical and hippocampal activity patterns of the words. To understand how similarity structure of semantic knowledge modulates episodic memory, analyses will examine how model-based cs relates to neural similarity/distinctiveness, and how similarity-driven cortical-hippocampal interactions predict memory.

Topic Area: LONG-TERM MEMORY: Episodic

D79 Targeted Memory Reactivation of Face-Name Associations Depends on Undisturbed Slow-Wave Sleep

Nathan Whitmore[1], Adrianna M. Bassard[1], Ken A. Paller[1], [1]Northwestern University

Targeted memory reactivation (TMR) is a powerful tool to study memory consolidation through the use of sensory cues to reactivate memories during sleep. Memories are typically strengthened by TMR compared to control conditions. Göldi and Rasch (2019) recently reported a more complex pattern of results when TMR was implemented in participants' homes. TMR weakened word-pair associations in participants who reported sleep disturbance from TMR, but strengthened associations in those who reported undisturbed sleep. Our results complement these findings, adding polysomnographic data on sleep disruption. Participants (N=24) learned and were tested on 80 face-name associations organized into two sets. Participants were retested following a 90-minute nap in which one set was reactivated during slow-wave sleep using spoken names and an associated music track. Both before and after sleep, participants were tested on cued recall of a name given a face. We performed offline sleep scoring and also measured each participant's sleep disturbance by calculating the degree to which spoken names perturbed the EEG spectrum during sleep. TMR improved cued recall performance for reactivated face-name pairs preferentially in participants with low sleep disturbance and high slow-wave sleep duration. Sleep disturbance and slow-wave sleep duration were inversely correlated and may both reflect a latent variable of slow-wave sleep quality. Combined with previous findings, our results suggest that slow-wave sleep duration and quality can shape the effects of TMR in multiple tasks and experimental settings. The fine-grained architecture of slow-wave sleep is thus relevant for understanding the consequences of memory reactivation during sleep.

Topic Area: LONG-TERM MEMORY: Episodic

D80 Differential Mnemonic Discrimination of Faces: A Contributing Mechanism to the Other-Race Effect

Jessie Yaros[1], Diana Salama[1], Derek Delisle[1], Myra Larson[1], Blake Miranda[1], Martina Hollearn[1], Bethany Houalla[1], Guanqiao Yu[1], Robert Jirsaraie[1], Michael Yassa[1], [1]UC Irvine

People often recognize and remember faces of individuals within their own race more easily than those of other races. While behavioral research suggests that the Other-Race Effect (ORE) is related to enhanced experience with and attention towards one's own race group, the neural mechanisms underlying the effect remain unclear. In addition to perception and attention, the potential contributions of mnemonic, or medial-temporal lobe processing to the ORE should be assessed. We address this gap using models of mnemonic interference reduction that are becoming increasingly popular in memory research; The hippocampus and surrounding medial-temporal cortices are involved in pattern separation, a neurocomputational process that allows for detailed encoding of similar experiences by reducing overlapping mnemonic 'interference' across similar inputs. By employing a mnemonic discrimination task (frequently used to assess this interference-reduction capacity in humans), we characterize the ORE as the ability to resolve mnemonic interference-- at levels of 50%, 60%, 70%, and 80% visual overlap-- between prior memories for faces and new experiences of faces of subjects' own and another race. Subjects demonstrated enhanced recognition accuracy for same-race over other-race stimuli at intermediate and high interference levels (60% - 80%). Furthermore, preliminary neuroimaging results indicate involvement of the perirhinal cortex rather than fusiform face area in representing race and interference differences across novel same and other-race faces. These findings suggest that the ORE may emerge in part due to 'tuned' mechanisms in non-traditional face-processing regions that enhance same-race, at the expense of other-race face detection.

Topic Area: LONG-TERM MEMORY: Episodic

D81 Consumption of a fermented dairy beverage over four-weeks improves relational memory in healthy young adults

Corinne Cannavale[1], Annemarie Krug[1], Hannah Holscher[1], Naiman Khan[1], [1]University of Illinois at Urbana-Champaign

Converging evidence suggests probiotic supplementation benefits in circulating cortisol, depression, and memory function for persons with gastrointestinal disorders. However, the data surrounding healthy populations is limited. This double-blind, randomized, controlled, crossover pilot trial aimed to elucidate whether similar effects are apparent in healthy adults. Twenty-six participants (25-45 years) completed testing prior to and after 4-week consumption, with an at least 2 to 4-week washout between treatments, of a dairy-based fermented beverage that contained a mix of Bifidobacterium, Lactobacillus, Streptococcus, Luconostoc, and Saccharomyces or isocaloric, non-fermented control beverage. Hippocampal-dependent relational memory and depressive symptoms were assessed using a spatial reconstruction task and the Depression Anxiety Stress Scales (DASS-42). Pooled 24-hour urine samples were analyzed using an enzyme-linked immunosorbent assay to determine urinary free-cortisol concentrations. Two-by-two repeated measure ANOVA revealed that consumption of the fermented beverage significantly improved misplacement and object-location binding scores extracted from the spatial reconstruction task ($F[1, 25] = 4.54$, $p=0.043$), ($F[1, 25] = 5.50$, $p=0.027$)). Urinary cortisol and DASS scores were not significantly changed by either arm of the intervention. These data suggest that consumption of a fermented dairy beverage improves hippocampal-dependent relational memory function in a healthy young adult population. This study indicates that more large-scale studies must be done to determine the effects of fermented dairy beverage consumption in healthy populations.

Topic Area: LONG-TERM MEMORY: Other

D82 Dissociating fMRI activity related to familiarity strength vs. decision criteria during recognition memory

Evan Layher[1], Courtney Durdle[1], Sara Leslie[1], Tyler Santander[1], Michael Miller[1], [1]UC Santa Barbara

Recognition memory judgments require comparing familiarity strength elicited by an item to a decision criterion. If memory strength exceeds the decision criterion people will decide that an item is 'old,' otherwise the item is reported as 'new.' Since a recognition response encompasses both memory and decision processes, it's difficult to dissociate fMRI activity associated with the criterion versus familiarity strength. Therefore, we administered a recognition memory task that manipulated decision criteria and familiarity strength at four different levels creating a fully crossed 4x4 design. To obtain sufficient statistical power, we scanned a single individual across 16 test-retest fMRI sessions, each of which contained 16 test blocks (one for each criterion/familiarity condition). During an initial study phase the participant viewed face images either one, two, four, or eight times. At test, the participant earned four cents for each correct response, but lost either one or eight cents for critical errors (either false alarms or misses) without any penalty for non-critical errors. In a whole-brain analysis of the old > new response contrast, we found criterion placement (c) to be strongly associated with widespread activity in frontal-parietal regions, particularly anterior insula, inferior/middle frontal gyrus, angular gyrus, and superior parietal lobule. Conversely, discriminability (d') showed much sparser associations with frontal-parietal

regions (e.g. precuneus and inferior frontal gyrus). The results from this individual are largely consistent with the group findings of Aminoff and colleagues (2012) who attributed much of the fronto-parietal activity in the hit > correct rejection contrast to c instead of d'.

Topic Area: LONG-TERM MEMORY: Other

D83 Using event related potentials to understand the effect of feedback timing on learning systems

Kristen Nunn[1], Robert Creighton[1], Victoria Tilton-Bolowsky[1], Yael Arbel[1], Sofia Vallila-Rohter[1], [1]MGH Institute of Health Professions

Categorization allows new and familiar information to be integrated into the appropriate schemas. Research manipulating feedback timing has elucidated the role of explicit and implicit learning mechanisms in rule-based and information-integration category learning tasks (e.g., Smith et al., 2014). The current study aims to understand the learning systems involved in prototype distortion tasks in younger and older adults. Two counterbalanced stimulus sets of an A/B prototype distortion task were presented to 19 younger and 18 older adults. Feedback on response accuracy was immediate (500ms) or delayed (6000ms). Event related potentials (ERPs) were used to examine the electrophysiological response to feedback under the two conditions. Feedback related negativity (FRN) is associated with dopaminergic reward processing in the anterior cingulate cortex during implicit learning. Conversely, the N170 is hypothesized to reflect information binding in the medial temporal lobe during explicit learning. Accuracy did not differ across feedback conditions. For younger adults, the FRN was larger in the immediate condition while the N170 was larger in the delayed condition suggesting that younger participants relied on implicit mechanisms in the immediate condition and explicit mechanisms in the delayed condition. Older adults exhibited a larger N170 in the delayed condition than in the immediate condition and relatively limited FRN under both conditions. Results support the hypothesis that feedback timing affects the mechanisms that support learning. Behavioral performance was consistent across conditions but associated with distinct electrophysiological processes. Dopaminergic reward processing in older adults merits further study and will be discussed.

Topic Area: LONG-TERM MEMORY: Other

D84 Disitinct disruption of functional connectivity in semantic dementia

Marty Fiatia[1], Francis Eustachea[1], Mikael Laisneya[1], Harmony Duclosa[1], Serge Belliarda[1], Vincent de La Sayettea[1], Béatrice Desgrangesa[1], Armelle Viarda[1], [1]Normandie Univ, UNICAEN, PSL Research University, EPHE, INSERM

Progressive deterioration of semantic memory and anomic speech, with relatively preserved syntax, prosody, articulation, phonology, and episodic memory are defining characteristics of semantic dementia(SD). Semantic deficits in SD are classically attributed to temporal lobe atrophy which is maximal at the ventral and lateral portions of the anterior temporal lobe(ATL). Recent neuroimaging studies have associated SD with disruptions of common intrinsic connectivity networks throughout the brain at task and rest. These impairments in functional connectivity(FC) mostly implicate regions of the Default Mode Network(DMN), particularly the anterior portions associated with semantic and executive functions. We employed whole-brain, seed-based connectivity analyses during task-free fMRI to examine the association of language and semantic SD impairments with DMN FC. We characterised DMN FC in 20 healthy controls and then compared FC strength to 16 SD patients. Patients exhibited hypoconnectivity between DMN seeds in the prefrontal, ATL, and posterior cingulate cortex, and hyperconnectivity between the ATL and a non-DMN insula region. Targeting seeds exhibiting SD impairments, we conducted whole brain correlations of FC with performance on semantic knowledge and fluency tests. These revealed associations of performance with SD disruptions in ATL and prefrontal FC, which persisted after correcting for influences of atrophy. The findings support conclusions that SD DMN disruptions are predominantly mediated by ATL regions, and provide evidence for proposals that verbal and semantic SD impairments are subserved by disruptions in ATL and prefrontal FC. The cognitive dissociations that typify SD may therefore be attributed to large scale FC changes throughout the DMN.

Topic Area: LONG-TERM MEMORY: Semantic

D85 Waves of Binding: EEG oscillations during integration of visual, auditory, and lexical stimuli

Hannah M. Morrow[1], Eiling Yee[1], [1]University of Connecticut

If conceptual knowledge about concrete objects is represented (in part) across the brain regions that are active when those objects are perceived, how is information from those regions integrated, or 'bound' into a coherent whole? One potential mechanism for binding is synchronized neuronal firing. In particular, high-frequencies (e.g., gamma) may support local interactions, while lower frequencies (e.g., theta) may support longer-range interactions. However, whether gamma reflects binding has been contested, and theta has also been implicated in inhibition and memory. We recorded participants' EEG while they were presented with pairs of visual and auditory stimuli that were either congruent or incongruent (e.g., a picture of a lion followed by either a roar, or a bang sound, respectively), predicting that integration and thus gamma power should be greater for congruent pairs (Schneider et al., 2008). We also manipulated whether the sounds following the pictures were non-lexical (e.g., a roar sound) or lexical (e.g., the word 'roar'), predicting that the interactions involved in integrating lexical information would be longer-range (e.g., visual areas to anterior temporal lobe and/or inferior frontal gyrus) and thus produce more sustained theta activity. We found no differences between conditions in gamma, but a significant increase in late theta for incongruent vs. congruent lexical trials, which we speculate may be due to working memory load. Our findings underscore the need to identify which aspects of theta (specific frequencies, coherence between regions, cross-frequency coupling) may be due to integration vs. inhibition vs. memory load.

Topic Area: LONG-TERM MEMORY: Semantic

D86 Behavior and neurophysiological correlates of sensitivity to positional regularity in a novel statistical learning test

Denise Wu[1], Andhika Renaldi[1], [1]National Central University

Statistical Learning (SL) is the ability to detect regularity in the environment. Previous SL research in the visual modality has mainly focused on people's sensitivity to the relationship between stimuli. To investigate SL of stimuli associated with specific positions in visual displays and to identify the neurophysiological correlates of such capacity, we have developed a novel SL test in which two shapes are presented consecutively in pairs with simultaneous recording of event-related potentials (ERPs). In the study phase, the standard pairs always include two shapes each of which appeared in a specific temporal position, though the combination of the two shapes was not specific or unique. In contrast, the deviant pairs always include two shapes appearing in the opposite positions from the standard pairs. In the test phase, each shape encountered in the study phase was paired with a novel shape that was not encountered before. Participants' sensitivity to the positional regularity was measured by familiarity judgment and pattern completion. The behavioral results from the test phase revealed great individual difference of the SL ability of positional regularity. The ERPs results recorded from the study phase further showed that the deviant pairs elicited a larger N400 component

than the standard pairs did in the posterior region of the scalp only in the participants whose behavioral performance in the test phase was better than the chance level. Whether the SL of positional regularity correlates with other types of SL or other cognitive abilities will be explored in future research.

Topic Area: LONG-TERM MEMORY: Skill Learning

D87 Distinct patterns of intrinsic spectral-power associations on the sub-second and seconds timescales

Marcia Grabowecky[1], Melisa Menceloglu[1], Satoru Suzuki[1], [1]Northwestern University

We investigated the global structure of intrinsic resting cross-frequency dynamics by examining power-based temporal associations between a broad range of oscillation frequencies within and across EEG-electrode sites. We focused on power-based associations that reveal unique timescale dependence (independently of interacting frequencies). Large power fluctuations across sites occurred at two characteristic timescales, sub-seconds (within 500ms) and seconds (~3.75s), yielding distinct patterns of spectral-power associations. On the sub-second timescale, within-site associations appeared consistently between pairs of beta-gamma frequencies differing by a constant delta-f, e.g., delta-f~10Hz at posterior sites and delta-f~16Hz at lateral sites) suggesting that higher-frequency oscillations are organized into amplitude-modulated packets, whereas cross-site associations were frequency-specific (particularly in the 6-12Hz and >30Hz ranges). On the seconds timescale, within-site associations were characterized by a broad range of frequencies selectively associated with ~10Hz at posterior sites and associations among higher (>20Hz) frequencies at lateral sites, whereas cross-site associations were characterized by a broad range of frequencies at posterior sites selectively associated with ~10Hz at other sites, associations among higher (>20Hz) frequencies between lateral and anterior sites, and prevalent associations at ~10Hz. Within-site associations were weak at anterior sites, suggesting relatively frequency-independent oscillatory processes. These results demonstrate that relatively simple timescale-dependent patterns characterize the global structure of intrinsic spectral-power associations. Recent studies have demonstrated the alpha-rhythm of visual perception and its association with occipital-alpha oscillations, whereas our results suggest that occipital-alpha oscillations also play a role in organizing higher-frequency oscillations into ~10Hz amplitude-modulated packets to communicate with other areas.

Topic Area: METHODS: Electrophysiology

D88 Uncovering dynamical states through concurrent electroencephalography (EEG) and electrocorticography (ECoG)

Nuttida Rungratsameetaweemana[1], Claudia Lainscsek[2], Javier O. Garcia[3], Kanika Bansal[3], Sydney S. Cash[4, 5], Terrence J. Sejnowski[2], [1]University of California, San Diego, [2]The Salk Institute for Biological Studies, [3]US Combat Capabilities Development Command Army Reseach Lab, [4]Massachusetts General Hospital, [5]Harvard Medical School

Identifying and mapping information flows between functionally heterogenous brain regions is fundamental to understanding human cognition and variability in behavior. Using tailored brain structural network models, a recent study (Bansal et al., Science Advances, 2019) has shown that chimera states (coexisting domains of synchrony and asynchrony) formed across different brain regions play a crucial role in the cognitive organization of the human brain. To further investigate these chimera states as well as their roles in large-scale brain function, the present study examines the spatio-temporal dynamics of chimera states in concurrent EEG/ECoG recorded from patients with epilepsy. We combined the network-based framework introduced by Bansal et al. with delay differential analysis (DDA; Lainscsek et al., Chaos, 2019). DDA is a noise-insensitive, non-linear analysis that has been shown to uncover the underlying dynamics of various neural states and behavior in a variety of biological systems. Due to their high spatial as well as temporal resolution, concurrent EEG/ECoG data allow us to examine not only the spatio-temporal dynamics throughout the brain, but also the directions of information flows between different brain regions. Our findings demonstrate that cognitive states in humans are highly dynamic and that variability in cognitive performance across individuals are partially explained through (i) their fluid cortical state changes, and (ii) the nature of information flows across brain regions. Our findings extend the previous work to human EEG and add to the growing body of literature that underscore the importance of partially synchronous populations of neural elements to human brain function.

Topic Area: METHODS: Electrophysiology

D89 QEEG based cortical sources of default mode network in addiction.

Simran Kaur[1], Shaon Ghosh Dastidar[1], Yatan Pal Singh Balhara[1], Prashant Tayade[1], Ratna Sharma[1], [1]AIIMS, New Delhi

Hindi language written in Devanagari script (orthography) has visuospatial complex features that increases neurocognitive load on the brain cortical areas. Dyslexic children face difficulty in reading due to the presence of this complex feature in the language. However, no literature is available reporting cortical sources of visuospatial complexity of Hindi language using Quantitative Electroencephalography (QEEG).This study aimed to identify the cortical sources during the presentation of visuospatially complex meaningful Hindi words using QEEG. Twenty healthy volunteers (23.7 ± 3.1 yrs.) were presented 30 complex words (with vowels diacritics and ligature consonants). EEG data were recorded during the task and source localization was performed using sLORETA. The current study showed significant ($p = 0.05$; $t = 1.169$) activation in Superior and middle frontal gyrus, inferior parietal lobule, cingulate gyrus and deactivation in anterior cingulate, and medial frontal gyrus during the presentation of complex words. Superior and middle frontal gyrus could be associated with the top-down control of visual attention during complex language processing. Inferior parietal lobule activation might represent the translation of the orthographic symbols to phonemic representation. Cingulate cortex along with inferior parietal lobule activation could be responsible for an accurate ambiguity resolution in complex language processing. Medial frontal cortex deactivation which has previously been implicated in action selection and outcome in complex cognitive tasks such as language might be due to the higher demand involved in the processing of complex language.

Topic Area: METHODS: Electrophysiology

D90 Using fNIRS to Determine Dual Task Walking Brain Activation Changes in Older Adults: Systematic Review and Meta-Analysis

Alka Bishnoi[1], Manuel Hernandez[1], [1]University of Illinois at Urbana-Champaign

Objective: Systematically review and quantitatively synthesize brain activation differences in adults with and without neuromuscular disease while dual-task walking. Methods: Searched using four databases: PubMed, Scopus, PychInfo and Web of science. The keywords used were: dual task, walking, adults, neuroimaging or functional near infrared spectroscopy. The studies included met the following inclusion criteria: used fNIRS to measure brain activation; included dual-task walking; done on humans; English language. Results: 37 out of 61 studies met the inclusion criteria of systematic review, out of which 18 were included for meta-analysis. The three different dual tasks used in most of the studies were obstacle walking (OW), serial subtraction

(SS), and walking while talking (WWT) tasks. Meta-analysis results revealed that SS (0.445, p

Topic Area: METHODS: Neuroimaging

D91 Predictive models of IQ from functional connectivity data may not be sex specific

Javid dadashkarimi[1], Dustin Scheinost[1], [1]Yale University

Predictive modeling based on functional connectivity data is a powerful method to elucidate brain-behavior associations. Emerging reports have suggested that predictive models of IQ are sex-specific. In other words, the connections that best predict IQ are different between males and females. Here, we show that reasonably high level of performance in prediction can be achieved when training on one sex and testing on another. We used fMRI data from Human Connectome Project consisting of 7 different tasks and 2 rest scans. A total of 515 participants were included (241 males; 274 females). Standard functional connectivity preprocessing was performed. Connectomes were calculated using the 'raw' task timecourses and the Shen 268 atlas. We used ridge connectome-based predictive modeling to create models of IQ, combing at task and rest connectomes. Correlation between actual and predicted IQ was used to assess prediction performance and permutation testing was used assess significance. When using all connectomes combined, we were able to successfully predict IQ in one sex with models trained exclusively with the other sex (males-to-females: r=0.34, p

Topic Area: METHODS: Neuroimaging

D92 Functional brain network is associated with cognitive decline in amyloid positive elders

Eun Hyun Seo[1], Yoon HyungJun[1], Ji-Yeon Chung[1], Hoowon Kim[1], [1]Chosun University

Background: In the current study we investigated whether functional brain network parameters were associated with cognitive decline and gray matter volume after one year. We also examined if the relationship is different according to amyloid positivity. Methods: Functional and structural MRI data, clinical and neuropsychological data were downloaded from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database. In the final analysis, 43 cognitively normal (CN) elderly and 43 elderly with mild cognitive impairment (MCI) were included. Resting state function image data preprocessing was carried out using MELODIC of FMRIB's Software Library. Network parameters were calculated using Brain Connectivity Toolbox. Multiple linear regression analysis was conducted to investigate the associations between network parameters and cognitive decline and gray matter volume, separately for amyloid positivity. Results: Fourty one (19 from CN; 22 from MCI) were amyloid positive (ab+). In ab+ group, clustering coefficients (R2=0.311, p=0.004)and path length (R2=0.224, p=0.017) were associated with logical memory delayed recall at 1 year later. Global efficiency (R2=0.237, p=0.014) were associated with Alzheimer's disease assessment scale cognitive subscale (ADAS-cog) at 1 year later. On the other hand, in amyloid negative(ab-) group, clustering coefficients (R2=0.224, p=0.030), path length (R2=0.229, p=0.028) and global efficiency (R2=0.238, p=0.025) were associated with entorhinal gray matter volume at 1 year later. Discussion and Conclusions: Our findings indicate that functional network parameters can play important role to predict future clinical changes differently according to amyloid positivity. Local and global connectivity could predict memory decline at 1 year later in ab+ group, whereas they could predict entorhinal volume.

Topic Area: METHODS: Neuroimaging

D93 From Lab to Livingroom: The Validation of low-cost fNIRS

Robert Trska[1], Jordan Kokkelink[1], Olave E Krigolson[1], [1]University of Victoria

Over the past 10 years, there has been an explosion in low-cost neuroscience - cheap and affordable eye-trackers, motion capture, and electroencephalography systems are now commonplace. Now, mobile and affordable has come to functional near-infrared spectroscopy (fNIRS). As an imaging technique, fNIRS is capable of measuring blood-oxygen levels via detecting concentrations of oxyhemoglobin (O2Hb) and deoxyhemoglobin (Hbb), the predominant molecules for oxygen transport. However, due to its limited penetration, only surface-level activity can be detected. This caveat still provides interesting research potential, as higher-order cognitive processes are observed towards outer cortex such as in the prefrontal lobe. To date, fNIRS measurement requires costly research or clinical grade equipment for data collection. In the current study, we validated a low-cost fNIRS system: the Blueberry - benchmarked against a research-grade fNIRS system. Participants performed a cognitively demanding n-back task in two conditions (1 back, 3 back) to engage different working memory loads. To compare measurements, participants wore both fNIRS devices over the prefrontal cortex during task performance.Comparison between the two n-back conditions demonstrated an increased concentration of O2Hb in the 3-back condition relative to the 1-back condition across both devices. Further, the cross-correlation in signal change suggested comparable performance between devices. As such, we demonstrate the viability of a low-cost fNIRS device in a research setting relative to its research-grade peer. With portable and affordable fNIRS, imaging the brain becomes even more accessible opening the door for a wide range of paradigms in which measuring signal

Topic Area: METHODS: Neuroimaging

D94 Modeling Degenerate Neural Architecture Using Neural Topographic Factor Analysis

Yiyu Wang[1], Zulqarnain Khan[1], Eli Sennesh[1], Jennifer Dy[1], Jan-Willem van de Meent[1], J. Benjamin Hutchinson[2], Ajay Satpute[1], [1]Northeastern University, [2]University of Oregon

Degeneracy in biological systems refers to a many-to-one mapping between physical structures and their functional outcomes. In cognitive neuroanatomy, degeneracy captures the relationship by which many pathways produce the same mental state or behavior. Degeneracy implies that the neural patterns of a psychological process measured by fMRI are likely to be distributed depending on the participant and stimulus. To enable the analysis of fMRI data without an implicit assumption of uniformity, we propose a novel approach referred to as Neural Topographic Factor Analysis (NTFA). NTFA is a generative model that uses a low-dimensional embedding space to capture spatial and temporal variation in neural activity across participants and stimuli. The low-dimensional embedding space can be projected back into voxel space to reveal how neural responses depend on the combination of a subject with a stimulus. We simulated three datasets using different activation patterns that varied along a scale from localized to distributed neural pathways. We then compared the performance of the standard analyses and NTFA on the simulated activation patterns under different neural architectures assumptions. The results showed that the univariate analysis and NTFA both detected the activation pattern in the localized activity dataset. When the distributed neural activity patterns vary as a function of participants and stimulus categories, the univariate analysis failed to capture the effect. NTFA was able to recover participant and stimulus embeddings that distinguish different participant groups and different stimulus categories. Our study suggests that NTFA has promising potential to uncover distributed neural pathways underlying psychological processes.

Topic Area: METHODS: Neuroimaging

D95 A Regularization Method for Linking Brain and Behavior

Woojong Yi[1], Inhan Kang[1], Brandon M. Turner[1], [1]The Ohio State University

The joint modeling framework is becoming popular in the field of model-based cognitive neuroscience as a method to simultaneously analyze behavioral and neural data. As for an example, the previously proposed factor analysis neural drift-diffusion model (FA NDDM, Turner et al., 2017) 1) analyzes behavioral and neural data by employing an appropriate model for each of the data sets and 2) integratively studies a covariance structure of model parameters by implementing a factor model as a linking function. The model is a hybrid of confirmatory and exploratory factor models in that some factor loadings are fixed to define factors based on cognitive components assumed in the behavioral model, such as the diffusion decision model, and the other factor loadings which connect the factors and manifest variables are freely estimated. Although this enables us to investigate a factor structure underlying data based on cognitive dynamics of interest, exhaustively estimating all the factor loadings may not be an optimal strategy. As an extension of the previous method, we propose the regularized FA NDDM in which a parsimonious factor structure is studied based on statistical regularization, namely Lasso. In this study, we perform three simulations to show that the new method can achieve a sparser factor loading matrix and correct over-bias in the FA NDDM. The result shows robustness across different true factor loading structures we assumed. A joint modeling example of perceptual decision-making and brain data is also provided to show the applicability of the proposed method.

Topic Area: METHODS: Other

D96 Early exposure to reading relates to leftward structural asymmetries critical for literacy development in pre-readers

Lindsay Hillyer[1, 2], Xi Yu[1, 3], Angeliki Mougiou[1, 2], Eline Laurent[1, 2], Jade Dunstan[1, 2], Emma Boyd[4], Lilla Zöllei[4], Nadine Gaab[1, 2], [1]Boston Children's Hospital, [2]Harvard Medical School, [3]Beijing Normal University, [4]A.A. Martinos Center for Biomedical Imaging, MGH

Reading is primarily supported by a left-lateralized neural network which starts to develop long before the start of formal reading instruction. Early exposure to print plays a critical role in facilitating literacy development in children before formal instruction begins. While home literacy exposure (HLE) has been shown to be associated with functional brain correlates relevant for phonological processing in beginning readers, it is still unknown whether and how HLE is associated with the structural brain characteristics in prereaders. To answer this question, 80 pre-kindergarteners (40 females, age = 66.4 ± 5.7 months) were selected from our longitudinal projects and HLE was characterized in terms of onset and frequency of shared reading, and number of books in the house. Structural MRI images were processed using FreeSurfer (https://surfer.nmr.mgh.harvard.edu/fswiki/FreeSurfer). Measures of cortical thickness, surface area (SA) and volume were extracted for 11 reading-related regions in both hemispheres (Richlan et al., 2011), and utilized to compute a left-lateralization index (LI) for each area. Correlation analyses between each HLE measure and LI of reading-related regions were performed. The onset of shared reading was negatively correlated with the LI of the superior temporal cortex for SA ($r = -0.38$, $p_{corrected} = 0.04$) and the transverse temporal gyri for volume ($r = -0.40$, $p_{corrected} = 0.019$), while no other significant correlations were observed. These results revealed that children who were read to at an earlier age showed increased left-lateralization in brain regions important for reading. Implications for early childhood practices will be discussed.

Topic Area: NEUROANATOMY

D97 Does functional connectivity within the DMN predict individual differences in social pleasure in schizophrenia?

Bridget Shovestul[1], Emily Dudek[1], Steven Lamberti[1], David Dodell-Feder[1], [1]University of Rohester

Background: Social anhedonia is a well-established symptom of schizophrenia, but its etiology remains unknown. Though extant studies have connected anhedonia to anticipatory pleasure deficits, little is known about the neural basis of these deficits, besides those localized to the reward system. Here, we test whether deficits in social prospective simulation (i.e., 'pre-experiencing' future social interactions), indexed by default mode network (DMN) functioning, explain group differences in anticipatory/ consummatory social pleasure and social affective forecasting.Methods: Healthy adults and patients with schizophrenia-spectrum disorders (SSD) underwent fMRI scanning while at rest. We characterized functional connectivity within subsystems of the DMN. Anticipatory/consummatory social pleasure and affective forecasting accuracy were measured outside of the scanner using the Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS) and daily diary data, respectively. Results: Connectivity between certain subsystems of the DMN were differentially associated with anticipatory/consummatory pleasure and affective forecasting accuracy between the two groups. Of these DMN subsystems, only the medial temporal lobe was related to affective forecasting accuracy. Conclusions: Together, these data suggest that prospection may underlie deficits in social pleasure and may ultimately serve as an area of intervention towards alleviating social anhedonia in patients with SSD.

Topic Area: NEUROANATOMY

D98 Age differences in cortical gyrification: Evidence from accelerated longitudinal datasets

Christopher Madan[1], [1]University of Nottingham

It seems intuitive that rewarding experiences may be remembered differently from unremarkable ones. Moreover, our decisions would benefit by remembering salient experiences. Episodic memory in value learning has become a recent focus in decision?making research, however the existing literature shows a complicated relationship between reward and memory. The current study provides a computational account that unifies mixed results from several experiments. Here participants first learned reward values associated with words through two-alternative forced choice tests. Participants were then asked to recall as many words as they could remember. Crucially, differences in the value learning procedure produced three qualitatively different results: linear, U-shaped, and attenuated relationships between reward and memory. Prior work interpreted these mixed results in terms of additive psychological processes (e.g. reward, salience, and boundary effects). The current results demonstrate these results can be explained by assuming a memory's strength depends on its contextual utility. That is, memory strength depends on how much mnemonic information changes reward expectations. This concept is distinct from assuming people merely remember highly rewarding experiences better (i.e., strictly linear relationship between reward and memory). We modeled our hypothesis within a reinforcement learning framework, and simulated participants' learning and memory behavior during these experiments. The model successfully reproduced all three reward-memory relationships observed in these experiments, without requiring additional psychological processes. This result provides a more parsimonious explanation for the data in this literature.

Topic Area: NEUROANATOMY

D99 A unified brain system of orientation and its disruption in Alzheimer's disease

Amnon Dafni-Merom[1], Gregory Peters-Founshtein[1], Shlomzion Kahana-Merhavi[2], Shahar Arzy[1], [1]The Hebrew University of Jerusalem, [2]Hadassah Hebrew University Medical School

Objective: To investigate whether a unified brain system manages one's orientation to different places, events and people in one's environment, and test the hypothesis that failure of this system (disorientation) is an early signature of Alzheimer's disease (AD). Methods: A total of 46 participants (patients along the AD-continuum and cognitively normal control subjects) were tested in a personalized, ecologically-valid task of orientation relating to the participant's own world in space, time and person under high-density electroencephalography. As a first step, we used evoked potential mapping to search for brain topography correlated with participants' performance in orientating themselves to different places (space), events (time) and people (person) (Experiment 1). We then compared behavioral and electrophysiological changes in patients along the AD-continuum (Experiment 2). Results: We identified a specific brain topography ('orientation map') that was active for orientation in space, time and person in correlation to participants' performance. Both performance and the map's strength gradually decreased with from health to mild cognitive impairment (MCI) and from MCI to AD. Another map, immediately preceding the orientation map, showed the longest activity in patients with MCI, significantly more than both patients with AD and cognitively normal controls. Interpretation: Our findings suggest that the same brain topography accounts for orientation in the different domains of space, time and person and provide a nexus between deterioration in patients' orientation with the aggravation of Alzheimer's disease.

Topic Area: OTHER

D100 Neuroprotective role of transgenic resveratrol rice DJ526 callus in Drosophila melanogaster

Mousumee Khan[1], Seong-Tshool Hong[1], [1]Jeonbuk National University, Jeonju, Republic of Korea

Resveratrol, a naturally occurring phytochemical, is well-known for its anti-oxidant property in the nervous system. Here, we investigated the neuroprotective role of transgenic resveratrol rice DJ526 callus in Drosophila melanogaster. We established a callus culture of resveratrol rice DJ526, which contains 180 times more resveratrol than the rice grain, and found that the transgenic resveratrol rice callus showed remarkable health benefits of D. melanogaster beyond expectations. The resveratrol rice callus significantly extended the median lifespan of D. melanogaster by up to 50% compared to the control. The anti-oxidant properties of transgenic resveratrol in DJ526 callus significantly ameliorated neurodegeneration during age progression. Moreover, the resveratrol rice callus improved other age-dependent symptoms, including locomotive deterioration, excess body weight as well as eye degeneration of D. melanogaster with age progression. Considering that resveratrol is the most preferred natural anti-oxidant compound due to its superior safety and proven mechanism against many serious adult diseases, the outstanding efficacy of transgenic resveratrol rice DJ526 callus on the neuroprotection as well as longevity of wild-type animals could cast a light on the development of therapeutic agents for neurodegeneration or longevity. Keywords: resveratrol; neuroprotective; transgenic; callus; Drosophila melanogaster; lifespan

Topic Area: OTHER

D101 Low Socioeconomic Status as a Proxy for Stress in the Brain

Ashley Mensing[1], Kristin Maurer[1], Nikita Das[1], Eleanna Burns[1], Yaakov Stern[1], [1]Columbia University

SES has an impact on a multitude of outcomes related to health and cognition, though the exact mechanism through which SES affects cognition remains unknown. While the stress pathway has been suggested, few studies have investigated the direct effect of SES on brain volume and cortical thickness in regions known to be sensitive to stress. Hypothesis: Lower SES status will be associated with decreased volume and cortical thickness in regions of the brain known to be sensitive to the effects of stress. Methods:411 healthy subjects between ages 20-80 were recruited from an ongoing longitudinal fMRI study. All subjects self-reported their highest level of education and current occupation from which a Hollingshead SES score was calculated for each. T1 images were acquired on a 3T MRI scanner and hippocampal and amygdala volume, and cortical thickness in the PFC were computed using standard FreeSurfer parcellation. Multivariate general linear models were constructed with SES as the predictor and PFC thickness, amygdala volume, and hippocampal volume as the outcomes. Age, education, gender, race and ethnicity were included as covariates in each model. Results:Hippocampal and amygdala volume varied significantly by SES (respectively: F=18531, p=

Topic Area: OTHER

D102 Contextual constraint and key membership influence neural correlates of melodic prediction violations

Allison Fogel[1], Emily Morgan[2], Gina Kuperberg[1, 3], Aniruddh Patel[1], [1]Tufts University; [2]University of California, Davis, [3]Massachusetts General Hospital

Neural studies of melodic prediction violations have mainly used incongruent events (e.g., out-of-key notes) in fixed melodic contexts. We have developed a new approach based on manipulating melodic context in terms of the degree to which it constrains expectations for one particular note. Using this method to study ERP responses to unexpected notes, we can disentangle the effect of a note being low probability (unexpected) from the effect of it also violating a strong expectation for another specific note. With this method, when a context leads to an expectation for one particular note, a different note can violate this prediction while still being in-key and congruous. Participants listened to short novel melodies that either did or did not lead to a strong prediction for a particular note. In Experiment 1, in-key target notes that violated a strong prediction (i.e., unexpected notes in a constraining melody) elicited a late anterior positivity compared to the same unexpected target notes in non-constraining melodies. This result differs notably from the early right anterior negativity that has previously been associated with musical expectancy violations. In Experiment 2, out-of-key target notes elicited a late posterior positivity (P600) compared to expected notes in constraining melodies; again, no early anterior negativity was observed. Across these experiments, we found brain responses to unexpected notes that differ from the responses reported by many music studies, but which bear a striking resemblance to neural responses found in language studies using comparable manipulations of word expectedness and sentential constraint.

Topic Area: PERCEPTION & ACTION: Audition

D103 WITHDRAWN

D104 Accuracy in chunk retrieval is correlated with the presence of acoustically driven delta brain waves

Johanna Rimmele[1], David Poeppel[2], Oded Ghitza[3], [1]Max Planck Institute for Empirical Aesthetics, [2]New York University, [3]Boston University

Oscillation-based models of speech perception postulate a cortical computation principle by which decoding is performed within a time-varying window structure, synchronized with the input on multiple time scales. The windows are generated by a segmentation process, implemented by a cascade of oscillators. Perceptual segmentation on the syllabic level has been shown to correlate with acoustic-driven theta neuronal oscillations (Doelling et al, 2014). The present study provides MEG evidence for an analogous role of acoustic driven delta in perceptual chunking in the phrasal level. Building on a recent behavioral study, which showed that performance is impaired when the phrasal presentation rate is outside the delta range (Ghitza, 2016), we recorded MEG while subjects perform a digit retrieval task. Stimuli comprised random-digit strings with a prescribed digit grouping to chunks, with the chunking rate (inside and outside of the delta frequency range) as a parameter. Our data show clear neural delta periodicities in primary auditory cortex for chunking rates inside and outside of delta, independent of accuracy in performance. In contrast, for a chunking rate outside of delta, presence of delta periodicities is diminished in superior and middle temporal areas, and is absent in motor cortex related areas, correlating with the reduced accuracy in performance. The data suggest that the observed effects are related to acoustically driven delta. In summary, we provide novel insights into the anatomy and temporal dynamics of delta brain waves underlying phrasal chunking.

Topic Area: PERCEPTION & ACTION: Audition

D105 Learning and Reward through a New Musical System

Matthew Sachs[1], Euan Zhang[1], Dana Walker[1], Psyche Loui[1], [1]Northeastern University

Previous studies have shown that the process of learning musical structure relates to preference and liking. However, it remains unclear how this relationship develops de novo, given that we are exposed to music, and develop preferences, very early in life. The Bohlen-Pierce (BP) scale, a unique musical system, can be exploited to help resolve this issue. While most musical scales recur at the octave, the BP scale recurs around the 3:1 frequency ratio. Here we compare and contrast the effects of preference and familiarity using new music in the familiar Western scale and in the Bohlen-Pierce (BP) scale. In Experiment 1, 100 participants rated newly composed BP musical clips for liking, musicality, and familiarity. Ratings were higher for musicality than liking and familiarity and there were significant positive correlations among liking, musicality, and familiarity ratings. In Experiment 2, participants listened to the BP clips and newly composed clips in Western musical scales and rated them for liking and familiarity in fMRI. Behaviorally, liking and familiarity ratings were similar between the two styles. When comparing fMRI activity during BP clips against new Western clips, greater activity was found in bilaterally in the Heschl's gyri, SMA, and DLPFC (p

Topic Area: PERCEPTION & ACTION: Audition

D106 Structural connectivity fingerprints of category-selective visual regions mature early in infancy

Laura Cabral[1], Leire Zubiaurre[2], Conor Wild[3], Annika Linke[4], Rhodri Cusack[5], [1]University of Pittsburgh, [2]University of Deusto, [3]University of Western Ontario, [4]San Diego State University, [5]Trinity College Dublin

By four months, infants display category-level knowledge, grouping similarly looking objects together. However, it is unclear when infants go beyond these perceptually based categories to make the rich, cross-modal, and affective associations characteristic of adult categories. These associations are thought to be encoded in each category-selective region's 'connectivity fingerprint', the distinctive pattern of each region's structural, long-range connectivity with the rest of the brain. Category-specific regions are already functioning in young infants, but structural connectivity fingerprints have yet to be investigated. Therefore, we used our MRI diffusion tractography data to characterize the connectivity of face, place and tool regions in infants up to 9 months old. Using a linear discriminant classifier, we found that the face and place regions had adult-like connectivity fingerprints throughout infancy, but the tool-network underwent significant maturation until 9 months. Our work suggests that face and place network connectivity fingerprints are either innately specified or mature with limited experience, while the fingerprint of the tool network continues to mature throughout the first 9 months of postnatal life. The protracted development of the tool network is consistent with motor experience, developing as infants learn to reach. Our work demonstrates the surprising maturity of ventral stream connectivity, which is capable of subserving mature category-level representations.

Topic Area: PERCEPTION & ACTION: Development & aging

D107 Inhibitory Gating in Older Adults and Persons with Parkinson's Disease after a Socially Evaluated Cold Pressor

Andrew Zaman[1], Elizabeth Stegemoller[1], [1]Iowa State University

Inhibitory gating (gating) is an automatic pre-attentive form of inhibition in the sensory pathway mediated by frontal regions of the cortex. It is thought to promote cognitive efficiency by filtering out irrelevant information. Gating is reduced following an acute stressor such as a cold-pressor (CP), but it is unknown how stress impacts gating in persons with Parkinson's disease (PD). The objective of this study was to determine how stress affects gating in persons with (PD). Fifteen older adults and fifteen persons with early stage PD completed the paired-click paradigm after both the CP and a control condition (warm water). For the paired-click paradigm, 80 pairs of identical auditory clicks (80dB) with a 500ms inter-click interval were used. Gating was measured by calculating the p50 ratio (peak-to-peak method) for the Cz electrode. Perceived stress, cortisol, and blood pressure were also measured to determine if the stressor was successful. A group by condition (2 x 2) repeated measures ANOVA revealed a main effect of condition for all of the measures. The p50 ratio ($p < 0.01$) was reduced after the CP (0.80±0.33) compared to control condition (0.60±0.20) The CP also increased perceived stress (p

Topic Area: PERCEPTION & ACTION: Development & aging

D108 Cross-frequency coupling explains preference for simple ratios in the relative phase of bimanual rhythmic tapping

Dobromir Dotov[1], Laurel Trainor[1,2], [1]PNB, McMaster University, [2]Rotman Research Institute

Neuroimaging studies of object recognition have revealed that object processing is largely a result of computations within the dorsal and ventral visual streams. Each stream is differentially recruited depending on object identity. Objects with strong action associations (e.g., tools) recruit dorsal regions more than non-tool objects, which are more reliant on ventral processing. We hypothesized that if this differential functional recruitment is indeed meaningful, it should have behavioral consequences. Due to the relative proportions of magno- and parvo-cellular input to each stream, processing along the dorsal stream, such as when a tool is seen, should have higher temporal sensitivity, while processing along the ventral stream, such as when a non-tool is seen, should have higher spatial sensitivity. We test this hypothesis using two tasks: gap detection, testing the spatial resolution of the ventral parvocellular processing, and object flicker discrimination, testing the temporal resolution of the dorsal magnocellular processing. Across four experiments we show (1) a non-tool advantage in spatial resolution, (2) a tool advantage in temporal discrimination, (3) that this advantage is reduced by impeding object recognition through inversion, and (4) that this advantage

diminishes when suppressing magnocellular processing with red light. These results demonstrate perceptual differences in object processing arising from differential recruitment of the two processing streams, such that tools, which recruit the more magnocellular dorsal stream regions have higher temporal resolution, and non-tools, which are reliant on the more parvocellular ventral stream regions, have higher spatial resolution.

Topic Area: PERCEPTION & ACTION: Motor control

D109 Neural reuse in the anterior insula? Disgusting smells selectively increase precision of visual looming perception

Matthieu de Wit[1], Michael Tronolone[1], Laura Styer[1], Calista Bender[1], [1]Muhlenberg College

According to the neural reuse hypothesis, brain regions are typically used and reused across multiple behavioral and cognitive task domains. The functional diversity of a region can be quantified using meta-analysis of fMRI data, producing its 'functional fingerprint'. We used Uddin et al.'s (2014) functional fingerprint centered on anterior insula (AI) to perform a targeted behavioral test of the neural reuse hypothesis. AI is activated by disgusting odors (Heining et al., 2005) as well as by time-to-collision (TTC) judgments for looming but not receding visual stimuli (Billington et al., 2011) leading to the prediction that the presence of a disgusting odor should selectively affect TTC judgments for looming stimuli. To test this prediction, we asked participants to perform TTC judgments for looming and receding TTC stimuli with and without the presence of a disgusting odor. While there was no effect of odor on accuracy of TTC judgments, their precision selectively increased for judgments of looming stimuli, as indicated by reduced standard deviations. The functional fingerprint also identified olfaction more generally as a source of AI activation. A follow-up study using a pleasant odor showed no increase in precision of TTC judgments, making it unlikely that the disgust effect was due to the mere presence of an olfactory stimulus, or to 'spreading activation' from functionally specialized neighboring subregions within AI. Results are discussed in the context of the increasingly influential theory of neural reuse.

Topic Area: PERCEPTION & ACTION: Multisensory

D110 The timing of spontaneous eye blinks shows different influences during a visual and an auditory temporal judgement task

Supriya Murali[1], Mareike Brych[1], Liyu Cao[1], Barbara Haendel[1], [1]University of Wuerzburg

Task-related, top-down factors have been shown to modulate spontaneous eye blinks. Our aim was to investigate the specific timing of this influence, see if it is comparable between the auditory and visual domain, and how dependent it is on sensory input. Participants completed a visual and an auditory temporal judgement task, wherein they had to judge whether two stimuli appeared at the same or different times. The inter-stimulus interval (ISI) and the duration that both stimuli remained on were varied independently. Our results showed that the sensory input influenced the blink probability in both modalities, with a stronger modulation in the visual domain. Furthermore, we found that both the ISI and the overall stimulus presentation time influenced the latency of blinking. While keeping the overall timing of the stimulus constant, ISIs (modulated in steps of 10 milliseconds) predicted the blink latency. Interestingly, in the auditory domain, task accuracy improved the prediction of the blink latency, while in the visual, it was mainly the length of the sensory input that drove this relationship. Similarly, while reaction time was predicted by the ISI in the visual domain, this was not the case for the auditory. Our work suggests that bottom-up processes in both modalities similarly affect the timing of blinks. Additional top-down influences can further be informative about cognitive processes, but might differ between domains. In the auditory modality, blink latency can be a better predictor of performance than reaction times, while this is not the case in for visual input.

Topic Area: PERCEPTION & ACTION: Multisensory

D111 Neurofunctional correlates of body-ownership and sense of agency: a meta-analytical account of self-consciousness

Silvia Seghezzi[1], Gianluigi Giannini[1], Laura Zapparoli[2], [1]University of Milano-Bicocca, [2]IRCCS Istituto Ortopedico Galeazzi

Self-consciousness consists of several dissociable experiences, including the sense of ownership of one's body and the sense of agency (SoA) over one's action consequences. The relationship between body-ownership and the SoA has been described by different neurocognitive models, each providing specific neurofunctional predictions. According to an 'additive' model, the SoA entails body-ownership, while an alternative 'independence' hypothesis suggests that they represent two qualitatively different processes, underpinned by distinct brain systems. We propose a third 'interactive' model, arguing the interdependence between body-ownership and the SoA: these constructs might represent different experiences with specific and exclusive brain correlates, but they also could partly overlap at the neurofunctional level. Here we sought to test these three neurocognitive models by reviewing the available neurofunctional literature of body-ownership and the SoA, with a quantitative meta-analytical approach. We identified (i) a body-ownership-specific network including the left inferior parietal lobule and extra-striate body area, (ii) a sense-of-agency-specific network including the left SMA and posterior insula and the right postcentral gyrus and superior temporal lobe and (iii) a shared network in the left middle insula. These results provide support for the interactive neurocognitive model of body-ownership and the SoA. Body-ownership involves a sensory network in which multisensory inputs are integrated, to be self-attributed. On the other hand, the SoA is specifically associated with premotor and sensory-motor areas, typically involved in action monitoring. Finally, body-ownership and the SoA interact at the level of the left middle insula, a high-level multisensory hub engaged in body awareness in general.

Topic Area: PERCEPTION & ACTION: Other

D112 Sensitivity to information about face shape in the fusiform gyrus of congenitally blind individuals

Lukasz Bola[1], Huichao Yang[2], Alfonso Caramazza[1], Yanchao Bi[2], [1]Harvard University, [2]Beijing Normal University

The ventral visual areas show functional preference for visual information about either inanimate or animate entities. It is commonly assumed that visual experience is necessary for this organization to emerge. Contrary to this assumption, typical preference for inanimate items has been recently observed in ventral visual cortices of congenitally blind individuals, following auditory or tactile stimulation. Whether visual inputs are required for the development of ventral areas showing preference for animate items is still debated, with conflicting results across studies. Here, we hypothesized that these conflicting findings emerge because the non-visual responsiveness of this territory is modulated by the transparency of the mapping between shape information computed locally and computations performed in downstream action brain systems. To test this hypothesis, we enrolled 20 congenitally blind and 22 sighted subjects in an fMRI experiment, in which they listened to animal sounds, object sounds and human voices. Critically, the human voice category included sounds of facial expressions, which were highly indicative of both face shape and relevant emotional and motor computations, and speech sounds, in which this mapping was less salient. We found strong functional selectivity for the sounds of facial expressions in the typical location of the fusiform face area (FFA), in the blind group. Furthermore, we were able to

decode the voice type, but not the speakers' gender, from activation patterns of this area in both blind and sighted subjects. We conclude that the FFA develops a certain degree of sensitivity to information about face shape even without visual experience.

Topic Area: PERCEPTION & ACTION: Vision

D113 Neural entrainment to synchronous and asynchronous observed human movement

Emiel Cracco[1], Haeeun Lee[2], Guido Orgs[2], [1]Ghent University, [2]Goldsmiths, University of London

While there is an extensive literature on the visual and motor processes involved in processing the actions of others, very little is known about how the brain processes the relationship between those actions. In a first experiment, we used EEG to measure steady-state visual evoked potentials (SSVEPs) evoked by passively observing four dancers making fluent or non-fluent movements either in or out of synchrony. The results revealed that SSVEPs coupled to movement processing but not SSVEPs coupled to body posture processing were modulated by whether or not the dancers moved synchronously. Importantly, this was true especially if the dancers made fluent movements and was observed both over occipital and fronto-central areas. In a second experiment, we then measured SSVEPs to synchronous or asynchronous movements of upright and inverted dancers. This confirmed that occipital and fronto-central SSVEPs coupled to movement processing but not those coupled to body posture processing were stronger for synchronous movements. Furthermore, movement related SSVEPs were stronger for upright than for inverted dancers, but this was independent of synchrony. Together, these results reveal how the brain binds together multiple individual observed actions into a higher-order percept encompassing the relationship between those actions. They further suggest that not only the visual system but also motor system contributes to this process, consistent with a motor way of seeing.

Topic Area: PERCEPTION & ACTION: Vision

D114 Discriminability of Neural Patterns within the Magnocellular and Parvocellular Visual Pathways

Daniel Elbich[1], Reginald Adams[1], Kestutis Kveraga[2], Nancy Dennis[1], [1]The Pennsylvania State University, [2]Harvard Medical School

The magnocellular and parvocellular pathways are two key visual pathways, integral to detecting gross differences in luminance as well as low contrast differences and color-sensitivity, respectively. While they are an integral part of visual perception in humans, relatively little research has been done examining how these pathways support perception outside of the non-human primate literature. Importantly, there is no work examining how these pathways may differ in older adults, despite a body of knowledge describing dedifferentiation of neural specialization with age. The goal of this study was to bridge this gap by evaluating the extent of dedifferentiation in the specialization of the magnocellular and parvocellular pathways using a large sample of adults (n = 102). Individuals were tested using fMRI, and shown images of faces biased toward either the magnocellular or parvocellular pathway. To examine differentiation of neural patterns within the magnocellular and parvocellular pathways, we employed multivariate pattern classification using a linear support vector machine (SVM) to quantify the neural discriminability between biased stimuli throughout the brain. Our results indicate that multiple regions exhibit significant above chance accuracy (>50%) for discriminating patterns associated with magnocellular and parvocellular stimuli, including left inferioparietal gyrus, right frontal pole, left fusiform gyrus and right superior frontal gyrus. However, with respect to aging, only the right transverse temporal gyrus showed a decrease in classification accuracy. Overall, results show that regions along both the magnocellular and parvocellular pathways exhibit some level of neural discriminability for the conditions, with little evidence for dedifferentiation in the pathways.

Topic Area: PERCEPTION & ACTION: Vision

D115 Drawing as a window into visual learning and plasticity following treatment for congenital bilateral blindness

Sharon Gilad-Gutnick[1], Katharine Wu[2], Juliette Sander[2], Sunny Tang[3], Pragya Shah[4], Priti Gupta[4], Pawan Sinha[1], [1]Massachusetts Institute of Technology, [2]Wellesley College, [3]Dartmouth College, [4]Project Prakash

Drawing is a multi sensory process, often used to study neurotypical and atypical development and visuo-motor integration. 'Project Prakash' is a dual humanitarian/scientific mission to treat congenitally blind children in India, while exploring their brain development and visual learning following treatment for early visual deprivation. We tested children on a battery of drawing tests pre-treatment, and at several points up to one year after treatment. We found that many children performed well on the 'recognition and copying from tactile' task, but were unable to perform the 'recognition and copying from vision' task prior to- or soon after treatment, despite reaching tracing performance that was comparable to their typically developing acuity-matched peers. This suggests that their impaired ability to reproduce simple shapes is not a manifestation of difficulties with fine motor skills or basic visually guided motor control. However, within 6-12 months following treatment, the children's performance on the 'copying from vision' task rapidly improved at a rate that is ~4X that of the typically developing trajectory. Finally, when asked to draw familiar objects from memory (e.g. draw a man or house), all children's drawings were far below age-level initially, but then not only improved with increased visual experience, but also mimicked the same sequence progression as observed in typically developing children, only faster. Future studies will focus on visual feedback for improving copying and drawing and how this may help provide insights for educational interventions for children with atypical visual development.

Topic Area: PERCEPTION & ACTION: Vision

D116 Saccadic and Pupillary Response as Biobehavioral Markers in a Perceptual Organization Task

Peter Gordon[1], Daniel Kurylo[2], Jean Ee Tang[1], Lingwei Ouyang[3], Cosku Arslanbogan[1], Anh Le[1], Jennifer Scheu[1], Courtney Windram[1], Cindy Romero[1], Christopher Riviera[4], Yanbin Niu[1], Richard Waxman[1], [1]Columbia University, Teachers College, [2]City University of New York, Brooklyn College, [3]Stanford University, [4]City University of New York, Hunter College

Visual form perception involves grouping elements that occur along the border of an object. Sometimes borders are well defined, and sometimes less so. The perceptual organization (PO) task (Kurylo et al., 2017) employs 20 x 20 dot arrays differentiated by Color, Gabor or Luminance properties. Elements show different degrees of organization along either a horizontal or vertical axis. Organization is defined as the percentage of elements that are arrayed along the main orientation (100%, 90%, 80%, 70%). In the PO task, perceptual thresholds are measured using psychophysical staircase procedures. The present study uses eye tracking and pupilometry to examine biobehavioral markers associated with perceptual processing in the PO task. In particular, we investigated whether pupil diameter --an indicator of processing load-is related to % organization levels within the PO task, and whether this correlates with behavioral performance in terms of RT and accuracy. We also examined whether saccades in the horizontal vs. vertical direction were correlated with task difficulty for Color, Gabor and Luminance respectively. We tested 60 participants on the PO task using Tobii and Gazepoint eye trackers. %organization level (100>90>80>70) was correlated with RT (p

Topic Area: PERCEPTION & ACTION: Vision

D117 Rapid reorganization in adult human primary visual cortex and consequent perceptual elongations are mediated by GABA

Yaseen Jamal[1], Derek Hu[1], Guldehan Durman[1], Eva Ratai[2], Daniel Dilks[1], [1]Emory University, [2]Harvard Medical School

When deprived of its typical visual input, the adult human primary visual cortex (V1) starts to reorganize within minutes, directly affecting visual perception (e.g., squares are perceived as rectangles). But what is the mechanism underlying such rapid neural and perceptual changes? Here we use magnetic resonance spectroscopy (MRS) and psychophysics to show that the inhibitory neurotransmitter, GABA, is the initial driver of reorganization in adult human V1. Specifically, we patched one eye in typical children, adults, and seniors, thereby depriving the cortical representation of the blind spot (BS) of its typical visual input. In adults, using MRS, we then found a significant reduction in V1 GABA concentration within just minutes of deprivation (relative to no deprivation), and, moreover, that this magnitude of GABA reduction closely predicted the extent of perceptual distortion near the BS after deprivation. Additionally, using psychophysics, we found that the magnitude of such perceptual distortions was reduced in kids and seniors relative to adults, thus mirroring the inverted U-shaped pattern of V1 GABA concentration across the lifespan. Taken together, these results provide converging neural and behavioral evidence that the disinhibition of preexisting connections ignites rapid cortical reorganization in the adult human visual system, and raise the intriguing question of whether and how additional changes continue to occur during subsequent, longer periods of deprivation.

Topic Area: PERCEPTION & ACTION: Vision

D118 Superior discrimination of complex biological motions in native ASL signers

Lorna Quandt[1], Emily Kubicek[1], Jason Lamberton[1], [1]Gallaudet University

Native sign language users are adept at extracting meaning from complex movements, even in non-ideal conditions. We wondered whether native American Sign Language (ASL) signers would show faster and less effortful responses to biological motions represented by point-light displays (PLDs). In particular, here we used biological motion PLDs which showed everyday actions presented from 3 different rotated conditions (0 degee head-on, 45 degree, and 90 degree profile). We recorded EEG while native Deaf Signers (N = 19) and Hearing Non-signers (N = 20) watched the PLDs. We also collected self-report ratings of the PLDs from separate groups of 34 Deaf and 144 Hearing individuals. Compared to the Hearing group, Deaf signers reported significantly less effort in identifying the actions ($p = .002$). Time-frequency activity in theta, alpha, and beta EEG ranges (4-25 Hz) was computed. Fronto-central electrodes showed theta-range differentiation between scrambled and coherent PLDs in Deaf Signers starting immediately after stimulus onset, with continued differences between conditions in theta and alpha ranges (ps

Topic Area: PERCEPTION & ACTION: Vision

D119 Information can be extracted from ventral stream multi-voxel patterns across spatial scales using the wavelet transform

Xueying Ren[1], Marc N. Coutanche[1], [1]University of Pittsburgh

Multivariate analysis techniques have become a popular approach to analyzing functional magnetic resonance imaging (fMRI) data. Machine learning decoding, and representational similarity analysis (RSA), measure the information content of distributed activity patterns by attempting to distinguish or track different conditions and stimuli. The properties of these neural patterns are, however, rarely examined. Some prior evidence suggests that information might be represented at multiple spatial scales across brain regions, and even across conditions. In this study, we propose and test a dual-tree complex wavelet transform that can extract spatial information (e.g., locality, orientation) from multiple scales of spatial resolution for multi-voxel patterns associated with a condition or stimulus. We apply this technique to fMRI data that were collected as eighteen participants viewed images of twelve different animal species, from three taxonomic groups. We have passed the resulting pre-processed fMRI response patterns through a wavelet function to obtain subsets of wavelet coefficients that represent five different scales of spatial resolutions. The information from different scales is then statistically compared for different items (species) and categories (taxonomic classes) across the ventral stream. These results reveal spatial principles underlying multi-voxel patterns of the ventral stream, at a deeper level than is possible from examining decoding or RSA results alone.

Topic Area: PERCEPTION & ACTION: Vision

D120 How Frank Lloyd Wright Used Fundamental Mechanisms of Perception To Generate His Uniquely Powerful Aesthetics

John Shoaff[1], [1]AIA, Architect

Frank Lloyd Wright's frequent assertion that his 'severe' discipline, by which designs emerged from 'the differentiation of a single,...simple form,' gave his buildings 'such vitality, integrity, and magic as they have' presents two challenges: to find this discipline; and to explain its remarkable aesthetic consequences. The specific goals of this study are to reveal the discipline, and then to propose an explanation for its immanent aesthetics by comparing his discipline to the early stages of form recognition as theorized in Vision by MIT scientist David Marr. I graphically present Wright's discipline with successive overlays over building plans that show Wright's 'differentiation' at work: each building emerges from the multiplication and rescaling of simple, symmetrical forms to generate forms that overlap and interweave, integrated by shared axes of symmetry. These forms retain their integrity even when woven into the fabric of an elaborate design. The percept is dynamic, requiring a duration of time. I then compare the shapes and essential mathematical symmetries of Wright's forms with those of the object-centered coordinate modules which, Marr theorized, enter early into the eye-brain processing of form recognition. Finding: the parallels are remarkable. For both Wright and Marr, their basic forms or modules, overlapping at different scales, emerge from the same structural symmetries. Conclusion: Wright intuitively went to the heart of the perceptual process, thereby reaping the most aesthetic order from the least computational and physiological effort. A theory of aesthetics follows that merges with George Birkhoff's mathematical formulation for a theory of aesthetics.

Topic Area: PERCEPTION & ACTION: Vision

D121 Food choice reflected in brain activation: age matters

Monicque Lorist[1], Marjorie van Kooten[1], [1]University of Groningen

Food choice and dietary intake changes with aging. Older adults are prone to create an insufficient diet pattern, which is associated with increased risk for malnutrition, weight loss and decreased quality of life. This study examines the role of the brain during food choice in 20 healthy younger- (18-30 years) and 18 older adults (60-75 years), who performed a forced food-choice task while we followed the brain response using functional magnetic resonance imaging. Participants selected the food they 'would most like to eat now' between food pictures different in taste (sweet vs salty) and calorie-content (low vs high). Our results show that older participants choose more often food with lower calorie-content, compared to younger participants. Moreover, older participants show significant stronger activation in the sensorimotor cortex,

superior parietal lobe, superior temporal gyrus, cingulate cortex, insula, striatum and cerebellum and less activation in the superior frontal gyrus, than younger participants during food choice. Functional connectivity analyses showed that the dorsolateral prefrontal cortex functioned as a hub with increased connections with the insula, precuneus, anterior cingulate cortex, visual and parietal regions. Our findings suggest that there is a difference in brain response during food choice between younger and older adults. An explanation is that older adults have stronger cognitive prefrontal control over food choice than younger adults. Further research in needed to investigate whether change in food choice decisioning in the brain with age can be a biomarker for risk of developing of anorexia of aging or even a target of prevention.

Topic Area: THINKING: Decision making

D122 Body representation distortions at a higher resolution: the role of the spatial acuity in length and width estimation of body parts.

Ben Reuveni[1], Paul Reber[1], [1]Northwestern University

Rational decision-making involves constructing an accurate internal model of the external environment based on experience and feedback. We examined this process as participants performed a visual category learning task during which the external environment (i.e. the task) appeared to change. Participants attempted to learn two visual categories of sinewave gratings while neuroimaging data were collected. During the initial 80 trials, the stimuli were sampled from regions where they could be accurately categorized with a simple, quickly learned one-dimensional rule. Over the next 400 trials, the full stimulus space was sampled to reveal that a more complex model was required. Approximately half of participants (13/28) gradually updated their internal model. However, the remaining 17/28 participants consistently performed at chance levels for the rest of the protocol and 15 of these appeared to be fully engaged in an unsuccessful attempt to deduce the category structure (two participants exhibited 'random responding' via long stretches of simple response alternation). Unexpectedly, their performance was reliably worse than using any simple one-dimensional rule (e.g., as in the initial block) indicating that these participants relied on complex, maladaptive rules in spite of 400 trials of consistent, accurate feedback. Computational model driven neuroimaging analysis revealed differences between learners and non-learners in precuneus, vmPFC and middle cingulate areas. These regions appear to be critical to updating a learner's internal model accurately based on feedback and avoiding irrational and maladaptive behavior that leads to reduced outcomes and can often obscure partially successful alternate solutions.

Topic Area: THINKING: Decision making

D123 Boundary Conditions for the Positive-Skew Preference in Risky Decision Making

Kendra Seaman[1], Sade Abiodun[2], [1]The University of Texas at Dallas, [2]Duke University

Gambles that involve a large but unlikely gain coupled with a small but likely loss - like purchasing a lottery ticket or insurance - are positively-skewed. Positively-skewed gambles are preferred by people and this preference becomes more exacerbated with age. Here we attempt to better understand when people are more drawn towards positively-skewed outcomes. For instance, animal research suggests that there may be a greater preference for more strongly-skewed options. In an online study (n = 209) of healthy participants between the ages of 22 and 85 participants made choices between a positively-skewed gamble and a certain outcome. Skewed gambles varied systematically in the degree of skewness on each trial, spanning from weakly-skewed (45%-55% win-lose) to strongly-skewed (5%-95% win-lose) in 5% increments, resulting in 9 gambles. While expected value of all stimuli for a participant was constant (-$5, -$0.5, $0, $0.5, or $5), it varied between participants. Participants were also queried about their decision-making strategy and real-world financial decision making. Logistic regression analyses revealed that people were more likely to accept moderately- and strongly-skewed gambles over equivalent certain outcomes, but age was not a significant predictor of gamble acceptance. Exploratory analyses revealed that participants who were more likely to accept skewed gambles claimed to use an affective (over deliberative) strategy and were more confident in their ability to resist high-pressure sales tactics. Thus, people show greater preference for more strongly-skewed options and positive-skew preference appears to be driven by affective strategies and confidence instead of deliberative reasoning and experience.

Topic Area: THINKING: Decision making

D124 Opinion Changes on Debatable Arguments Involve Executive Process, but Opinion Amplification does not

Masako Tanaka[1], Motoaki Sugiura[1], Ketaro Oba[1], Shigeyuki Ikeda[1], Seishu Nakagawa[2], Ryuta Kawashima[1], [1]Tokyo Denki University, [2]Tohoku Medical and Pharmaceutical University

When we decide to update our opinions based on given reasons from others, the process of changing opinions to the opposite (i.e., opinion changes) and that of shifting extreme (i.e., opinion amplification) are considered different. The biased assimilation theory posits that acceptance of the reasons refuting our preexisting belief requires conscious scrutiny, while that of supporting reasons does not, leading to polarization. To provide neural evidence of this theory, using an fMRI, 21 healthy participants were presented with the debatable arguments and asked to disclose their opinions by rating the degree of agreement (8-point scale). Then they were presented with some reasons for supporting or refuting the initial opinions, and asked to rate their opinions again. In total 60 arguments were presented and half of the subsequently presented reasons were supporting and the rest were refuting. Neural activity during the second rating (i.e., after the presentation of the reasons) was compared between the trials where the opinion was updated (i.e., from the first to the second rating) and those unchanged. In the case of the opinion changes, updated trials showed activation of the bilateral fronto-parietal network and putamen. For the opinion amplification, however, these regions were not activated and lower activation of the bilateral superior temporal gyri only was observed during the updated trials. The observed involvement of the executive function during the conceptual opinion changes, but not during the opinion amplification may suggest the differential degree of the conscious scrutinizing process, thus supporting the biased assimilation theory.

Topic Area: THINKING: Decision making

D125 Prolonged Cannabis Use Decreases Cognitive Effort

Mackenzie Taylor[1], Francesca Filbey[1], [1]The University of Texas at Dallas

Acute THC administration in humans and rats has been associated with decreased willingness to exert cognitive effort that may explain amotivational behavior during acute cannabis intoxication. To date, however, whether decreased cognitive effort is also present following prolonged use (vs. acute use) has yet to be determined. The goal of this study was to test whether cannabis exposure has residual effects on cognitive effort in non-acutely intoxicated cannabis using adults. To that end, we evaluated performance on the Effort Expenditure for Reward Task (EEfRT) between 44 adult cannabis users and 51 non-using controls. A MANOVA was performed to examine the effect of group on EEfRT performance and Pearson correlations were calculated between EEfRT scores and SES/education, cannabis use

variables, impulsivity (IMPSS), and anhedonia (SHAPS). We found that users chose significantly less hard trials than non-users, despite earning the same amount of money overall ($F = 9.23$, $p < .01$). Additionally, cannabis users' trait impulsivity was negatively correlated with amount of hard trials chosen ($r = -.74$, $p < .01$), and THC/CR ratio was positively correlated with amount of hard trials chosen for low probability/low reward trials ($r = .496$, $p < .05$ and $r = .415$, $p < .05$, respectively). The correlation between EEfRT and anhedonia approached significance ($p = .057$). These results are in accord with findings of reduced cognitive effort following acute exposure to THC and suggest a mechanism by which prolonged use of cannabis may lead to amotivation and reduced psychosocial outcomes in regular cannabis users.

Topic Area: THINKING: Decision making

D126 Effects of posterior-anterior shift in the aging brain on creativity: A combined ICA and resting-state fMRI study

Abhishek Uday Patil[1], Deepa Madathil[1], Ovid J L Tzeng[2], Hsu-Wen Huang[3], Chih-Mao Huang[4], [1]Vellore Institute of Technology, [2]Academia Sinica, [3]City University of Hong Kong, [4]National Chiao Tung University

There is converging evidence that cognitive aging is associated with significant changes in functional connectivity between various regions of the aging brain. In the present study, we employed the resting-state functional magnetic resonance imaging (rs-fMRI) technique and independent component analysis (ICA) approach to examine whether and how posterior- anterior shift in aging (i.e., PASA) in functional connectivity of various resting-state networks (RSNs) relates to individual differences in creative ability in the elderly. Group- ICA of RSNs from 34 healthy old adults and 21 young adults were performed to identify default mode network (DMN), executive-control network (ECN), temporal-occipital network, and cerebellar network. Each participant's creative assessment questionnaire (CAQ) score was used as a covariate to examine the association between mental ability of creativity and functional connectivity of RSNs. The rs-fMRI results demonstrated the stronger connectivity of prefrontal gyri whereas reduced connectivity of temporal-occipital regions for the older adults, consistent with the notion of PASA. Moreover, individual variations in CAQ scores were related to the patterns of PASA in older but not in young adults. Our findings provide the neuroimaging evidence that age-related changes in creative ability may be associated with a posterior-to-anterior gradient of declines in functional connectivity of the aging brain.

Topic Area: THINKING: Development & aging

D127 The Role of Intuitions on the Emergence of Conscious Knowledge: Evidence from a Serial Reaction Time Task

Adam Weinberger[1], Adam Green[1], [1]Georgetown University

Intuition ? commonly defined as the sense of 'knowing without knowing how one knows' ? has been a popular topic of study in psychological, philosophical, and cognitive disciplines for several decades. Intuitions have been theorized to develop based on incomplete perceptions of regularity and coherence via implicit learning. In turn, such intuitions may influence more explicit beliefs, knowledge, and behaviors. Despite these prominent perspectives, however, there is surprisingly little empirical work to support intuitions based on implicit learning, and the role of intuition on the subsequent development of more explicit knowledge is largely untested. Here, participants completed a modified version of the Serial Reaction Time Task, a commonly used measure to assess implicit learning that involves responding by button-press to rapidly appearing and disappearing targets. Half of the target blocks adhere to a repeating pattern while half are random. Patterned sequences were designed to be complex enough to elude explicit awareness upon initial exposure, but ? upon repeated presentations ? eventually yield explicit knowledge. Consistent with theoretical perspectives, results indicated that intuitions of patterns emerged on pattern blocks prior to explicit knowledge. Moreover, we identified a relationship between intuition and implicit learning and later explicit awareness of the patterns. These findings provide empirical evidence of the process by which individuals become consciously aware of unconsciously learned regularities, and have the potential to inform new hypotheses on the emergence of conscious awareness and knowledge.

Topic Area: THINKING: Other

D128 WITHDRAWN

D129 Higher intelligence is associated with a more effective adaptation of brain activity to cognitive demands

Ulrike Basten[1], Rebecca A. Mayer[1], Rebekka Weygandt[1], Christian J. Fiebach[1], [1]Goethe University Frankfurt

A prominent theory on the neural basis of human intelligence states that brains of more intelligent people are more efficient. Empirical evidence for this so-called neural efficiency hypothesis of intelligence is inconclusive as previous studies have associated intelligence with both weaker and stronger brain activation in response to cognitive challenges. We studied the role of task difficulty as a potential moderator of the association between intelligence and brain activation. For 73 healthy adult participants, we used fMRI to measure brain activity during a decision making task with 5 levels of difficulty. Intelligence was assessed with a matrix reasoning test (BOMAT-Advanced). In three brain regions, we observed an interaction effect of intelligence and task difficulty on brain activation. In the dorsomedial prefrontal cortex as well as in the left inferior parietal lobe and middle temporal gyrus, higher intelligence was associated with stronger decreases in brain activity for increasing task difficulty. We interpret our finding as indicating that more intelligent people show a stronger down-modulation of the brain's default activity when tasks get difficult. Overall, our study confirms that the brains of more intelligent people are not generally more or less efficient. Instead, observed associations depend on task difficulty. Specifically, our findings suggest that in more intelligent people brain activity is more effectively adapted to varying task demands.

Session E

Monday, March 16, 2:30–4:30 pm, Exhibit Hall C

E1 Neural networks supporting memory-guided and cued attention in children: Mechanisms explaining the achievement gap

Maya Rosen[1], Lucy Lurie[1], Kelly Sambrook[2], Andrew Meltzoff[2], Katie McLaughlin[1], [1]Harvard University, [2]University of Washington

Academic activities engage complex sets of cognitive processes including perceptual processing, attention, and memory. Variation in socioeconomic status (SES) may impact development of the neural systems that support these processes which in turn may contribute to the income-achievement gap. Cued attention is the ability to use an external visual cue (e.g. an arrow) to direct attention to an important location in the environment while memory-guided attention is the ability to use past experience to direct attention. In the present study, we use functional MRI to investigate the neural networks that support these two critical aspects of healthy cognitive function and the relation of these systems to SES and academic achievement in school-aged children (n = 63, aged 6-8 years). Results revealed that like adults, children demonstrated greater activation in the lateral occipital cortex and other regions of the ventral visual stream (VVS) during cued attention compared to memory-guided attention. Children also demonstrated greater activation in the precuneus, a key node of the default mode network, for memory-guided

attention compared to cued attention. Moreover, results revealed SES-related differences in recruitment of the anterior insula during the cued attention, but not memory-guided attention. Critically, recruitment of the VVS during both cued and memory-guided attention was associated with academic achievement and activation in this region explained SES-related differences in academic achievement. These findings extend previous work by highlighting the role of visual processing regions in complex cognitive functions to support children as they make the transition to school.

Topic: ATTENTION: Development & aging

E2 Relationships between age-related changes in attention span and anticipatory neural activity

Alexander Simon[1], Joaquin Anguera[1], Courtney Gallen[1], David Ziegler[1], Adam Gazzaley[1], [1]UCSF

Sustained attention is the ability to maintain attention over time. Previous research has characterized how performance on such tasks changes with age, as measured by response time (RT), response time variability (RTV), and accuracy (e.g., D'). However, age-related changes in the duration that someone is able to maintain a stable focus of attention (attention span) remains unknown. Here, we sought to 1) develop a metric for characterizing attention span, 2) uncover how it changes during normal aging, and 3) uncover the neural correlates that facilitate maintaining an attention span, and how those change with aging. Here, 90 healthy young adults (age range: 18-35 years) and 93 healthy older adults (age range: 55-80 years) performed a go/no-go task while EEG was recorded. Attention span was computed by calculating the amount of time that a participant was able to keep RTs within 1 standard deviation from their mean RT without making an error. We found that while attention span declined with age, RTV, RT, and D' did not. Trial-wise time-frequency analysis of the EEG revealed that attention span is related to the ability to consistently reduce posterior alpha power during the pre-stimulus period in both younger and older adults. Additionally, these age-related changes in attention span are related to changes in anticipatory neural activity. Future work will involve relating attention span metrics to populations with sustained attention deficits, such as in kids with ADHD and older adults with mild cognitive impairment.

Topic: ATTENTION: Development & aging

E3 Neural oscillatory dynamics in directed and divided attention

Marie McCusker[1], Alex Wiesman[1], Tony Wilson[1], [1]University of Nebraska Medical Center

The spatial location of cortical regions serving directed and divided attention has been extensively studied using a myriad of methods, including functional neuroimaging. However, research on the dynamic patterns of neural activity underlying attention is relatively sparse. An enhanced understanding of this topic is important since spectrally-distinct patterns of neural oscillatory activity are thought to underlie numerous cognitive and behavioral processes, including attention. Using high-density magnetoencephalography (MEG) and a visual-somatosensory oddball task, we investigated the oscillatory dynamics of both directed (Experiment 1; N = 26) and divided (Experiment 2; N = 32) visual attention. All sensor-level MEG data were first analyzed in the time-frequency domain, and significant neural responses relative to baseline were imaged via beamforming for whole-brain analyses. Generally, we found that multi-spectral neural oscillatory responses were stronger when visual attention was sustained relative to when it was directed away or divided between sensory modalities. More specifically, we found stronger frontal theta (4 - 8 Hz), frontal and occipital alpha (8 - 14 Hz), occipital beta (16 - 22 Hz), and frontal gamma (74 - 84 Hz) responses when visual attention was sustained than when it was directed away from the visual domain. Similarly, in divided attention, we observed stronger frontoparietal theta activity and occipitoparietal alpha and beta oscillations when visual attention was sustained toward the visual stimuli than divided between the visual and somatosensory domains. Quantifying neural oscillatory activity in humans is essential for better understanding how attention is implemented in the brain and becomes dysfunctional in disease.

Topic: ATTENTION: Multisensory

E4 Prestimulus alpha modulation during a semantic judgement task

Lisa Payne[1], Many Jiwjinda[2], Chad Dubé[3], [1]Rutgers University, [2]Swarthmore College, [3]University of South Florida

Cortical alpha band oscillations (8 - 14 Hz) have been used as a marker of attentional control for sensory stimuli. Increase in alpha oscillations over auditory, visual and somatosensory brain regions is believed to represent suppression of task irrelevant information. The purpose of this study was to examine electroencephalogram (EEG) alpha modulation during selective attention to visual, verbal information. On each trial of the task, two words were briefly presented in sequence. A green or red fixation cross preceding each word cued whether that word should be remembered or ignored, respectively. Following this sequence presentation, participants judged whether a probe word was related to the to-be-remembered word. Consistent with visual selective suppression, ignoring words also led to increased alpha activity over parietal and occipital regions. However, when ignoring the first word was compared with attending the first word, increased alpha emerged over left-lateralized parietal and temporal regions involved in word recognition. These results indicate that there might be more to suppressing printed words than just visual sensory inhibition and that mechanisms reflected by alpha oscillations might play a role in selective attention for verbal information.

Topic: ATTENTION: Nonspatial

E5 Attentional control as a potential mechanism linking worry and error monitoring: An event-related potential study

Anthony Cruz[1], Kevin Saulnier[1], Annmarie Huet[1], Nicholas Allan[1], [1]Ohio University

Error-related negativity (ERN) is an event-related potential (ERP) indicative of error monitoring. Individuals with elevated worry demonstrate heightened ERN, reflecting a stronger reaction following the commission of an error. Worry also negatively impacts an individual's ability to regulate attention (i.e., attentional control [AC]). Occipital alpha activity, an EEG measurement typically derived from a resting state task, has been used as a neurophysiological measure of AC. However, the joint relation among worry, AC, and the ERN is unclear. Given worry impairs AC, it may be that reductions in AC explain the relations between worry and the ERN. Analyses were conducted in a sample of 68 community adults (M age 29.55, 67.7% female) to determine if the relation between worry and the ERN was explained through AC. Participants completed self-report measures of worry and AC, occipital alpha was captured during a resting state task, and the ERN was derived during a flanker task. Separate path analytic models were then conducted to test whether worry was related to the ERN through AC (both self-reported and occipital alpha). There was a marginally significant indirect effect of worry on the ERN through self-reported AC (B = .38, 90% CI: [.04,.75]). However, there was no indirect effect of worry on the ERN through occipital alpha (B = -.01, 95% CI: [-.15,.12]). These results indicate that the relation between worry and error monitoring may be mediated by self-reported AC. Finally, more research is needed to establish convergence across self-report and neurophysiological indicators of AC.

Topic: ATTENTION: Other

E6 Perceptual distraction disrupts the filter that gates visual working memory access

Blaire Dube[1], Julie Golomb[1], [1]The Ohio State University

Given the complexity of our visual environments, a number of mechanisms help us prioritize goal-consistent information. When searching for a friend in a crowd, for instance, visual working memory (VWM) maintains a representation of your target (i.e., your friend's blue shirt) so that attention can be subsequently constrained to elements of the environment sharing its features. When distracting (i.e., unexpected/salient) information appears, however, attention is captured, increasing search time. Although the effect of distraction on search times is heavily studied, we know little about its consequences for the mechanisms that support behavior and the filters that underlie their efficient use. Does distraction also disrupt the VWM filter that restricts storage of irrelevant information? On each trial, participants performed two consecutive visual searches. In the first (S1), they located a target (T) among non-targets (Ls), all presented within colored squares. On 40% of trials, a distracting white border flashed briefly surrounding a non-target square-we asked whether the (task-irrelevant) color associated with this S1 distractor would be encoded into memory. In the second search (S2), participants located a uniquely oriented landolt stimulus among homogeneously colored non-targets. One item was uniquely colored and, critically, its color sometimes matched the S1 distractor. We observed memory-driven capture in this critical S2 condition-that is, response times increased relative to when this unique item matched a non-target, non-distractor S1 color. We suggest that distraction disrupts the filter that regulates VWM encoding, resulting in the encoding of irrelevant inputs at the time of capture.

Topic: ATTENTION: Other

E7 Trait anxiety modulates event-related potentials to alcohol images in social drinkers

Alyse Finch, Allison Zborowski[1], Scott Oettli[1], Natalie Ceballos[1], Reiko Graham[1], [1]Texas State University

The transition to college is a stressful time accompanied by exposure to alcohol, increasing the risk for problem drinking. Reactivity to alcohol is thought to play a role in problem drinking, resulting in cravings and alcohol-seeking. However, individuals differ in the cue reactivity that they exhibit and less is known about these differences. This study examined the role of trait anxiety in event-related potentials (ERPs) to images of alcoholic and non-alcoholic beverages using a Go/No-Go paradigm. ERPs were recorded in 23 social drinkers (5 males, 18 females; mean age = 22.0 years), who completed a Go/No-Go task using images of preferred alcoholic and non-alcoholic (control) beverages. Self-report measures included state and trait anxiety, alcohol consumption, impulsivity and reward sensitivity. A median split was used to create high- (n = 11) and low-anxiety (n = 12) groups. N2 latency was not affected by target type (alcohol vs. control) or Go/No-Go status, whereas the P3 peaked earlier for alcohol Go trials relative to alcohol No-Go trials. P3 latency was also modulated by stimulus type and state anxiety, such that individuals with high state anxiety had shorter P3 latencies and low-anxiety participants had shorter P3 latencies to alcohol. Analysis of N2 amplitudes revealed that the N2 was larger for No-Go trials. P3 amplitudes were larger for non-alcoholic images and for No-Go trials. Our results suggest that the N2 is sensitive to behavioral inhibition, while the P3 component is sensitive to individual differences in trait anxiety, stimulus type, and response status.

Topic: ATTENTION: Other

E8 Engagement of the IPL Depends on Perceptual and Semantic Processing Demands

Oliver Gray[1,2], Lewis Fry[1,2], Martyn Mcfarquhar[1,2], Daniela Montaldi[1,2], [1]DNEP, [2]University of Manchester

The inferior parietal lobule (IPL) reportedly supports a diverse range of functions. Previous work has linked the right hemisphere's IPL with specialised spatial attention processing, and the left hemisphere's IPL with memory retrieval and semantic processing. However, the dynamics governing IPL processing remain poorly understood. Here, we provide novel and compelling evidence that allows us to propose that, rather than being task specific, hemispheric specialisation in the IPL depends on the information being processed. First, we present a review of fMRI episodic memory retrieval studies (122 contrasts, 65 studies). It demonstrates that across the literature, the right IPL is much more consistently activated during the retrieval of the perceptual than the semantic aspects of episodic memories (96% versus 46%). In contrast, left IPL activation is more consistently associated with the retrieval of the semantic, than the perceptual aspects of memory (95% / 83%). Next, we demonstrate how this same relationship dictates the lateralisation of attention allocation to visual space. We observed the established pseudoneglect attention effect (a left visual field bias, reflecting a right hemisphere processing bias) with highly perceptual line bisection tasks. In contrast, the bisection of objects revealed the opposite visual field bias, with the left hemisphere dictating a right visual field bias. Our evidence suggests a redefinition of IPL functional specialisation, refines our understanding of both left and right IPL processing, and should guide future investigations exploring the role of the IPL and connected structures.

Topic: ATTENTION: Spatial

E9 Abnormal Cortical Folding Correlates with Spatial Working Memory in Unaffected Relatives of Schizophrenia

In Kyung Park[1], Tae Young Lee[2], Wu Jeong Hwang[1], Minah Kim[2], Jun Soo Kwon[2], [1]Seoul National University College of Medicine, [2]Brain and Cognitive Sciences, Seoul National University

Objectives: Although alterations in gyrification have been frequently reported in patients with schizophrenia, it is not clear whether abnormal gyrification and its regionally specific associations with impaired cognitive function reflects a genetic risk of schizophrenia. Methods: A total of 30 unaffected relatives of schizophrenia who have high genetic loading but no prodromal symptoms and 31 healthy controls (HC) underwent T1-weighted magnetic resonance imaging to compare whole brain local gyrification index (lGI). The relationship between the lGI and primary cognitive features such as spatial working memory was also investigated in the unaffected relatives of patients with schizophrenia.Results: Compared with the HC, unaffected relatives exhibited significantly reduced lGI in bilateral precentral gyrus, postcentral gyrus, and medial parietal cortex. The higher number of spatial working memory (SWM) total errors as well as strategy in the unaffected relatives was positively correlated with hypogyria in broad regions mainly in lateral and medial prefrontal cortex in both hemispheres and precentral, postcentral, and parietal regions in left hemisphere. Conclusion: Our findings suggest that genetic risk of schizophrenia may affect cortical morphology, resulting reduced gyrification in fronto-parietal regions, and that precentral and postcentral hypogyrification in unaffected relatives may underlie possible genetic contribution to working memory deficits during early neurodevelopment in schizophrenia.

Topic: ATTENTION: Spatial

E10 Are attention-related modulations of alpha-band dynamics local or global?

Mattia Pietrelli[1], Jason Samaha[2], Bradley Postle[1], [1]UW Madison, [2]UC Santa Cruz

Research on endogenous attention has shown that predictive cues about the location and timing of forthcoming visual stimuli can influence behavior and several stages of neural processing. One proposed neural mechanism is that spatial and temporal predictions are influence the processing of visual stimuli by hijacking ongoing alpha-band oscillatory activity in brain areas involved in visual perception. However, it is not known if this top-down modulation of alpha oscillatory activity is selective for the circuits that represent target locations, or if it more broadly influences the physiological tone of the representation of the entire visual field. To answer this question, we manipulated spatial and temporal predictability during a Posner-style visual discrimination task, in which, within a block, stimuli could only appear in two of the four cardinal locations (i.e., either left-right or top-bottom). Consequently, in each block, two locations were task-relevant while the other two were task-irrelevant. Inverted encoding modeling (IEM) was used to isolate patterns of alpha-band activity specific to each of the four locations. Results showed that top-down expectations biased alpha-band power in a target location-specific manner, suggesting that alpha-band oscillatory activity can be controlled within discrete, local networks in order to optimize visual perception. Furthermore, periodic waxing waning of IEM reconstructions between cued and uncued location, consistent with the idea that alpha oscillatory activity sampled the two task-related locations rhythmically.

Topic: ATTENTION: Spatial

E11 Age-related differences in the statistical regularity of emotional faces

Yi-Wen Kao[1], Hsing-Hao Lee[1], Joshua Oon Soo Goh[1], Su-Ling Yeh[1], [1]National Taiwan University, Taiwan

Greater prior experience increases the contribution of statistical regularity on neurocognitive processing. We hypothesized that older adults have more experience and exposure to facial emotional expressions than younger adults and thus tend to make farther facial expression predictions. In a functional magnetic resonance imaging (fMRI) experiment, 19 young adults (mean±SD=22.6±3.01 years old) and 19 older adults (mean±SD=66.3±3.74 years old) viewed picture quartets of a sequence of facial expressions that changed in 10% intervals (i.e., 0%, 10%, 20%, 30%) from neutral to either a happy or disgusted face. A fifth target face was then presented that was either a 49% or 99% morph of the same or different emotion. Participants then responded whether the target met their expectation for the face that would immediately follow the quartet. Discrimination between 49% and 99% morphs was lower in older than younger adults when target emotions were congruent with quartets. Interestingly, target endorsement was generally higher in older than younger adults for happy than disgusted faces. Neural responses were higher for 49% than 99% morphs in younger than older adults in left inferior parietal areas but higher for 99% than 49% morphs in older than younger adults in left precentral areas. Generally, supportive of our hypothesis, our findings suggest that older adults make less distinctions between minute degrees of emotional expression levels. Furthermore, older adults prefer positive emotions to negative emotions, consistent with socioemotional selectivity theory. Such a behavioral effect of age might involve lower contributions from perceptual processing and more dominant top-down processing.

Topic: EMOTION & SOCIAL: Development & aging

E12 Different oscillatory networks underlie reward processing of novel and familiar music

Alberto Ara[1], Josep Marco-Pallarés[1], [1]University of Barcelona

Recent accounts have unveiled the brain interactions underlying music-reward processing. These include functional connectivity between right frontal and temporal areas, as well as the striatum. Until very recently, however, the temporal dynamics of these interactions had remained unexplored. In a recent study, we pinpointed that phase synchronization between right frontal and temporal nodes increases with greater music-evoked pleasantness in the theta oscillatory band. Nonetheless, the interaction of this effect with familiarity has not been accounted for. In the present EEG experiment we studied phase synchronization with temporal electrodes in the theta band as a function of music-evoked pleasantness moderated by familiarity. Twenty-two participants listened to and rated 30 novel and 30 familiar music excerpts 24 h after an exposure session. We replicated the effect of increased synchronization between right frontal and temporal nodes in the theta band with music-evoked pleasantness only in the case of novel music. With familiar music, instead, we found greater synchronization between right temporal and left parietal nodes. Importantly, similar connections exhibited the opposite effect when music was novel. Overall, we conclude that different brain mechanisms underlie music-reward processing depending on familiarity. We theorize that when music is novel, predictive coding mechanisms come into play when assigning value to music, whereas memory retrieval takes over when listening to familiar music.

Topic: EMOTION & SOCIAL: Emotional responding

E13 Deep and surface feature representations of affective dimensions in the human brain

Saeedeh Sadeghi[1], Xinyi Li[1], Junichi Chikazoe[2], Eve DeRosa[1], Adam Anderson[1], [1]Cornell University, [2]Japan National Institute for Physiological Sciences

Interpreting semantic content of visual emotional stimuli is computationally demanding and requires high-level cortical processing. However, recent evidence shows that basic visual features such as the frequency spectra of images, have above chance power to predict affective value. Here we ask if there are distinct representations in the brain for shallow features from deep content analysis in deriving affective value. In an fMRI experiment, Images (n=128) selected from the International Affective Picture System (IAPS) database were displayed to participants (n=20) during BOLD imaging. Following each trial, participants rated their positivity and negativity on two separate scales. Subjective arousal was defined as positivity + negativity. From each image we extracted eighty visual features derived from spatial frequency amplitudes. In a first set of analysis, all images in the IAPS database were used as training data for a random forest regression model that estimated arousal values. This model was then used to predict arousal of the experimental images (p

Topic: EMOTION & SOCIAL: Emotional responding

E14 Alterations in the Sympathetic Nervous System Reflecting Challenge and Threat When Confronted with Failure or Success

Viktoriya Babenko[1], Neil M. Dundon[1], Evan Layher[1], Scott T. Grafton[1], [1]University of California, Santa Barbara

The biopsychosocial (BPS) model of challenge and threat states that a change in perception of a situation and of a person's capabilities can lead to one of two physiological states, either 'challenge' or 'threat'. These differing states, previously explained by individual differences and shown to alter with task difficulty, have been associated with task performance, anticipatory worry, and mindfulness. This study incorporates a false feedback manipulation to

examine whether participants' sympathetic nervous system (SNS) response can be altered as a function of trial by trial performance feedback rather than reward or task difficulty. A modular math calculation task required participants to respond as quickly and accurately as possible while undergoing cardiovascular monitoring. A combination of electrocardiogram and impedance cardiography data estimated pre-ejection period (PEP) to define quantitative changes in SNS along with total peripheral resistance (TPR) to characterize trialwise stress responses as either 'challenge' or 'threat'. As positive feedback began to decline in an otherwise bountiful interval, significant decreases in PEP (p

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

E15 Effects of stress-related changes in pre-encoding intrinsic connectivity on subsequent emotional memory biases

Jaclyn Ford[1], Sara Y. Kim[2], Sarah Kark[3], Ryan Daley[1], Jessica Payne[2], Elizabeth Kensinger[1], [1]Boston College, [2]University of Notre Dame, [3]UC Irvine

Exposure to a stressor immediately before experiencing an event can influence how that event is later remembered. In the current study, we examined the hypothesis that acute stress affects memory by altering the underlying brain state of individuals prior to encoding. Specifically, we examined whether stress-related changes in intrinsic functional connectivity are related to subsequent emotional memory performance and valence biases. The reported data are from 25 participants (age 18-27; 15 female) who underwent a psychosocial stressor before an incidental emotional memory encoding task. Cortisol samples and resting state functional connectivity scans were obtained before and after the stressor to measure individual differences in stress-reactivity and to evaluate stress-related changes to intrinsic connectivity of the left and right amygdala. The primary analysis examined how stress-reactivity predicted change in amygdala connectivity and how such reactivity-related connectivity changes interact with memory bias (negative bias = greater effects for negative relative to positive memory; positive bias = greater effects for positive relative to negative memory). Although greater stress-reactivity was not associated with changes in amygdala connectivity patterns, there was a reactivity-by-memory bias interaction (p

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

E16 The Influence of Media Violence Exposure on Explicit and Implicit Emotional Face Processing

Zoa Glab[1], Laura Stockdale[1,2], Sylena Wilson[1], Marley Hornewer[3], Sydney Samoska[1], Joseph Vukov[1], Rebecca Silton[1], Robert Morrison[1], [1]Loyola University Chicago, [2]Brigham Young University, [3]University of Michigan

Past studies from our lab have shown that short-term and chronic exposure to media violence can modulate the implicit processing of emotional faces (Stockdale et al., 2015, 2017). However, other research has shown that media violence can increase the speed and accuracy of identifying angry faces when participants are explicitly asked to attend to emotion. To investigate how media violence interacts with attention to emotional stimuli, we asked participants to complete a stop-signal task (SST) with happy and angry face stimuli, while they either categorized the gender (Implicit SST; n = 47) or the facial expression (Explicit SST; n = 40). Prior to completing the SST, participants watched a violent and non-violent film one-week apart in counterbalanced order. RT and SST accuracy did not differ based on film condition during the explicit version of the task. However, during the implicit task, exposure to the violent video eliminated differences in gender classification between happy and angry faces, once again showing the desensitizing effects of media violence on emotional face processing. A similar pattern emerged in N170 amplitudes, where violent film exposure eliminated differences between happy and angry faces when participants watched a non-violent clip. Media violence did not impact performance in the explicit task; however, processing angry faces received increased resources as measured by both increased angry face RT and increased amplitudes and delayed peak P100 and N170 latencies. These results suggest that short-term exposure to media violence differentially impacts emotional face processing depending on whether emotion processing receives focused attention.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

E17 Brain-Behavior Connections in ASD: Making Sense of Neural Activity in Emotion Recognition and ToM

Yu Han[1], Patricia Prelock[1], Emily Coderre[1], [1]University of Vermont

Children with Autism Spectrum Disorder (ASD) often struggle with social interactions and connecting with others due to deficits in theory of mind (ToM). In this study, we will collect behavioral and neuroimaging data for children with and without ASD, particularly in the areas of emotion recognition and understanding which are key skills required for meaningful social interaction. The research will use these measures to determine which brain systems contribute to behavioral functions associated with ToM. Insights derived from clarifying the neural systems involved in ToM surrounding desire-based emotion and more complex emotions (i.e., surprise and embarrassment) are expected to facilitate improvement in the diagnosis, design and target of intervention methods for the population. The study will include 40 children (7 to 14 years of age), 20 children with ASD and 20 neurotypycal children (NT). We will use two novel fMRI paradigms. The first is an fMRI Emotion Recognition task to assess recognition of less well studied basic and complex emotions (i.e., surprise, embarrassment) requiring ToM using a series of visually presented faces. The second is an fMRI ToM task developed to assess desired-based emotions, in which participants are required to infer the reaction of a cartoon character to a gift using knowledge provided about the preferences of that character. Results showed that the two novel fMRI tasks elicited brain activations in ToM related brain areas (e.g. anterior cingulate, prefrontal cortex), and ASD and NT groups demonstrated different brain activation patterns.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

E18 The Emotional Regulation Effect of Cognitive Reappraisal and Psychological Anticipation on Behavior Inhibition

Xiaoli He[1], Lichen Zhou[1], Sha Xu[1], Jiaxu Gu[1], [1]NingXia University

Conflict, a common social interaction behavior, plays an essential role in the development of human society. Negative emotions such as anger result from social conflicts have great impacts on individual behavior, which may lead to serious consequences. Regulation of negative emotions can promote behavioral inhibitions and avoid social conflicts. The influence of emotional regulation strategies on behavioral inhibition in specific conflict scenarios, however, has been relatively understudied. 101 participants, who were activated separately to be urban inspector group (51s) and vendor group (50s) by group identity materials, were recruited from NingXia University. The effects of emotional regulation strategies on anger for each group were acquired by MP150 and subjective emotional reports. Influences of emotional regulation strategies on behavior inhibition in the conflict between urban inspectors and vendors were explored by double-choice Oddball paradigm and the advantage of high time resolution of Event-Relatedâ??PotentialS (ERP).Participants using different emotional regulation strategies had lower level of anger emotion, skin electricity, and heart rate, compare to those with no emotional regulation strategies, which showed effective regulation of anger emotion in the conflict between urban inspectors and vendors. Participants using emotional regulation strategies showed higher emotional regulation ability and shorter response time to biased stimuli than the free-watch group. The N2 and

P3 components in the bias-standard difference wave of behavioral inhibition control process were significant with the participants using emotional regulation strategies, compared to the free-watch group.Compared to psychological anticipation, cognitive reappraisal can reduce anger emotion and inhibit behavior effectively.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

E19 Brain's sensitivity to other's stimuli processing, a potential factor for the similarity of percepts across individuals.

Matthieu Ienne[1], Amanda Tardif[1], Bruno J. Debruille[2], [1]Department of Neurology and Neurosurgery, McGill University, [2]Department of Psychiatry, McGill University

Our perceptual world, the 3D film (Chalmers) created by our brain from information from our receptors, must have its physics, like everything else. A sensitivity to this physics must also exist to account for our reactions to our percepts. Moreover, the others should also be sensitive to this physics, otherwise their brain could not produce percepts similar to ours. Indeed, percepts do not depend closely on brain structures. The visual cortex, for instance, can produce auditory percepts. To test this view of consciousness, we used the fact that, to create similar percepts, this sensitivity of others must be used only for the processing of the same stimulus. We therefore tested whether the event-related potentials (ERPs) evoked by images in simple memorization task depend on a) differences between the stimulus presented to a close other and the one presented to the participant and b) an announcement of these differences that was made just before each block of trials. For each participant to be sensitive only to the percepts created by his partner, and not to his partner's real stimulus or behavioral reactions to it, the two partners were separated by a double glass and a curtain. ERPs were found to depend on the match between the announcement and the actual differences between the stimuli, despite the impossibility for a participant to see the image of his partner. We therefore conclude that a person's brain could be used to detect the physics of the perceptual world of his close others.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

E20 Individual differences in personality traits and meta-traits are associated with features of intrinsic brain networks

Matthew Moore[1], Grace Goodwin[1], Evan Anderson[1], Chris Zwilling[1], Tanveer Talukdar[1], Charles Hillman[2], Neal Cohen[1], Arthur Kramer[2], Aron Barbey[1], [1]University of Illinois at Urbana-Champaign, [2]Northeastern University

Despite recent progress targeting specific personality traits and the function of particular brain regions, it remains unclear what features of individual differences are associated with large-scale intrinsic networks observed in resting state functional connectivity. Clarifying these associations has important implications for identifying factors that influence cognitive function and socio-emotional well-being. Given that higher-order personality dimensions, or meta-traits, have received relatively little attention, we sought to examine their association with intrinsic connectivity networks. In the present study, the Big Five personality traits and two meta-traits (i.e., plasticity and stability) were examined in relation to the mean participation coefficient (measuring how well distributed the links of a node are among modules) of seven intrinsic connectivity networks, in a sample of 289 healthy adults (18?43 years old, 148 females). Plasticity (meta-trait super-ordinate to extraversion and openness) was negatively associated with the mean participation coefficient in the dorsal and ventral attention networks, suggesting that participants high in plasticity had attention networks with more within-module connections. Further examination at the trait level showed that extraversion and openness were negatively associated with the dorsal and ventral networks, respectively, suggesting that the associations with plasticity were differentially linked to specific traits. These results support the idea that there are associations between individual differences in personality and features of intrinsic connectivity networks, which can provide novel insights with valuable implications for understanding the interaction of these factors in healthy and clinical groups. Future studies will explore the relationship of network?personality associations with specific cognitive abilities.

Topic: EMOTION & SOCIAL: Other

E21 Irritability in Adolescent ADHD: Relations with Functional Connectivity and Subsequent Degree of ADHD Symptoms

Julie Schweitzer[1], Veronika Vilgis[1], Sarah Kahle[1], Shawn Rhoads[1], Grant Shields[1], Prerona Mukherjee[1], Amanda Guyer[1], [1]University of California, Davis

Irritability in adolescent attention deficit hyperactivity/disorder (ADHD) is increasingly recognized as an important symptom as it may escalate risk for social problems, comorbid psychiatric disorders and suicidality in ADHD. Study 1 examined whole-brain functional connectivity of amygdala and nucleus accumbens seeds in relation to irritability in ADHD (n=34) and typically developing (TD) (n=34) adolescents, matched on sex, age, head motion and IQ. In the ADHD versus TD group, irritability was associated positively with connectivity between bilateral amygdala and putamen/caudate and the right amygdala and medial PFC/frontal pole, in ADHD only. Irritability was associated positively with connectivity of left nucleus accumbens and left medial temporal gyrus but associated negatively with connectivity of both amygdala and nucleus accumbens connectivity with posterior parieto-occipital regions (e.g., precuneus, lateral occipital regions), only in the ADHD group. Study 2 used path analysis to examine multiple dependent variables in ADHD and TD adolescents (n=108; Mean age=14.21 years) with parent ratings of irritability at Time 1 and Time 2 (n=80), approximately 18 months later. Irritability ratings were significantly correlated with the two dimensions of ADHD (inattention and hyperactivity/impulsivity). Time 1 irritability predicted higher levels of Time 2 hyperactivity/impulsivity (?=.24; 95% CI .09-.39) differentially by gender, with higher relative hyperactivity/impulsivity for females only (females: ?=.50, 95% CI .25-.76; males: ?=.17, 95% CI -.02-.36). These analyses suggest irritability in ADHD is associated with alterations in reward/emotion neural systems and may also predict the course of future symptoms, particularly in females with ADHD.

Topic: EMOTION & SOCIAL: Other

E22 Not always the face: differences between human and dog neural face- and conspecific-preference

Attila Andics[1], Nóra Bunford[2], Raúl Hernández-Pérez[1], Eszter Borbála Farkas[1], Laura V. Cuaya[1], Dóra Szabó[1], Ádám György Szabó[3], Márta Gácsi[1], Ádám Miklósi[1], [1]ELTE Department of Ethology, Budapest, Research Centre for Natural Sciences, Budapest, MR Research Center, Semmelweis University

What drives processing preferences when viewing individuals, and how these preferences evolved, are key questions of comparative social neuroscience. Preference for faces and for same-species stimuli are two well-documented organizing principles. Yet, the evolutionary origin and the relative role of neural face- and species-sensitivity in visual social processing are largely unknown. We performed awake fMRI with humans (n=30) and family dogs (n=20), presenting them with identical stimuli: short videos of human and dog faces and occiputs (back of the head). We compared neural sensitivity to conspecificity and faceness between the two phylogenetically distant mammal species. Across-species representational similarities were mostly driven by species-sensitivity for faces. Both humans and dogs showed stronger neural response to same-species stimuli, suggesting that conspecific-preference may be an ancient characteristic of the visual system. In contrast, while in

humans we identified all previously reported face areas, in dogs we found no brain regions responding preferentially to faces. In humans, only the face areas involved in processing emotional information (e.g. the pMTG) preferred human to dog images and 89.2% of the visually-responsive cortex showed face-over-conspecific preference. In dogs, a bilateral temporo-parietal region (mid suprasylvian gyrus) showed increased response to dog relative to human images and 94.6% of the visually-responsive cortex showed conspecific-over-face preference. These findings suggest that visual social perception follows different organizing principles in humans and dogs. The central role of face-sensitivity in human (and primate) perception of individuals may not be general across all mammals.

Topic: EMOTION & SOCIAL: Person perception

E23 Political identity priming and own-race bias in Caucasian and Hispanic/Latino college students.

Aspen Madrid[1], Crystal Oberle[1], [1]Texas State University

Individuals' enhanced recognition for faces of one's own race or ethnic group as opposed to faces belonging to other racial or ethnic groups is known as own-race bias, or ORB. Recent models of face processing suggest that a perceiver's motives, individuation experience, and contextual cues can all play a role in an individual's automatic decision to selectively attend to a face. However, an emerging body of research suggests contextual cues priming individuals with meaningful aspects of their identity that are not inherently indicated by one's physical appearance may influence in-group recognition bias in such a way that ORB may be attenuated. To date very little has been published regarding how one's political identity may influence ORB. The purpose of this study was to assess whether ORB can be attenuated for faces belonging to members of one's political in-group. Researchers hypothesized that when target faces were labeled as endorsing the same political ideology as the participant as opposed to a different political ideology, participants would exhibit (a) greater hit rates (b) lower false alarm rates (c) greater response sensitivity, and (d) more conservative response biases for other-race faces. Four separate 2 (same race, other race) x 2 (same ideology, other ideology) ANOVAs were conducted to analyze data for the dependent variables used to assess recognition memory accuracy: hits, false alarms, response sensitivity, and response bias. There were no significant differences in measures of recognition memory between groups.

Topic: EMOTION & SOCIAL: Person perception

E24 The dimensional structure of social relationship knowledge

Haroon Popal[1], Yin Wang[2], Mark Thornton[3], Ingrid Olson[1], [1]Temple University, [2]Beijing Normal University, [3]Dartmouth University

When we interact with other people, we make inferences about them, and act accordingly based in part on our social relationship to them. Key older work on social relationships in social psychology and sociology explored the semantic space of social relational concepts and hypothesized that these concepts are represented dimensionally. However, these studies failed to reach agreement on the organizing dimensions of human relationships and no attempt was made to understand the neural foundations. The goal of this study was to understand the representational architecture of social relationship knowledge. We hypothesized that our concepts of social relationships are organized along multi-dimensional components, which are represented in portions of the 'social brain'. We conducted a survey on Amazon Mechanical Turk in which participants were asked to rate 159 social relationships on 30 dimensions derived from theories from the literature on social relationships. Next, we conducted Principal Component Analysis to find the overarching components that could account for the variance in social relationships. We found that four components - emotional proximity, exchange opportunity, valence, and monetary exchange - accounted for 77% of the variance in the dimensional ratings of social relationships. Finally, we used a subset of the social relationship concepts as stimuli in an fMRI study. Preliminary findings using RSA show that regions of the social brain, such as medial prefrontal cortex and the precuneus, are recruited to process information about social relationships. These findings suggest that the human brain uses a common neural code to represent social relationships.

Topic: EMOTION & SOCIAL: Person perception

E25 Differential modulation of brain responses to face stimuli after exposure to urban versus forest environments

Eszter Toth[1], Jane Raymond[1], Ali Mazaheri[1], [1]University of Birmingham

There is currently a number of epidemiological studies which suggest that an urban environment increases the risk for the development of Schizophrenia as well as mood disorders (Mortensen et a., 1999; Peen et al., 2010). In addition empirical studies have observed greater amygdala activation, a key region for emotional face processing and attention allocation as a function of an individual's urban upbringing during stress (Lederbogen et al., 2011). In the current 64 channel electroencephalogram (EEG) study we investigated whether transient exposure to videos of an urban versus natural environment impacted the visual evoked responses elicited by face stimuli in 24 healthy young adults. The volunteers watched 20 minute videos showing either a forest or a city walk, and subsequently performed an oddball paradigm with neutral and emotional faces as the standard and target stimuli respectively. We focused our analysis on the early visual evoked potentials locked to the onset of the face stimuli, and found significant differences depending on the videos preceding the oddball task. Specifically, we found that the P1 over the right hemisphere was larger after the city than the forest video. Furthermore, the N170 occurred earlier over the right than the left hemisphere after the forest, but not the city video. The P1 results suggest that people attend more to faces after an urban than nature exposure video. This increased attention, which may deplete resources very fast, might account for why city living has been reported to be related to greater mental fatigue (Lee et al., 2015).

Topic: EMOTION & SOCIAL: Person perception

E26 Does combined decision-making training and tDCS produce generalizable cognitive benefits in healthy older adults?

Kristina Horne[1], Hannah L. Filmer[1], Jason B. Mattingley[1], Paul E. Dux[1], Zoie Nott[1], [1]University of Queensland

Much excitement has been generated about the use of brain stimulation techniques to ameliorate age-related neurocognitive decline. Existing studies suggest that transcranial direct current stimulation (tDCS) might enhance cognitive training effects. It remains unclear, however, whether benefits 'transfer' to other cognitive domains or persist over time. This study is the largest to date, and the first Registered Report (Stage 1 in-principal accepted at Nature Human Behaviour) to investigate the effects of a combined training and tDCS protocol on cognitive functions in older adults. We assigned 131 healthy participants, aged 60-75, to four demographically-matched groups. Each group received one of four protocols over five consecutive days: decision-making training and anodal tDCS over the left prefrontal cortex (PFC); decision-making training and sham tDCS (left PFC); training on a control task and anodal tDCS over the left PFC; or decision-making training and anodal tDCS over the visual cortex (control electrode location). Participants completed a comprehensive battery of eleven cognitive tasks and two ecologically valid questionnaires pre- and post-intervention and at one and three-month follow-up time-points. In contrast to young adults, anodal tDCS did not enhance training benefits in healthy older adults, perhaps reflecting structural and functional brain changes experienced in ageing. In addition,

observed training gains did not transfer to other cognitive domains or everyday function at the group level. However, analysis of individual differences revealed that for individuals who received tDCS, magnitude of training benefits was associated with performance gains on several transfer tasks at follow-up time-points hinting the possibility of transfer.

Topic: EXECUTIVE PROCESSES: Development &aging

E27 Differences in Cognitive and Motor Inhibition of Aging Musicians and Non-Musicians

Patricia Izbicki[1], Kate Rumel[2], Andrew Zaman[1], Elizabeth Stegemoller[1], [1]Iowa State University, [2]Elmherst College

Older adults experience declines in inhibitory control. These declines have been associated with declines in instrumental activities of daily living. Older adult musicians have behavioral and neurophysiological enhancements in various cognitive and motor domains as compared to non-musicians, suggesting that music training may delay the decline in cognitive and motor inhibition with aging. Yet, this has not been studied across the lifespan in currently practicing musicians and non-musicians. Thus, the aim of this study was to investigate the behavioral and neurophysiological differences in cognitive and motor inhibition in aging musicians and non-musicians. Twenty young adult musicians and non-musicians and twenty older adult musicians and non-musicians were recruited. To measure cognitive inhibition, the Stroop task was performed while electroencephalography (P300 amplitude and latency) was recorded. To measure motor inhibition, finger taps in sync and between auditory tones presented at 1 Hz were performed while transcranial magnetic stimulation short latency intracortical inhibition (SICI amplitude) was applied in between finger taps. 2 x 2 ANOVAs revealed main effects of age for inhibitory brain measures (decreased P300 amplitude over Fz, F3, F4 and increased SICI in older adults) and Stroop reaction time (increased for older adults). Interactions were revealed only for inhibitory brain measures (P300 amplitude over F3 and SICI). Post-hoc Bonferroni corrections showed significant differences only for the P300 amplitude over F3 between young musicians (increased amplitude) and non-musicians. Results demonstrate that practicing a musical instrument may alter neural correlates of cognitive inhibition in young adults and not older adults.

Topic: EXECUTIVE PROCESSES: Development &aging

E28 The distinct roles of prefrontal GABA and glutamate/glutamine in two types of cognitive control

Boman Groff[1], Hilary Traut[1], Rebecca Helmuth[1], Harry Smolker[1], Mark Brown[1,2], Hannah Snyder[3], Benjamin Hankin[4], Marie Banich[1], [1]University of Colorado Boulder, [2]Anschutz Medical Campus, [3]Brandeis University, [4]University of Illinois Urbana-Champaign

This study tested whether individual differences in neurotransmitter levels in lateral prefrontal cortex are associated with brain activation during a cognitive control task. More specifically, we tested the hypothesis that individual differences in levels of excitatory (glutamatergic) neurotransmitter in the dorsolateral prefrontal cortex (dlPFC) are associated with brain activation when maintaining a task goal in the presence of competing information (goal-maintenance), while inhibitory (GABAergic) neurotransmitter levels in ventrolateral prefrontal cortex (vlPFC) are associated with brain activation when selecting information from multiple task-relevant options to guide responding (goal-related selection). In a sample of 47 adult women, PRESS and MEGAPRESS sequences were used to determine resting GABA+ and Glutamate/Glutamine (GLX) concentrations (accounting for grey matter) in two separate voxels (dlPFC, vlPFC). Participants then underwent functional magnetic resonance imaging while performing a verb generation task with a 2-by-2 design that separately manipulated the difficulty (high, low) of goal-maintenance and goal-related selection. Concentration of GABA+ (controlling for GLX) in vlPFC was associated with differences in activation between the high and low goal-related selection conditions in occipital and temporal regions. In contrast, GLX concentration (controlling for GABA+) in dlPFC was associated with differences in activation between the high and low goal-maintenance conditions in parahippocampal and inferior temporal regions. These findings are the first to show that individual differences in GLX and GABA+ in lateral prefrontal cortex are associated with brain activation during a cognitive control task, and that these relationships differ by region (dlFPC, vlPFC) and type of control mechanism required (goal-maintenance vs. goal-related selection).

Topic: EXECUTIVE PROCESSES: Goal maintenance & switching

E29 Effects of Action Priming on Involuntary Imagery in the Reflexive Imagery Task

Alejandro Heredia Cedillo[1], Christina Y. Wong[1], Ezequiel Morsella[1], Mark W. Geisler[1], [1]San Francisco State University

Involuntary mental imagery has been elicited by several experimental manipulations. In one version of the Reflexive Imagery Task (RIT), for example, subjects are presented with two line drawings of everyday objects (e.g., FLOWER and HAMMER) and instructed to not think of the name of any of the objects (Cho et al., 2018). For this 'Two-Object' RIT, involuntary subvocalizations occur on a substantive proportion of the trials. We investigated, in a Two-Object RIT, whether priming a goal-directed action increases the rate of occurrence of the subvocalization of the name of manipulable objects. In this RIT, a trial could consist of HAMMER (the Tool category) presented along with CLOUD (the Non-Tool category). Would action priming render the subvocalization of 'hammer' to be more likely than that of 'cloud'? Subjects (n = 19) were primed, before a block of 40 RIT trials, with a Cognitive-Motor task (involving weight estimation) or a Cognitive Task (the control condition, a digit-span task). A Wilcoxon signed-rank test, performed on the arcsine-transformed proportions, revealed no difference between the rates of RIT effects for tools (Mdn = 0.44) versus non-tools (Mdn = 0.56), p = 0.25. Effects were more likely for Non-Tool stimuli following the Cognitive Task (Mdn = 0.52) than the Cognitive-Motor Task (Mdn = 0.39), p = .007, r = .60. We also examined whether tool-related involuntary mental imagery is associated with fluctuations in mu frequency (9-13 Hz) power over motor cortex (electrode sites: C3, and C4).

Topic: EXECUTIVE PROCESSES: Goal maintenance & switching

E30 Exploring Developmental Changes In Functional Connectivity Associated With Cognitive Flexibility

Meagan Smith[1], Anastasia Kerr-German[2], Aaron Buss[1], [1]The University of Tennessee, [2]Boys Town National Research Hospital

Previous research has shown that the frontal-parietal neural network (FPN) supports cognitive flexibility. This includes shifts of attention between stimulus dimensions or between response sets during a task. Functional connectivity (FC) of this network during these tasks increases from childhood to adulthood. Our goal was to explore this in later childhood when this skill rapidly develops. We used functional near-infrared spectroscopy (fNIRS) to compare FC of the FPN between children at age five, seven, and nine during the digital Trail-Making, DCCS, and Switcher tasks. Regression analyses indicate that three predictors accounted for 87.4% of the variance in switch costs (R2= .91, F(3,7)=24.086, p

Topic: EXECUTIVE PROCESSES: Goal maintenance & switching

E31 Atypical response inhibition in 22q11.2DS: diminished error registration and awareness

Ana Clara Alves Francisco[1], Douwe J Horsthuis[1], John J Foxe[1, 2], Sophie Molholm[1, 2], [1]Albert Einstein College of Medicine, [2]University of Rochester

22q11.2 deletion syndrome (22q11.2DS; also known as DiGeorge syndrome or velo-cardio-facial syndrome) is characterized by increased vulnerability for neuropsychiatric symptoms, with approximately 30% of the individuals with the deletion developing schizophrenia. Clinically, deficits in executive function have been noted in this population, but the underlying neural processes are not well understood. Using high-density electrophysiology (EEG), we investigated the neural dynamics of inhibition of a prepotent response (a critical component of executive function) in individuals with 22q11.2DS with and without psychotic symptoms. Twenty-seven individuals with 22q11.2DS (14-35 years old, 14 with at least one psychotic symptom) and 27 age-matched neurotypical controls participated in a go/no-go task while EEG was recorded. Analyses were focused on the P3 go/no-go response and error-related positivity (Pe). Behaviorally, individuals with 22q11.2DS were slower and unable to inhibit prepotent responses as the controls, with significantly more false alarms. Atypical inhibitory processing was confirmed by significantly reduced P3 no-go responses in the 22q11.2DS group. Such reductions were particularly marked in those with psychotic symptomatology. Pe was likewise significantly decreased (regardless of the presence of psychotic symptoms), suggesting impaired ability to register errors (i.e., false alarms) in 22q11.2DS. Both Pe and P3 correlated with clinical measures of inhibition (DKEFS and CPT). P3 and Pe reductions, which have also been shown in schizophrenia, suggest diminished error registration and awareness in 22q11.2DS and, possibly, a consequent difficulty in adjusting response strategies.

Topic: EXECUTIVE PROCESSES: Monitoring & inhibitory control

E32 Mobile brain/body imaging of cognitive-motor impairment in multiple sclerosis

Pierfilippo De Sanctis[1], Brenda R Malcolm[1], Peter Mabie[1], Ana Francisco[1], Wenzhu Mowrey[1], Sonja Joshi[1], Sophie Molholm[1], John J Foxe[1], [1]Albert Einstein College of Medicine

Individuals with multiple sclerosis (MS) often present with deficits in the cognitive and motor domains. The ability to perform tasks that rely on both domains may therefore be particularly impaired. Yet, behavioral studies designed to measure costs associated with performing two tasks at the same time such as dual-task walking have yielded mixed results. Individual variability to cope with brain insult and to mobilize additional brain resources to sustain performance may contribute to mixed findings. To test this hypothesis, we acquired event-related potentials (ERP) in thirteen individuals with MS and fifteen healthy control (HC) participants performing a Go/NoGo response inhibition task while sitting or walking on a treadmill. Previously we showed that the nogo-N2 elicited by the cognitive task was reduced when healthy adults are also asked to walk, and that nogo-N2 reduction was accompanied by sustained dual-task performance. The HC group performed the Go/NoGo task more accurately while walking, thus showing a dual-task benefit, whereas the MS group showed a trend towards dual-task costs. The expected nogo-N2 reduction during dual-task walking was found in the HC group, but was not present at the group level in the MS group, suggesting that this group did not modulate the nogo-N2 process in response to higher task load. Further, we found a link between nogo-N2 reduction and better dual-task performance. We conclude that impaired nogo-N2 adaptation reflects a neurophysiological marker of cognitive-motor dysfunction in MS. Dual-task walking captures closely real-world issues and may improve assessment and treatment of MS.

Topic: EXECUTIVE PROCESSES: Monitoring & inhibitory control

E33 Drift rates confirm the critical role of interference control during metaphor comprehension

Hyeon-Ae Jeon[1], Minho Shin[1], Hee-Dong Yoon[1], [1]Daegu Gyeongbuk Institute of Science & Technology

The ability to comprehend metaphors is known to be mediated by the familiarity of the metaphor and the given context as well as individuals' executive functions. However, how they interact and their influence on metaphor comprehension have not been fully investigated. Our goal was to investigate the effects of familiarity and context on metaphor processing, emphasizing the influence of individuals' executive functions measured by various neuropsychological tests. Participants read 124 two-sentence pairs in Korean and responded whether a metaphoric sentence made sense given the first sentence that imposes a context. The experiment included four different conditions that varied in metaphor (familiar vs. novel metaphors) and context (supporting vs. opposing contexts). Particularly, we divided participants into two groups (high vs. low scores) according to their performance in neuropsychological tests. Adopting a drift diffusion model made it possible to investigate group differences in drift rates which represent individuals' cognitive performances. In result, we found main effects of drift rates in both group (higher drift rates in the high scoring group) and familiarity (higher drift rates in familiar metaphors). Moreover, only the high scoring group in the inference control showed significantly higher drift rates in all four conditions with respect to familiarity and context. We suggest that the ability to control interference is a key factor in processing a metaphor by inhibiting its familiar meaning and choosing a less familiar meaning that is contextually more appropriate.

Topic: EXECUTIVE PROCESSES: Monitoring & inhibitory control

E34 The neural correlates involved in the early and late phases of statistical learning

Jungtak Park[1], Hyeon-Ae Jeon[1], [1]DGIST, Daegu, Republic of Korea

Statistical learning (SL) is an essential learning mechanism which enables humans to extract probabilistic regularities from the world. Although a potential and an efficiency of learning have been known to be dissociated, no attempt has been made to elucidate both factors in SL. Here, we examined the potential as well as the efficiency of SL separately and investigated which subcomponents of executive functions mainly exerted on them using mathematical modeling. In addition, since it is still under debate which brain regions are mainly associated with SL, we investigated the core brain regions involved in SL. In a behavioral study, we quantified the potential and the efficiency of SL using participants' performances in alternating serial reaction time (ASRT) task and correlated them with individuals' executive functions. In an independent fMRI study, we investigated the neural correlates between early and late phases of SL. In results, the high potential of SL was closely related to good visuo-spatial working memory and poor inhibitory control whereas the high efficiency of SL was correlated with good set-shifting and good inhibitory functions. In fMRI results, the right middle frontal gyrus and the left superior frontal gyrus were activated in the early phase of learning whereas the left middle occipital gyrus and the right angular gyrus were activated in the late phase of learning. Altogether, SL activated the frontal regions for a demanding process in the early phase of learning and the occipital regions for a relatively automatized process in the late phase of learning.

Topic: EXECUTIVE PROCESSES: Monitoring & inhibitory control

E35 Structural Brain Correlates of Procedural Learning in Dyslexia

Francesca Pentimalli[1], Ola Ozernov-Palchik[1], Sara Beach[1], Tracy M Centanni[2], John D.E Gabrieli[1], [1]MIT, [2]Texas Christian University

Dyslexia is a learning disability characterized by difficulties in word reading and spelling. The etiological mechanisms of dyslexia have been widely debated. It has been suggested that dyslexia stems from an underlying deficit in the procedural learning system, yet few studies to date have directly examined the brain basis of this hypothesis. We investigated procedural learning in 40 adults (20 females, 20 males, 18-38 years, mean age=23.5) with (DYS=19) or without (TYP=21) dyslexia. Participants performed out-of-scanner mirror tracing and rotary pursuit tasks, for which learning was defined as the slope of improvement (accuracy or speed) across trials. Structural MRI images were segmented and parcellated using FreeSurfer v6.0. We ran an exploratory analysis with age, gender, DYS status, and slopes of learning for each task as predictors of cortical thickness in several regions of interest in the hippocampal, basal ganglia, parietal, and cerebellar areas. We also examined whether the association between procedural learning and cortical thickness differed between the DYS and TYP groups. Across both groups, better procedural learning was associated with greater cortical thickness in left cingulate and bilateral superior parietal regions. There were no differences between groups in cortical thickness in these regions or in behavioral performance on mirror tracing or rotary pursuit. Current results do not support a procedural learning deficit in dyslexia, but do illuminate the neural correlates of individual differences in procedural learning.

Topic: EXECUTIVE PROCESSES: Monitoring & inhibitory control

E36 Neurophysiological markers of sensorimotor and cognitive-motor dysfunctions in autism

Lisa N. Cruz[1], Douwe Horsthuis[2], Brenda Malcolm[2], Sonja Joshi[2], Carol Terilli[3], John J. Foxe[4], Pierfilippo De Sanctis [2], Sophie Molholm, [1]Yeshiva University, [2]Albert Einstein College of Medicine, [3]Montefiore Medical Center, [4]University of Rochester Medical Center

Gross motor behavior in autism spectrum disorder (ASD) has been less emphasized in research, despite up to 80% of individuals with ASD exhibiting deficits including gait instability. The integrated processing of sensory, cognitive, and motor functions during ambulation has become recognized, but no studies have examined this in ASD using mobile-brain body imaging (MoBI). MoBI allows for the concurrent acquisition of EEG electrophysiological and 3D kinematic data to monitor brain dynamics and gait pattern during ambulation. We used a dual-task walking design to assess 17 ASD and 15 neurotypical (NT) individuals while they were exposed to sensory load (walking with and without being exposed to perturbed full-field optical flow stimulation) and motor load (performing a Go/NoGo task while standing or walking). Our aim was to determine sensitive brain measurements of sensorimotor and cognitive-motor dysfunction in ASD. No differences were seen in Go/NoGo performance between groups, or between standing and walking. However, mean stride width and stride length variability increased in the ASD compared to the NT group, and exposure to optical flow further increased these group differences. These data suggest a general deficit in motor behavior that is enhanced under conditions of increased sensory load (as evidence in reduced walking stability). In the electrophysiological data, P3 responses to NoGo trials were reduced for walking (dual-task) versus standing (single-task) conditions, and this reduction was much greater for the ASD group. Stronger reduction in P3 during walking in ASD may indicate increased effort in the ASD group to sustain.

Topic: EXECUTIVE PROCESSES: Other

E37 Executive functioning profiles in unaffected relatives, prodromal and early psychosis

Wu Jeong Hwang[1], Tae Young Lee[1], Minah Kim[1], Jun Soo Kwon[1], [1]Seoul National University

Mounting evidence suggests individuals at clinical high risk (CHR) and first-episode psychosis (FEP) patients have particular deficits in executive functioning (EF). However, to date, most of the existing studies have administered a few selected tasks to examine their EF deficits. Thus, it is still to be revealed as to in which subdomains, the participants have strengths and weaknesses. 90 CHR subjects, 102 FEP patients, 85 unaffected relatives of psychosis and 100 healthy controls (HCs) were assessed with a battery of neuropsychological tests to identify the EF profiles. CHR individuals and FEP patients showed significant deficits compared to HC in the subdomains of shift, attention, and fluency. Further, detailed analysis revealed that intermediate deficits of spatial working memory and semantic fluency in CHR individuals, and comparable attention shifting and phonemic fluency compared to FEP and unaffected relatives of psychosis. Further, the low EF group had worse negative symptoms and lower functioning scores measured by the Global Assessment of Functioning, compared to the high EF group.Overall, the findings of this study, as well as elucidating detailed EF profiles in unaffected relatives, prodromal and early psychosis patients, and highlight the significance of the EF profile in relation to prodromal patients' clinical status.

Topic: EXECUTIVE PROCESSES: Other

E38 Cognitive and neural deficits associated with a history of mTBI

Hector Arciniega[1], Marian Berryhill[1], [1]University of Nevada, Reno

Head injury is a major public health issue. In the USA alone, traumatic brain injury (TBI) causes 235,000 hospital visits, each year. The bulk of these TBI are categorized as mild (mTBI). It is assumed that after a few months patients gradually return to their premorbid performance including the general assumption of full cognitive recovery. However, there is a fundamental gap in knowledge as to whether this is always true, or whether there are lasting cognitive consequences of mTBI. We have previously reported visual working memory deficits in undergraduates with a history of mTBI (~4 years post-injury). To begin to understand the extent of cognitive deficits and their neural underpinnings we further tested working memory for visually presented stimuli and more broadly tested cognitive performance (RBANS) as well as collecting resting state electroencephalography (rs-EEG), and resting state functional magnetic resonance imaging (rs-fMRI) in undergraduates with a history of mTBI. Although there is no general cognitive deficit, there is a general visual working memory deficit in the empirical task and in the neuropsychological assessment. The resting state data reveal wide-ranging deficits in connectivity, particularly in those whose performance is most severely impaired. These data serve as a conservative indicator for executive disfunction in individuals with a history of mTBI.

Topic: EXECUTIVE PROCESSES: Working memory

E39 Functional organization of hippocampus is altered by associative encoding and retrieval

Wei-Tang Chang[1], Stephanie Langella[1], Weili Lin[1], Kelly Giovanello[1], [1]UNC at Chapel Hill

The hippocampus is critical for learning and memory and can be separated into anatomically-defined hippocampal subfields (aHPSFs), including subiculum, CA1, CA2/3, CA4 and dentate gyrus. However, the assumptions of within-subfield functional homogeneity and across-subfield functional dissociation were not supported by clear evidence. The data-driven approaches offer an alternative means to investigate the hippocampal functional organization without a priori assumption. Nevertheless, the relatively low spatial resolutions employed in the previous studies precluded the examination of the functional specialization across aHPSFs. Hence, we developed a functional Magnetic Resonance Imaging (fMRI) sequence on a 7T MR scanner with 1-mm isotropic resolution, a TR of 2s and brain-wide

coverage. Healthy young adults were scanned at rest and in associative memory task. We aim to investigate: 1) how the associative memory tasks alter the functional organization of hippocampus, and 2) how the functionally-defined hippocampal subfields (fHPSFs) connect with the rest of the brain. Using a spatially restricted hippocampal Independent Component Analysis (ICA) and k-means approaches, we observed that the fHPSFs were distinct from aHPSFs with the exception of CA1. Additionally, 30+ fHPSFs were identified at encoding phase while only 5 fHPSFs were identified at retrieval phase. More areas within hippocampus were relatively inactive at retrieval phase than at encoding phase. For the brain-wide functional networks, primary sensory networks connected with selective fHPSFs while high-level association networks connected with the hippocampus more uniformly. Our analyses of the fine-grained functional segmentation and the respective functional networks hold a great promise in the applications of neurodegenerative diseases.

Topic: EXECUTIVE PROCESSES: Working memory

E40 The Cerebellum Works Across Task-Positive and Task-Negative Networks

Magda L. Dumitru[1], Laurens Van Calster[2], Steve Majerus[2], Kenneth Hugdahl[1], [1]University of Bergen, [2]University of Liege

The organization of neural activation in anti-correlated networks is a fundamental property of the human brain (Duncan et al. 2001; Fox 2005; Hugdahl et al. 2015; Raichle et al. 2001). However, the distinction between task-positive networks (e.g., the Dorsal Attention Network DAN and the fronto-parietal cortical network FPCN) and task-negative networks (i.e., the Default-Mode Network DMN) as well as the definition of their scope (e.g., exclude the cerebellum) are not clear. Here, we used structural, functional, and resting-state MRI to investigate the interplay of neural structures before, during, and after a working memory task involving maintenance and recognition of weak and strong visual Gestalts. We used SPM12 for analysing univariate task-based data, PRONTO for investigating multivariate task-based data, and CONN for exploring resting-state connectivity. Whole-brain task-related activation foci were stronger for weak compared to strong Gestalts, they extended over cortical regions typically associated with DAN including bilateral intraparietal sulcus IPS, superior parietal lobule SPL, and precentral gyrus, as well as with FPCN, and further involved cerebellar regions. Whole-brain multivoxel pattern analysis MVPA showed high classification accuracy of weak versus strong Gestalts. Seed-based functional connectivity analysis of post- versus pre-task resting-state sessions revealed deactivation of cortical networks driven primarily by the posterior cingulate cortex, i.e., from a DMN node, accompanied by increased connectivity within the cerebellum. We conclude that cortical network activity is involved in task processing, which prompts post-task downregulation, and that the cerebellum plays a singular role in both task- and post-task processes.

Topic: EXECUTIVE PROCESSES: Working memory

E41 Feedback Processing and Working Memory in Children with Typical and Atypical Language Development

Isabel Fitzpatrick[1], Xinyi He[1], Zoya Surani[2], Yael Arbel[1], [1]MGH Institute of Health Professions, [2]Harvard University

This research aimed to evaluate the relationship between working memory and feedback processing in children with typical language development (TD) and children with developmental language disorder (DLD) performing a declarative learning task. Thirty-five participants completed a declarative paired-associate learning task under two conditions. In the feedback-based condition (errorful), participants learned through trial and error guided by performance feedback. In the no-feedback (errorless) condition, participants learned through observation (i.e., repeated presentation of correct associations). Participants' electrophysiological data were recorded during the learning tasks, and their accuracy was evaluated at the end of each task through a test that was free of feedback. Participants completed two working memory (WM) subtests. An errorless advantage (EA) score was calculated for each participant as the accuracy difference between the errorless and the errorful conditions. EEG data were time-locked to the presentation of feedback, and two event related potentials (ERPs) were evaluated, the Feedback Related Negativity (FRN) and a Fronto-central Positivity (FCP). Regression analysis indicated that in the DLD group, scores on the familiar sequences subtest of WM predicted EA scores, such that lower WM scores were associated with greater errorless advantage in the DLD group. The results of the mixed ANOVA of the FRN and FCP suggested that while differences between positive and negative feedback were observed in the TD group, they were absent in the DLD group. Group differences were also found in the amplitude of the FCP. FCP amplitude to negative feedback was found associated with EA scores in the TD group.

Topic: EXECUTIVE PROCESSES: Working memory

E42 Acute bouts of intense interval and moderate continuous exercise alter neural oscillation during working memory

Alvin Kao[1], Chun-Hao Wang[2], Keita Kamijo[3], Chih-Chun Lin[2], Naiman Khan[4], Charles Hillman[5], [1]Purdue University, [2]National Cheng Kung University, [3]University of Tsukuba, [4]University of Illinois at Urbana-Champaign, [5]Northeastern University

Although research has demonstrated transient enhancements in working memory following moderate-intensity continuous exercise (MICE), it remains to be determined whether a single bout of high-intensity interval training (HIIT) generates similar benefits to behavioral performance and neural correlates of working memory. The purpose of this study was to investigate the acute effects of HIIT versus MICE on neuroelectric mechanisms underlying working memory processes by utilizing frontal alpha event-related desynchronization (ERD). Thirty-six healthy young adults were recruited to perform a 20-min bout of HIIT, MICE, and rest on separate days in counterbalanced order. At 25-min following each intervention condition, electroencephalogram was recorded while participants performed a modified Sternberg task requiring varying amounts of working memory (3-, 5-, 7-letter tasks). The behavioral results showed a condition effect, indicating a general improvement in response time following HIIT compared to rest. Analysis of frontal alpha ERD showed an interaction of condition and task, indicating no differences across tasks following rest but a task effect following the two exercise conditions, with frontal alpha ERD increasing in the 7-letter task compared with the 3-letter task. Further, this task-related contrast of frontal alpha ERD lasted longer on the time-frequency representation during working memory processes following HIIT, with such effects extending to the time period when memory retrieval occurred. After a delay following exercise cessation, HIIT induces a temporally wider alteration in frontal activation underlying working memory processes compared to MICE, along with improved behavioral performance. These findings provide support for potential applications of HIIT for enhancing working memory.

Topic: EXECUTIVE PROCESSES: Working memory

E43 Causal Evidence that Theta and Alpha Neural Oscillations Dynamically Coordinate Output-gating

Justin Riddle[1], Trevor McPherson[1], Flavio Frohlich[1], [1]University of North Carolina at Chapel Hill

Cognitive control requires the manipulation of internal representations for goal-directed behavior, referred to as output-gating. Output-gating recruits two

distinct processes: selection of relevant information, correlated with theta oscillations (4-7Hz) in prefrontal cortex (PFC), and suppression of irrelevant information, correlated with alpha oscillations (8-12Hz) in posterior parietal cortex (PPC). However, there is no study that examines the causal interactions between theta and alpha oscillations in output-gating; therefore, we designed a pre-registered (https://osf.io/37ey4/), crossover, randomized study using simultaneous EEG and rhythmic transcranial magnetic stimulation (TMS) (N=48). Using a retro-cue during the delay period of a working memory (WM) task, we elicited theta oscillations in PFC (100-500ms post-cue) as a function of selection (retro-cue relative to neutral-cue). Memory items were lateralized to the left and right visual hemifield. Using a retro-cue towards the left versus right hemifield, we elicited alpha oscillations in PPC (500-900ms) as a function of suppression (contralateral to the irrelevant memory items). Participants with the greatest lateralized PPC alpha activity, also showed the greatest benefit to WM capacity from the retro-cue. Additionally, theta frequency functional connectivity (weighted phase lag index) between PFC and PPC increased contralateral to relevant WM representations (500-900ms). Finally, online rhythmic TMS post-cue disrupted WM capacity (relative to arrhythmic TMS) only for alpha to PFC and theta to PPC, but had no effect on behavior for theta to PFC and alpha to PPC. Our findings suggest that frontal theta and parietal alpha oscillations play a causal role in output-gating.

Topic: EXECUTIVE PROCESSES: Working memory

E44 Indicators of intellectual activity mediate the relationship between adult poverty and executive function.

Alexandre Schaefer[1], Sony Kusumasondjaja[2], Fandy Tjiptono[3], Nobuhiko Goto[4], Xue Li Lim[5], Dexter Shee[1], Nuri Herachwati[2], Wai Ching Poon[1], Min Hooi Yong[6], Faisal Mushtaq[7], [1]Monash University, [2]Airlangga University, [3]Victoria University of Wellington, [4]Kyoto Notre Dame University, [5]Jülich Research Center, [6]Sunway University, [7]University of Leeds

It has long been known that people who live in poverty tend to have lower cognitive performance than wealthier individuals. This phenomenon is thought to be one of the main drivers of the poverty cycle, and understanding it is important to design policies aimed at tackling inequalities. Recently, it has been suggested that socioeconomic status (SES) predicts cognitive performance mainly because it modulates a core neural system termed 'Executive Function' (EF), or 'Cognitive Control' system. However, the reasons why SES predicts EF during adulthood are still not fully understood. The main goal of this study was to examine whether lifelong intellectual activity, emotional well-being and economic worries could mediate the relationship between adult SES and EF. We conducted a field study on a sample of 450 Indonesian adults living in Eastern Java that included both people below the poverty line and wealthy individuals. We measured executive function with a computerized N-back working memory task, and SES and emotional indicators were measured through a structured interview. We found that two key indicators of intellectual activity, the diversity of reading patterns and online behaviours, significantly mediated the relationship between adult SES and 3-back task performance. Our results were obtained while controlling for the effects of childhood SES, suggesting that these results are specific to how adult SES relates to EF. Our findings are consistent with the idea that adult wealth predicts EF because it may be linked to greater opportunities for cognitively stimulating activities, which can potentially modulate EF-related neuroplasticity.

Topic: EXECUTIVE PROCESSES: Working memory

E45 Pretrial EEG microstates correlates of performance in a visuospatial working memory

Ratna Sharma[1], Suriya Muthukrishnan[1], Sunaina Soni[1], [1]All India Institute of Medical Sciences

Humans have limited capacity of processing up to 4 integrated items of information in the visuospatial working memory (VSWM) and the errors committed increases at high VSWM loads. However, the neural mechanisms underlying the load effect of VSWM are not clear in health and patients with schizophrenia exhibiting cognitive impairment. We hypothesized that pre-trial brain state could be related to the outcome at high cognitive load. Using EEG microstate analysis, we identified a pre-trial microstate map and the underlying cortical sources in twenty-four healthy adults, which determined the response accuracy. The cortical sources of this microstate were localized to visuospatial processing brain regions in occipital, temporal and limbic cortices with the maximal change at right middle occipital gyrus. We propose that the behavioural outcome in a VSWM task could be determined by the activity in visuospatial processing brain regions. The error rate for the same task was more in patients with schizophrenia compared to their first-degree relatives and healthy controls. Pre-trial microstate was significantly different between controls and patients which could qualify it as a state marker, for which the cortical sources were localized to right inferior frontal gyrus (rIFG). Pre-response microstate map for correct trials was significantly different between controls and first-degree relatives which could be considered an endophenotypic marker for schizophrenia. Our results indicate that microstate-based biomarkers have the potential to predict performance in a cognitive task and could facilitate diagnosis of schizophrenia at a preclinical stage.

Topic: EXECUTIVE PROCESSES: Working memory

E46 Sentence listening comprehension among Chinese bilinguals and English monolinguals: An fNIRS study

Guoqin Ding[1], Kathleen Mohr[1], Ronald Gillam[1], Carla Orellana[1], [1]Utah State University

The purpose of this study is to compare the mechanisms underlying the processing of canonical and noncanonical sentences and to examine whether monolinguals and bilinguals process structurally complex sentences via different cortical networks and whether Age of Acquisition (AoA) is an influential factor. Method: participants included 15 monolingual children,16 early-bilingual children and 12 late-bilingual adults. They completed an English listening comprehension task during fNIRS scans. Auditory stimuli included four sentence types: Subject-Verb-Object (SVO), Passive (PAS), Subject Relative (SR), and Object Relative (OR) clauses. The semantic plausibility of the sentences was controlled, so that word order was the only relevant linguistic cue. Participants were asked to select the agent of each sentence. Behavioral Results: Repeated-measure ANOVAs showed that all groups performed better on canonical sentences (SR, SVO) and no significant differences between groups. fNIRS results: Bilingual adults evidenced more brain activation in left and right dorsolateral prefrontal cortex [L/RDLPFC], middle pre-frontal cortex [MPFC] and left inferior parietal lobule [LIPL] than children groups. No difference was found between children groups. OR sentences corresponded with more brain activation in L/RDLPFC, MPFC, LIPL, and left superior temporal gyrus [LSTG] than SVO and PAS. No difference was found between SR and OR. Conclusions: Findings of more activation in adults and no difference between children suggest that AoA is an influential factor. No difference between SR and OR indicated that participants performed relative clauses similarly. Further studies are needed to examine whether clauses rather than noncanonical sentences are more difficult to process.

Topic: LANGUAGE: Development & aging

E47 VWFA Functional Connectivity for Print and Speech Processing in Emerging Readers

Rebecca Marks[1], Lynn Eickholt[1], Yuuko Uchikoshi[2], Fumiko Hoeft[3], Ioulia Kovelman[1], [1]University of Michigan, [2]University of California, Davis, [3]University of Connecticut

Learning to read requires children to develop an efficient neural network that connects the visual and language systems of the brain. Recent work suggests that specificity for print processing in the Visual Word Form Area (VWFA) emerges rapidly over the first year of schooling (Dehaene-Lambertz, Monzalvo & Dehaene, 2018). Furthermore, the VWFA has been found to be responsive to auditory stimuli in beginning readers, ages 5-6 (Wang, Joanisse & Booth, 2018). How is the VWFA functionally connected to language regions of the brain during word reading, and how does this connectivity differ between print and speech processing for emerging readers? 78 kindergarteners (mean age = 5.7) completed visual and auditory word processing tasks during fMRI. PPI analyses suggest that during print processing, beginning readers show functional connectivity between the VWFA and the left superior temporal gyrus, inferior parietal lobe, and bilateral frontal cortex. During auditory word processing, VWFA activity is significantly correlated with activation in the left superior temporal gyrus (STG), a critical region for language processing in speech and print. This suggests the emergence of a functional network connecting the VWFA and language regions during the early phases of literacy acquisition. Ongoing analyses will further examine connectivity between VWFA and key language regions. We hypothesize that more advanced readers will show greater VWFA activation in response to auditory stimuli, and that VWFA-STG connectivity will be associated with concurrent reading ability.

Topic: LANGUAGE: Development & aging

E48 Reading abilities of the right hemisphere in left- and right-handers

Rolando Bonandrini[1], Eraldo Paulesu[1], Elena Capelli[1], Claudio Luzzatti[1], [1]University of Milan-Bicocca

The 'two orthographic lexicons' framework suggests that the advantage of the left hemisphere (LH) over the right (RH) for reading is due to lexical factors, suggesting the existence of one orthographic lexical store for each hemisphere. Accordingly, left-handers, i.e. subjects with a lesser degree of functional lateralization than healthy right-handers, should show a small hemisphere effect for words, since the LH lexicon is 'less dominant' over the right one. Conversely, a 'unique lexicon' view suggests the 'hemisphere effect' to depend on the length of the information that must be transferred from the RH to the LH, regardless of its lexical status. In line with the latter framework, performance in lateralized reading should not differ across different laterality groups. At most, any group differences should depend on factors preceding lexical access, and they should be evident for both words and non-words. We administered a tachistoscopic eye-tracking-controlled lateralized lexical decision task to 60 right-handed and 60 left-handed volunteers. We manipulated target hemisphere, stimuli length, lexicality and word frequency.â?¨We found that word frequency, rather than pre-lexical factors, best explained hemispheric differences. Left-handers showed better performance in the RH than right-handers for words only. Finally, while right-handers showed chance-level performance for low-frequency words presented to the RH, left-handers performed significantly better than chance level in this condition. Our findings show that each hemisphere contains an orthographic lexical store. In right-handers the LH lexicon is highly dominant over the RH one, in which low-frequency words are poorly represented. In left-handers, such dominance is less pronounced.

Topic: LANGUAGE: Lexicon

E49 When two vowels go walking: an ERP study of the vowel team rule

Donna Coch[1], Margaret Rose Mahoney[2], [1]Dartmouth College, [2]Vanderbilt University School of Medicine

The vowel team rule in American English ('when two vowels go walking, the first does the talking') teaches that two vowels together in a word are pronounced like the name of the first vowel, with the second vowel silent. In an ERP investigation of the vowel team rule, we used a lexical decision task to determine whether words that follow the rule (e.g., braid) elicit different lexicosemantic processing than well-matched, controlled words that do not follow the rule (e.g., cloud), and whether this extends to nonwords (e.g., braip, cloup). In 32 college students who recalled learning to read with phonics and/or learning reading and spelling rules, N400 amplitude did not distinguish between rule-following and rule-breaking words, with a similar pattern for nonwords. However, behavioral responses in the lexical decision task were sensitive to rule status: Participants were both more accurate with and faster to respond to rule-following words; this pattern was not observed with nonwords. The N400 findings indicate that vowel team rule adherence does not affect lexicosemantic processing of either words or nonwords in fluent readers. In contrast, findings from the behavioral measures suggest facilitation for familiar rule-following lexical items, perhaps at a late decision stage, but no extension of facilitation to unfamiliar nonwords. Overall, these results call into question the utility of teaching the vowel team rule as a standard component of many phonics programs.

Topic: LANGUAGE: Lexicon

E50 Neural Correlates of Auditory Comprehension: Single-Word versus Sentence Comprehension

Juliana Baldo[1], Sandy Lwi[1], Brian Curran[1], Nina Dronkers[2], Timothy Herron[1], Krista Schendel[1], [1]VA Northern California, [2]University of California, Berkeley

Debate exists as to the neural correlates of auditory comprehension. Some discrepancy in the literature is likely due to the use of different types of comprehension tasks across studies. In the current study, we used lesion-symptom mapping to identify critical brain regions in the network underlying auditory comprehension in three distinct tasks: Yes/No sentence comprehension, comprehension of sequential commands, and single-word comprehension. This retrospective study included 168 chronic left hemisphere stroke patients who met strict inclusion/exclusion criteria and had a wide range of comprehension impairment from mild to severe. Both multivariate and univariate LSM analyses were run to ensure that findings were robust. Several nuisance variables were included as covariates, including lesion volume, age, months post-onset, and overall aphasia severity. For single-word auditory comprehension, significant voxels centered primarily in left mid- to posterior middle temporal gyrus, and also included smaller portions of the left angular gyrus, mid-posterior inferior temporal gyrus, and inferior-middle occipital gyri. Yes/No sentence comprehension was associated almost exclusively with the left mid-posterior middle temporal gyrus. For comprehension of sequential commands, significant voxels were located primarily in the left posterior middle temporal gyrus. There was only a small region of convergence between the three comprehension tasks, in the very posterior portion of the left middle temporal gyrus. These findings suggest that auditory comprehension is mediated by a network of regions in the left posterior temporo-parietal cortex with a core region in the posterior middle temporal gyrus and partially distinct subregions underlying different types of comprehension tasks.

Topic: LANGUAGE: Other

E51 Cerebral Perfusion and Brain Activity Related to Reading Aloud in Subacute-to-Chronic Stroke Recovery

Olga Boukrina[1], William Graves[2], A.M. Barrett[3], [1]Kessler Foundation, Center for Stroke Rehab Research, [2]Rutgers, The State University of New Jersey, [3]Center for Visual and Neurocog Rehab

We report preliminary results from a study investigating the neural mechanisms of recovery from stroke-induced reading impairments. Four survivors (3 women, M age = 60.75, SD = 14.45) of first-ever left-hemisphere stroke (brainstem, putamen, thalamus, superior parietal lobule) completed behavioral testing and MRI 3 months post-stroke (chronic). Participants completed touch-screen orthography, phonology, and semantics tasks and in-scanner reading aloud (words and pseudowords). Brain activity was recorded using fMRI and cerebral perfusion was measured with ASL. Reading aloud accuracy improved from 66% (SD=14%) to 86% correct (SD=5%) for words and from 24% (SD=14%) to 41% correct (SD=22%) for pseudowords. Minimal changes were observed on the touch-screen tasks. Subacute word reading (vs fixation) produced activity in areas typically recruited in healthy readers (e.g. left occipito-temporal fusiform gyrus, left anterior middle temporal gyrus (MTG), temporal pole, insula). Subacute pseudoword reading activated bilateral pre- and postcentral gyri, primary auditory cortex, and left supramarginal gyrus, likely due to increased reliance on sound processing and spelling-to-sound mapping. Chronic word and pseudoword reading showed increased reliance on bilateral auditory cortex, anterior cingulate cortex (implicated in conflict resolution and attention), frontal operculum, IFG pars triangularis and posterior MTG (thought to support semantic processing). This indicates adaptive post-stroke plasticity in the domain of reading with increased reliance on fronto-temporal, rather than occipito-temporal and parietal regions. Areas of increased activation in the bilateral auditory cortex, anterior cingulate, and the operculum overlapped with areas where resting cerebral perfusion increased from subacute to chronic period.

Topic: LANGUAGE: Other

E52 Modulation of motor-induced suppression by phonotactic probability and syllable stress

Alexandra Emmendorfer[1], Milene Bonte[1], Bernadette Jansma[1], Sonja Kotz[1], [1]Maastricht University

Anticipating the timing and content of sensory consequences of an action, such as speech production, leads to a suppressed sensory response to self-generated sensations, known as motor-induced suppression (MIS), which is observable in the N1 and P2 components. Previous M/EEG studies of speech production have demonstrated that MIS is sensitive to variations in stimulus properties, such as the prototypicality of an utterance: more prototypical (predictable) utterances show greater MIS than less prototypical utterances of the same vowel. Our EEG study examined whether MIS is sensitive to statistical regularities of language, including phonotactic probability (probability of co-occurrence of speech sounds) and syllable stress (first vs. second syllable). We employ a motor-to-auditory paradigm comparing ERP responses to externally and self-generated (via button-press) bisyllabic Dutch pseudowords, manipulating the predictability of phonotactics and stress patterns. If MIS of the N1-P2 components are sensitive to these factors, we predict higher predictability to result in greater MIS compared to lower predictability. Preliminary results (N=22) suggest an effect of syllable stress on MIS of N1-P2 components, with greater suppression for the less predictable stress pattern. Furthermore, we observe an interaction between phonotactic probability and syllable stress, with an effect of syllable stress for low phonotactic probability but not high phonotactic probability. While our findings do not match previous reports of greater suppression for more predictable stimuli, the current approach is the first to apply this paradigm to investigate more complex stimuli, therefore further analyses are warranted to disentangle these differential effects on MIS.

Topic: LANGUAGE: Other

E53 Third person perspective impedes comprehension in patients with lesions in right temporo-parietal junction

Franziska Hartung[1], Emily Coderre[2], Stacey Humphries[1], Anjan Chatterjee[1], [1]University of Pennsylvania, [2]University of Vermont

Right temporoparietal junction has been shown to be (causally) involved when people take a third person perspective. First person perspective taking on the other hand is hypothesized to have processing benefits in terms of lower working memory load. In two case studies we show that lesions in right temporoparietal junction resulting from stroke show comprehension deficits for stories written in third person perspective. Participants listened to six short stories - half of which were written in a first-person perspective and the other half in a third person perspective. Each paragraph contained a probe sentence that was either metaphorical or literal, which was tested for comprehension right after the paragraph. In addition, we tested reading habits, general working memory performance on discourse level, perspective taking, as well as appreciation of and immersion into the stories. While there was no difference in comprehension between metaphorical and literal probe sentences, both patients had difficulty understanding probe sentences in third person stories, while performing at ceiling for probe sentences in first person stories. Both patients preferred narratives in first person perspective. Our results suggest a role for the right temporo-parietal junction for processing language in third person narrative perspective, without affecting a first person perspective, when listening to narratives.

Topic: LANGUAGE: Other

E54 Neural Activation for Lexical Sign and Pantomimic Gestures in Deaf Signers.

Tatiana Matyushkina[1], Kayoko Okada[2], Gregory Hickok[3], Svenna Pedersen[4], Ursula Bellugi[4], David Corina[1], [1]UC Davis, [2]Loyola Marymount University, [3]UC Irvine, [4]Salk Institute for Biological Studies

There is debate about the degree to which motor systems are involved in language comprehension. Some accounts suggest that speech comprehension relies on motor systems similarly to comprehension of observed actions. Signed languages provide an interesting test case, having the linguistic properties of spoken languages but sharing a modality with actions. American Sign Language (ASL) makes use of a variety of manual and body actions to convey meaning. These include conventional lexical signs as well as pantomimic enactments (aka constructed actions). In this fMRI study we examined neural requirements for the production and processing of lexical signs and pantomimic actions in deaf signers. Sixteen deaf signers observed and produced lexical signs for, and pantomimes of object-oriented actions (e.g. ASL: SWEEP, pantomime: using a broom). Image and statistical ROI analysis (SPM12, REX) revealed a graded activation of anatomically similar bilateral visual cortical and posterior temporal activation (pantomime > ASL), suggesting commonality in the neural regions for the perception of complex manual actions. In production, we observe an expected pattern of bilateral Rolandic motor-sensory and inferior frontal gyrus activation, but increased medial and selected inferior frontal activation for pantomime relative to ASL production (MFG-1 $p < .008$, MFG-2 $p < .05$ and IFGop $p < .04$), and no differences in IFGtr and IFGorb $p > .1$).These patterns of activation suggest differential metabolic demands reflecting a cognitive efficiency for linguistic processing and increasing demands for the on-line construction of pantomimic gestures and that co-engagement of action-perception systems varies with task demands.

Topic: LANGUAGE: Other

E55 Early signed language exposure does not harm phonemic discrimination for individuals with cochlear implants (CIs)

Shakhlo Nematova[1], Benjamin Zinszer[1], Thierry Morlet[2], Giovanna Morini[1], Laura-Ann Petitto[3], Kaja Jasinska[1, 4], [1]University of Delaware; [2]Nemours/Alfred I. duPont Hospital for Children, [3]Gallaudet University, [4]Haskins Laboratories

We tested two competing hypotheses about age of signed language exposure (age-ASL) with CIs. Geers et al. (2017) have claimed that signed language exposure harms spoken language development, while others suggest the contrary -- early signed language exposure supports language development by offsetting the negative effects of language deprivation prior to implantation (Davidson et al., 2014; Jasinska & Petitto, 2013; Petitto et al., 2016). Hypotheses tested: (1) only early-life spoken language exposure through CI-or, (2) early-life simultaneous signed and spoken language exposure-supports neural systems underlying phonemic discrimination. Eighteen adults with CIs exposed to signed language between age 1-22 years completed an auditory phoneme discrimination task while undergoing fNIRS neuroimaging. Phonemic discrimination showed no significant effect of age-ASL, and was only marginally better for individuals implanted earlier (b=-.019, t(16)=-1.777, p=.094). There was significant age-ASL and age-CI interaction in LIFG and LSTG. As age-CI increased, adults with earlier age-ASL showed increased activation in LIFG (b=2.345, t(23)=3.034, p

Topic: LANGUAGE: Other

E56 Interplay of episodic and semantic memory in repeat object reference

Zachary Ekves[1], Yanina Prystauka[1], Gerry Altmann[1], [1]University of Connecticut

Language comprehension involves an interaction between episodic information about particular object tokens and semantic information about object types: 'The man will chop the tomato' activates information about how tomatoes typically look/taste, and the episodic trajectory of the tomato's states as it changes from intact to chopped. The Intersecting Object Histories account of event representation claims that understanding an event ('chopping a tomato') entails the activation of both the pre-chopped and chopped states of the tomato. fMRI studies show that reference to a changed object ('The man will chop the tomato. Then, he will taste the tomato') elicits a 'competition effect' in Stroop-sensitive voxels in Left Inferior Frontal Gyrus (LIFG), arising from a need to select one of these two object-states (compared to events which do not change object states). However, these studies contained potentially infelicitous repetitions of the full noun phrase. Competition could arise not from competition between two episodic states, but between the current episodic state and bottom-up activation of semantic information associated with reading 'the tomato.' The current study includes the contrast above, as well as conditions using pronouns ('â?¦ then he will taste it') which must refer to the episodic entity. We show a competition effect in LIFG for the pronoun conditions, although not in Stroop-sensitive voxels. We found no competition for repeated noun phrases (their infelicity being heightened by the pronoun conditions). This suggests that the competition effect for state-change events reflects cognitive control mechanisms within LIFG that select between episodic states of an object.

Topic: LANGUAGE: Semantic

E57 The Time Course of Meaning Construction with Varying Expectations

Matthew Kmiecik[1], Lauren Kim[1], Mandy Maguire[1], John Hart[1], Daniel Krawczyk[1], [1]The University of Texas at Dallas

Mechanistic theories of the N400 event-related potential-a neural correlate indexing semantic processing in the brain-implicate the roles of prediction, priming, and bottom-up sensory integration in language comprehension; however, mechanisms explaining volitional aspects of semantic meaning construction are not fully understood. To explore this, participants were visually shown sentences, with words presented one at a time, and evaluated whether the final words of sentences formed sensible (SC) or unconnected completions (UCs). Participant expectancies were modulated using colored boxes that surrounded the words of each sentence cueing the participants to either expect a SC (green) or UC (orange). A neutral cue (purple) did not indicate the completion type and served as a baseline condition. Expectancies were factorially crossed with completion type forming valid, invalid, and neutral conditions. Trial presentations were weighted such that sentences were validly, invalidly, and neutrally cued 60/20/20% of the time, respectively, incentivizing participants to utilize the colored cues. Cues successfully modulated participant expectations such that participants were more accurate when evaluating validly than invalidly cued sentences and selectively faster when solving validly cued sentences that were semantically congruent. The N400, as measured following the presentation of the final word, was modulated by completion type such that UCs elicited more negative deflections than SCs. However, expectations generated via colored cues did not modulate N400 mean amplitudes. These results suggest that volitionally generated expectancies do not dramatically affect neural signatures of semantic access, but ultimately lead to additional processing responsible for resolving discrepancies between semantic congruency and expectancy.

Topic: LANGUAGE: Semantic

E58 Evolution of Symbolic Neuronal Operations: of Fish and Men

Donald O'Malley[1], Whitney Kuwamoto[1], [1]Northeastern University

Cognition in humans and other animals depends upon the storage and manipulation of symbols in the brain. Of special note is language, whose impairment is acutely felt from childhood ADHD to stroke / dementia patients. Alas, poor understanding of language neurobiology hinders clinical efforts. A key-log here is the implicit misconception that human language is set apart from the symbolic neuronal operations of animals. Indeed, an analytical assessment of vertebrate information systems suggests that all symbolic (and thus cognitive) operations are deeply rooted in neural architectures that trace to the dawn of the vertebrate lineage. Our systems for sight, sound, balance, olfaction and motor control derive from primitive antecedents, yet rely upon conserved structures such as the retina, olfactory bulb and brainstem. Forebrain systems, in turn, rely upon specialized sensory representations which are encoded, stored and manipulated in mammalian neocortex. Yet our ability to rapidly learn a fully-arbitrary symbolic language is puzzling and gave rise to the universal grammar (UG) concept. But analysis of daily memory records (Ganz and O'Malley, 2012) reveals a massive, sub-linguistic symbol-manipulation capability that captures most aspects of both our physical world and our mental lives. This leads to the universal physics (UP) concept, as documented by innate knowledge in infants and other species. Elements of UP are so richly woven into neocortical circuitry, including forebrain and association cortices, that this symbol sequencing and manipulation system provides a neuronal foundation that cannot be fully divorced from the fully-arbitrary symbolic system that is human language.

Topic: LANGUAGE: Semantic

E59 Responsiveness to cues as a measure of emerging language ability in aphasia

Megan Schliep[1], Victoria Tilton-Bolowsky[1], David Caplan[2], Sofia Vallila-Rohter[1], [1]MGH Institute of Health Professions, [2]Harvard Medical School

Two million people in the United States are living with aphasia, which is an acquired communication impairment most frequently caused by stroke. Prior research suggests that initial aphasia severity, lesion size and lesion location are the most salient factors in predicting recovery outcomes. While these factors provide important prognostic information, information that is individualized and readily available to clinicians is limited. Deficits in naming, a skill central to effective communication, is common to all aphasia types and is routinely targeted in aphasia assessment and treatment, with cues provided to facilitate lexical retrieval (naming). Meaning cues and sound cues tap into levels of lexical processing that are essential to effective naming-semantic cues activate the underlying concept of the word, while phonological cues provide information about the word form. In this longitudinal study, I propose that a person's ability to improve naming with cues will be predictive of future word retrieval and provide insights into the integrity of the lexical processing system. At four timepoints over the course of one year, we evaluated naming ability in individuals with aphasia and measured the proportion of successful lexical retrieval with the presentation of feature, sentence, and phonemic cues. Data have been collected from six participants at two or more timepoints, with three participants reaching study completion. Analyses suggest that cue responsiveness may differentiate individual recovery patterns, with individuals who responded best to sentence-based cues at 6 weeks post-stroke demonstrating greater improvements in naming ability without cues at 3 months post-stroke.

Topic: LANGUAGE: Semantic

E60 P600 and dispositional affect

Veena Dwivedi[1], Janahan Selvanayagam[2], Brent Dryczewycz[1], Louis Schmidt[3], [1]Brock University, [2]Western University, [3]McMaster University

Affective state is known to influence cognitive processing (Loftus et al., 1987). Here we investigated whether this relation extended to sentence processing. In an event-related potential (ERP) study, we examined whether individual differences in dispositional affect interacted with syntactic processing. We used stimuli from Osterhout and Holcomb's seminal paper on the P600 effect, a marker of syntactic anomaly (Osterhout & Holcomb, 1992). To this end, 20 participants read sentences (critical words are underlined) such as (i) The broker planned to conceal the transaction *was sent to jail vs. (ii) The broker persuaded *to conceal the transaction was sent to jail. We expected to replicate findings from the original work, where P600 effects were expected at 'to' in (ii) vs. (i) and at 'was' in (i) vs. (ii). We did not replicate the P600 effect at 'to', however, the P600 effect downstream at 'was' did replicate. Regarding affect, we hypothesized that individuals who reported more positive affect would show larger P600 effects at was. Chwilla and colleagues (2010) conducted an induced mood study and found that positive participants produced larger P600 effects for syntactically anomalous sentences, vs. negative participants, who did not. Our results showed a significant positive correlation between positive affect scores and P600 amplitude. Results are discussed in terms of 'family of P600' components and affect.

Topic: LANGUAGE: Syntax

E61 Listeners' experience with face-accent (in)congruencies modulates speaker identity effects in native-and foreign-accent

Carla Fernandez[1], Janet van Hell[2], [1]Duke University, [1]The Pennsylvania State University

Comprehending foreign-accented speech is more effortful than native-accented speech, but few studies examined how speakers' facial features affect listeners' speech comprehension. In two ERP experiments, we presented American and Chinese-accented English sentences preceded by White or Asian faces (creating 4 face-accent (in)congruent conditions). Sentences contained semantic anomalies or pronoun violations, or no errors. To examine how listeners' experience with face-accent (in)congruencies affects processing, sentences were presented to White-American (Expt.1) or Asian-American (Expt.2) listeners. Overall, White-Americans demonstrated strong sensitivity to (in)congruency of face-accent pairings. Specifically, semantic anomalies in American-accented sentences yielded a larger N400 for incongruent (Asian face/American accent) than for congruent (White face/American accent) face-accent pairings. Semantic anomalies in Chinese-accented English elicited an N400 only for congruent but not for incongruent face-accent pairings, and pronoun errors in American-accented English elicited an Nref for congruent, but not for incongruent pairings. In contrast, Asian-Americans (American-English accented speakers with extensive experience with face-accent incongruencies) showed little sensitivity to (in)congruency of face-accent pairings. Semantic anomalies elicited N400s in American- and Chinese-accented English, of similar magnitude for congruent and incongruent face-accent pairings. Likewise, Asian-Americans' sensitivity to pronoun violations in American- and Chinese-accented English was largely comparable for congruent and incongruent pairings. White-Americans are thus more sensitive to face-accent incongruencies than Asian-Americans, which indicates that listener experience modulates the effects of facial cues on native- and foreign-accented speech processing, thereby providing a more in-depth understanding of the role visual cues play in language processing.

Topic: LANGUAGE: Syntax

E62 The impact of altered sleep on memory consolidation in Parkinson's disease patients

Soraya Lahlou[1,2], Marta Kaminska[2], Julie Carrier[3], Madeleine Sharp[1,2], [1]Montreal Neurological Institute, [2]McGill University, [3]Université de Montréal

Healthy sleep is crucial to memory consolidation. Sleep impairments are common in Parkinson's patients and have been associated with worse cognitive outcomes. Research has mostly focused on the link between REM sleep behaviour disorder and cognitive impairment but abnormalities in non-REM sleep structure are also common and have been associated with worse cognitive performance. Whether this is due to a direct impact of impaired sleep on sleep-dependent cognitive processes is not known. The goal of this study was to determine if alterations in sleep structure are associated with deficits in overnight memory consolidation.We recorded overnight sleep with polysomnography in twenty-one Parkinson's patients and measured memory consolidation with a word pair association task. Patients first learned 50 word pairs. Memory for the word pairs was tested twice: once before sleep and again in the morning. Consolidation was measured as the relative difference in recall between the morning and the night tests. We restricted our preliminary analysis to patients without REM sleep behaviour disorder (n=16).We found no relationship between total sleep time or sleep efficiency and memory consolidation. We did find that greater severity of obstructive sleep apnea (as measured with the apnea-hypopnea index) was associated with worse overnight memory consolidation. Ongoing analyses are focused on the relationship between obstructive sleep apnea, sleep structure and memory consolidation, with a particular focus on sleep spindles and slow oscillations. These results suggest that targeting sleep could have direct benefits on cognition in Parkinson's patients.

Topic: LONG-TERM MEMORY: Development & aging

E63 Naturalistic auditory narratives synchronize 'visual' cortices of congenitally but not late blind or sighted people

Elizabeth Musz[1], Rita Loiotile[1], Janice Chen[1], Marina Bedny[1], [1]Johns Hopkins University

In individuals who are born blind, 'visual' cortices are activated during auditory and tactile tasks such as judging sound location (e.g. Sadato et al., 1996; Collignon et al., 2011). 'Cross-modal' activity during these tasks is reduced or absent in people who lose vision as adults. Do adult-onset blind individuals recruit 'visual' cortices for different cognitive processes? Alternatively, is there a sensitive period in cortical development? To gain insight, we used naturalistic auditory movies and narratives that engage many varied cognitive processes. Congenitally blind (CB, n=18), adult-onset blind (vision loss >18 years-of-age, LB, n=12) and sighted (n=18) participants listed to six-minute auditory excerpts from movies; a spoken narrative; and matched degraded auditory stimuli (i.e., shuffled sentences, backwards speech) during fMRI scanning. We correlated the voxel-wise timecourses of different participants within and across groups. Both within and across all groups, all conditions drove synchrony in auditory cortex, while only narrative stimuli synchronized activity in higher-cognitive fronto-parietal and temporal regions. Inter-subject synchrony in visual cortices only emerged for the CB group, and only for narrative stimuli. Synchrony was low in 'visual' cortices of the LB group, both among LB participants and between LB and CB and LB and sighted participants. Unlike in the CB group, 'visual' cortex synchrony of the LB group did not vary systematically as a function of stimulus cognitive complexity. In sum, these results suggest that visual cortices are consistently reorganized across congenitally but not adult-onset blind people, and provide support for sensitive periods in functional reorganization of 'visual' cortex.

Topic: LONG-TERM MEMORY: Development & aging

E64 Neural mechanisms underlying the use of learned value to guide memory across development

Kate Nussenbaum[1], Daphne Valencia[1], Jamie Greer[2], Nora Keathley[3], Catherine A. Hartley[1], [1]New York University, [2]Vassar College, [3]Emory University

Previous work has revealed that the ability to strategically encode high-value information may improve gradually over development, as the systems supporting cognitive control processes mature. However, studies of value-directed memory have relied on explicit cues that signal the importance of information, which are rarely present in real-world contexts. Here, using a novel fMRI paradigm, we examined whether individuals across a wide age range (N = 90; ages 8 - 25 years) could learn the relative frequency of items in their environment and prioritize memory for information associated with higher frequency items, which would ultimately enable them to earn more reward. We found that from childhood to early adulthood, individuals improved both at transforming their experiential learning into explicit representations of information value and at using these value estimates to strategically modulate encoding. Memory for high-value information was supported by increased engagement at encoding of the left caudate, putamen and lateral prefrontal cortex -- regions that have been implicated in value processing and the implementation of cognitive control mechanisms. We also observed increased recruitment of the thalamus and occipital and parietal cortices during encoding of high- vs. low-value information. Our results suggest that over development, the ability to dynamically adjust memory based on the statistics of the environment engages a wide network of brain regions that support both the recognition and use of information value to implement strategic control over encoding.

Topic: LONG-TERM MEMORY: Development & aging

E65 Reinstatement of Item-Specific Contextual Details During Retrieval Supports Recombination-Related False Memories

Alexis Carpenter[1], Preston Thakral[1], Alison Preston[2], Daniel Schacter[1], [1]Harvard University, [2]University of Texas at Austin

Flexible retrieval mechanisms that allow us to link together related memories, infer novel relationships across event boundaries, and recombine experiences into possible future events may also leave memory prone to error or distortion when details of one event are misremembered as having come from the related or overlapping event. To determine how flexible retrieval and cross-episode binding mechanisms affect the reinstatement of related contextual details and subsequent false memories, we developed a modified version of an associative inference paradigm in which participants viewed each event context during a pre-exposure phase prior to encoding overlapping events (AB, BC) that may later be linked to support successful associative inference (AC). During the retrieval phase, we correlated neural patterns when participants were asked to retrieve the currently cued context (AB) with neural patterns when participants viewed the overlapping, yet incorrect context (BC) during the pre-exposure phase. Results revealed that after successful inference, when participants were asked to retrieve contextual details of the currently cued event, neural patterns in the anterior hippocampus, posterior medial prefrontal cortex, and content-reinstatement regions were more similar to the overlapping, yet incorrect context compared to pattern similarity after unsuccessful inference. Further, the degree of 'false' contextual reinstatement evident in our content-reinstatement region correlated with the strength of participants' false memory effects. Results suggest that retrieval-mediated recombination mechanisms support not only successful associative inference but play a role in the misattribution of contextual details and that these misattributed details are reinstated during subsequent retrieval attempts, resulting in false memories.

Topic: LONG-TERM MEMORY: Episodic

E66 Does reset of hippocampal theta predict dynamics of memory encoding?

Ryan Colyer[1], Michael Kahana[1], [1]University of Pennsylvania

Both human and animal studies have implicated hippocampal theta oscillations in learning and memory function. Furthermore, theta oscillations reset following the appearance of a behaviorally relevant stimulus. Here we asked whether reset of hippocampal theta oscillations predict the dynamics of memory encoding for subsequently recalled and forgotten items. Our dataset comprised 42 neurosurgical patients who studied lists of common words for a subsequent delayed free recall test. We observed significant phase reset in the 125-375ms interval following stimulus presentation for both subsequently recalled and forgotten items. This effect, which appeared most prominently at frequencies 5-16Hz, distinguished between the encoding of subsequently recalled and forgotten items. These findings lend support to the view that hippocampal theta oscillations serve an important role in the encoding of new episodic associations.

Topic: LONG-TERM MEMORY: Episodic

E67 Manipulating associative encoding strategy impacts neural discriminability at encoding and retrieval

Courtney R. Gerver[1], Amy A. Overman[2], Jordyn Cowan[2], Carter Jenkins[2], Bennet E. Kautz[1], Manzhao Long[1], Min Sung Seo[1], Nancy A. Dennis[1], [1]The Pennsylvania State University, [2]Elon University

Recent studies of associative memory in young adults have found that manipulating the strategy used to encode item-item or item-context associations can lead to unitization of the stimulus pair (Overman & Stephens,

2013). While unitization leads to improved memory performance compared to associative encoding (e.g., Hertzog et al., 1998; Naveh-Benjamin et al., 2007; Rogers et al., 2000), the neural mechanisms underlying this strategy have not been fully examined. The current study examined the effect of manipulating encoding strategy on neural activation using a low-association condition and a high-association condition that promotes unitization. In line with previous studies, participants were significantly better at recollecting associative pairs in the high-association condition than the low-association condition. To investigate whether these behavioral differences were underscored by neural differences, we used multivoxel pattern analyses to examine whether patterns of activation between our strategic manipulation conditions were discriminable within regions known to support associative memory at encoding and retrieval. At encoding, a classifier was marginally able to distinguish between encoding conditions in the perirhinal cortex. Whereas, at retrieval, these conditions were significantly distinguishable in the inferior occipital cortex and perirhinal cortex, and marginally distinguishable in the angular gyrus/ BA5/ BA7. Results suggest that inducing unitization leads to better memory, and the benefit may lie in differences at retrieval associated with how the pair are retrieved.

Topic: LONG-TERM MEMORY: Episodic

E68 NSF Funding Opportunities for Cognitive Neuroscience

Kurt Thoroughman, NSF

E69 Hippocampal-targeted noninvasive stimulation alters objective memory for naturalistic episodes

Melissa Hebscher[1], Joel Voss[1], [1]Northwestern University Feinberg School of Medicine

Episodic memory depends on a widespread network of regions including the hippocampus and posterior parietal lobes. Two previous studies have shown that single-session theta-burst transcranial magnetic stimulation (TBS) of lateral parietal regions showing high functional connectivity with the hippocampus can alter episodic memory and its neural correlates. These studies reported stimulation-induced improvements in word-list and spatial precision tests of episodic memory. However, it is currently unclear whether the effects of hippocampal-targeted stimulation generalize to more naturalistic forms of episodic memory, which likely involve distinct neural mechanisms. The current study therefore investigated the effects of hippocampal-targeted parietal stimulation on memory for naturalistic video-clip episodes, which afford high experimental control while more closely approximating memory for life events. Participants (N=20) received TBS to a lateral parietal target demonstrating high functional connectivity with the hippocampus, or to a control stimulation site, on separate days. Immediately following stimulation, participants viewed short video clips depicting everyday activities. At retrieval, participants answered true/false questions to test their accuracy for the videos and rated their subjective vividness of the memory. Compared to control stimulation, parietal stimulation enhanced memory accuracy for the videos, but had no effect on memory vividness. These findings demonstrate that hippocampal-targeted parietal stimulation alters objective memory for naturalistic episodic events. Potential differences between the effects of stimulation on distinct forms of episodic memory and their neural correlates will be discussed.

Topic: LONG-TERM MEMORY: Episodic

E70 Dissociable neural reinstatement of emotional memories in human PFC

Augustin Hennings[1], Mason McClay[1], Jarrod Lewis-Peacock[1], Joseph Dunsmoor[1], [1]The University of Texas at Austin

Neurophysiological research in rodents using activity-dependent neural tagging shows separate neural ensembles in the hippocampus, amygdala, and medial PFC activate at encoding and retrieval of threat memories and extinction memories (Frankland et al., 2019). Detailing this level of neuronal organization is not currently possible using human neuroimaging, but multivariate analysis of fMRI data can quantify reinstatement of encoding-related activity patterns during memory retrieval (Ritchey et al., 2013). Here, we developed a hybrid threat conditioning-episodic memory paradigm that allowed us to localize distinct patterns of threat versus safety memories using multivariate representational similarity analysis in healthy adults (N=24) and patients with PTSD (N = 24). Subjects first learned to associate non-repeating exemplars from a semantic category with a shock (CS+) or no shock (CS-), immediately followed by extinction. Then 24 hours later participants completed a surprise recognition memory test for all CS stimuli previously encoded during both conditioning and extinction. Encoding-retrieval overlap was analyzed by stimulus type (CS+/-), encoding phase (baseline, acquisition, extinction), and group (healthy, PTSD). Healthy controls showed dissociable reinstatement patterns for CS+ items relative to CS- items in the dACC for items encountered during conditioning, and in the vmPFC for items encoded during extinction. PTSD displayed significant reinstatement for both threat and safety memories in the dACC, but no reinstatement in the vmPFC, consistent with an extinction deficit associated with the disorder. These results provide evidence for the neural reinstatement of emotional memories in human PFC, and show dysregulation of extinction memory processing in PTSD.

Topic: LONG-TERM MEMORY: Episodic

E71 Mismatch negativity (MMN) predicts mnemonic specificity: A new metric for auditory pattern separation

Deena Herman[1], Stevenson Baker[2], Jaime Cazes[3], Claude Alain[3,4], R. Shayna Rosenbaum[2,4], [1]McMaster University, [2]York University, [3]University of Toronto, [4]Rotman Research Institute

Humans are very good at differentiating highly similar inputs belonging to separate, yet overlapping events into discrete episodes at encoding, a process known as 'pattern separation.' This process likely depends on our ability to automatically encode similar sensory input into distinct memory representations. In this study, we combine a behavioral paradigm with the brain's perceptual discrimination index known as mismatch negativity (MMN) to determine the neural substrates enabling pattern separation. We hypothesized that the MMN -- mainly considered a measure of sensory memory -- would predict participants' ability to discriminate incidentally learned items from highly similar lures and from relatively dissimilar foils. We measured ERPs of young adults as they passively listened to 700 standard and 300 deviant micropatterns presented in a random order. These micropatterns were 500 ms long and consisted of a sequence of five 100 ms tones rising and falling in frequency. After exposure, all participants completed a surprise memory test in which they were presented with old micropatterns, highly similar lures, and relatively dissimilar foils. At test, participants were better at remembering the standard compared to the deviant micropatterns, and better at identifying foils as new compared to lures. Importantly, we also found a significant correlation (p

Topic: LONG-TERM MEMORY: Episodic

E72 Neural reactivation of mnemonic interference during associative memory

Kyoungeun Lee[1], Soroush Mirjalili[1], Brittany Corbett[1], Audrey Duarte[1], [1]School of Psychology, Georgia Institute of Technology

Episodic reinstatement is predicted to play an important role in recollection memory. However, it remains unknown how neural reinstatement is affected

by mnemonic interference arising during new learning or memory retrieval. The purpose of the present study was to use representational similarity analyses to measure the extent of neural reactivation of interfering memory representations and its impact on associative memory performance in young and older adults. Younger and older participants completed an associative memory task in which objects were paired repeatedly with either faces or scenes. Participants were asked to memorize the most recent pairing for each object under different levels of proactive interference during the encoding session. The level of interference was manipulated by increasing the number of presentations for the other, least recent, face or scene. In the retrieval session, participants made a decision whether a face or scene was the most recently paired with the object. EEG was recorded over the encoding and retrieval sessions. Across interference levels, greater episodic reinstatement supported better associative memory accuracy. Emerging results suggest that proactive interference reduces the degree of episodic reinstatement between encoding and retrieval of the target (recent) associated face or scene, suggesting that mnemonic interference of the associated lure in turn contributed to worse memory performance across age groups.

Topic: LONG-TERM MEMORY: Episodic

E73 Coarse-grained event segmentation induces false memory

Aedan Li[1], Audrey Huang[1], Morgan Barense[1], [1]University of Toronto

Humans segment continuous streams of experience into fine-grained events (e.g., eating breakfast, commuting to work, meetings), simultaneously grouping these events into coarse-grained summaries (e.g., the typical Monday morning). The granularity of event boundaries not only influences the types of details we can access in memory, but may also influence false memory of details that never happened. Here, we manipulate the granularity of event boundaries through task instructions and examine false memory in young adults. In the fine-grained condition, participants were asked to remember picture-word pairings in each block, with a displayed trial number denoting the current temporal position within the experiment. In the coarse-grained condition, participants were instead asked to remember picture-word pairings across all trials, with no knowledge of temporal position within the experiment. Critically, all picture-word pairings were trial unique, with the number of stimuli and timings identical in both groups. The only difference between groups was the wording of instructions, which biased participants into segmenting experience in a fine-grained ('each block') or coarse-grained ('all trials') manner. Participants in the coarse-grained condition not only made twice as many false alarms to recombined picture-word pairings, but made false alarms to pictures and words presented further apart in temporal distance. We replicate this effect in Experiment 2 after controlling for potential confounds, suggesting that the wording of instructions can robustly influence false memory through the granularity of event segmentation. The manner in which we segment experiences alters the veridicality of memory, providing new insight into age-related susceptibility to interference.

Topic: LONG-TERM MEMORY: Episodic

E74 How basic emotion categories and emotional congruency with context interacts to influence memory

Monika Riegel[1], Marek Wypych[1], Ma'gorzata Wierzba[1], Micha Szczepanik[1], Katarzyna Jednoróg[1], Artur Marchewka[1], Patrik Vuilleumier[2], [1]Nencki Institue of Experimental Biology, [2]Swiss Centre for Affective Sciences/ University of Geneva

Information congruent with prior knowledge is remembered better than incongruent information. At the same time, emotionally charged items are often remembered better, but emotional associations -worse. We investigated how emotional congruency and basic emotions influence associative memory for words in communicative context of faces. 18 subjects (females, age 22-29) took part in fMRI study. Stimuli included emotional words and faces (disgusting/fearful/neutral) from standardized datasets. During encoding sessions, words were presented with faces, emotionally congruent or incongruent. Subjects were instructed to memorize these pairs and imagine as messages and senders. During retrieval sessions, old and new words were shown, and participants indicated what was the emotion of accompanying faces.Behavioural analyses showed interaction between emotion and congruency â?' disgust was remembered better than fear when congruent, but not incongruent. During correct encoding, we observed that left parahippocampal gyrus was more active for incongruent than congruent pairs, while right hippocampus was more active for disgust than fear. Correct encoding of congruent disgust was specifically related to activation of right amygdala and hippocampus. During correct retrieval, right parahippocampal gyrus was more active for congruent than incongruent pairs and also for disgust than fear. Retrieval of congruent disgust activated specifically left hippocampus and medial prefrontal cortex. Here we provided behavioral and neuroimaging evidence that encoding and retrieval of verbal stimuli depends on basic emotions and emotional congruency between item and communicative context. Emotionally congruent information might be unitized more easily and only encoding and retrieval of incongruent emotional information was related to the hippocampal

Topic: LONG-TERM MEMORY: Episodic

E75 The primacy of processing speed on episodic memory maintenance: A single-blind randomized trial assessing the effects of

Rachael Romero[1], Dinesh K. Sivakolundu[1], Rahma Ahmed[1], Sheeva Shahinfar[1], Iman Popal[1], Dema Abdelkarim[1], Kathryn L. West[1], Bart Rypma[1], [1]University of Texas at Dallas

Episodic memory (EM) is defined as the recollection of autobiographical events. Behavioral studies investigating memory maintenance have suggested a central role for processing speed (PS). The extent to which episodic memory maintenance (EMM) depends on PS remains unknown. Furthermore, studies assessing caffeine's influence on EMM are limited. We conducted a participant-blind, two-part study to investigate caffeine's effects on EMM. Participants completed two sessions, about a week apart, during which they were administered a pill containing either caffeine (250mg) or placebo before performing an EM task during each session. The task required participants to learn 70 face-name pairs. Each pair was presented for 5s. The same pairs were shown during both sessions. EM performance was assessed by the recall-accuracy of the face-name pairs following each session. PS was measured as the average time to retrieve face-name pairs. The participants were randomly assigned to one of three groups, namely: 'caffeine-placebo', 'placebo-caffeine', and 'placebo-placebo', indicative of the pill they received for sessions 1 and 2. We found no significant group-differences in recall-accuracy or PS in either session. These results suggest caffeine has no effect on encoding or retrieval of EM. We observed significant between-session increases in task accuracy and processing speed across all three groups (all p's

Topic: LONG-TERM MEMORY: Episodic

E76 Human MTL Neurons are Phase-locked to Hippocampal Theta

Daniel Schonhaut[1], Ashwin Ramayya[1], Ethan Solomon[1], Nora Herweg[1], Itzhak Fried[2], Michael Kahana[1], [1]University of Pennsylvania, [2]University of California, Los Angeles

Functional interactions between the hippocampus and surrounding medial temporal lobe (MTL) regions are critical for episodic memory integrity. Animal studies have proposed a role for neural oscillations in coordinating brain

activity between regions, and in rodents, phase-locked firing of cortical neurons to hippocampal theta oscillations facilitates information transfer to the hippocampus and supports memory-guided behavior. In this work, we explored a role for hippocampal phase-locking in the human brain. We recorded 1348 MTL and neocortical neurons and simultaneous hippocampal local field potentials from intracranial microwires implanted in 18 epilepsy patients who played a virtual navigation game. For each neuron, we calculated the mean resultant length across spike-coincident hippocampal LFP phases for frequencies from 0.5 to 90.5 Hz. We compared these values to null distributions drawn from circularly shifted spike trains and applied false discovery rate correction (alpha=0.05) across comparisons to determine significance. We identified 419 neurons (31.1%) that phase-locked to hippocampal oscillations, almost exclusively within the delta (1-4Hz) and theta (4-8 Hz) bands. Phase-locking occurred robustly across patients and most prominently among entorhinal cortex and amygdala neurons. Highly phase-locked firing, but not firing rate, coincided with greater hippocampal delta and theta power and with elevated functional coupling (correlated LFP power across frequencies) between a neuron's region-of-origin and the hippocampus. Our results reveal that spike-time coordination between MTL neurons and hippocampal low frequency oscillations is a defining feature of their functional interactions. We propose that hippocampal phase-locking could mediate flexible interregional communication to guide the encoding and retrieval of episodic memories.

Topic: LONG-TERM MEMORY: Episodic

E77 Spatial memory activation patterns classify females but not males

Dylan Spets[1], Scott Slotnick[1], [1]Boston College

In a previous fMRI investigation, we identified sex differences during spatial long-term memory. During study, abstract shapes were presented to the left or right of fixation. During test, old shapes were presented at fixation and participants classified each shape as previously on the 'left' or 'right'. We selected eighteen female participants (from forty) to match the behavioral accuracy and standard error of the eighteen male participants. Despite equivalent behavioral performance, females and males activated widely different brain regions. In the current investigation, we used the same dataset to classify sex using multi-voxel pattern correlation analysis. For each pair of left-out participants (1 female, 1 male), an independent functional ROI was defined from the remaining participants as the union of activity produced from the contrasts of female hits versus misses and male spatial hits versus misses (thresholded such that each contrast produced the same number of activated voxels). A female template and a male template were created from the remaining participants by averaging the response magnitude for each sex within the functional ROI. The sex of each left-out participant was classified depending on whether their activation pattern was more highly correlated with the female or the male template (this was repeated for all participant combinations). Sex classification accuracy was significantly above chance for females but not males, which suggests spatial memory activation patterns are more consistent between females than between males. More broadly, these results contribute to the growing body of evidence supporting sex differences in the field of cognitive neuroscience.

Topic: LONG-TERM MEMORY: Episodic

E78 Spatiotemporal analysis of a neural contiguity effect in episodic memory retrieval

Wei Tang[1, 2], Zoran Tiganj[3], Hesheng Liu[4], Marc Howard[3], [1]McLean Hospital, [2]Harvard Medical School, [3]Boston University, [4]Medical University of South Carolina

An important neural correlate of episodic memory is the increased activity of the posterior cortex during successful retrieval. In the old/new paradigm for recognition memory, Hit trials elicit greater activity than Correct Rejection trials in electroencephalography (EEG) recordings. However, the neural processing underlying this increased activity and how it supports memory retrieval remain poorly understood. In this study, we tested whether this neural activity reinstates the temporal order in which the item was encoded -- a contiguity effect that serves as the basis for encoding temporal context into memory. Twelve subjects underwent simultaneous EEG/MEG when performing an old/new recognition memory task, and completed the same task in functional magnetic resonance imaging (fMRI) scans. A feature vector of EEG amplitude across 64 channels was used to compare the neural representations between items. Feature vector similarity across items during retreival reflected the order in which items were presented during encoding. The similarity was significant in the 26-30 Hz range, 600 ms post-stimulus, and decreased as the lag between items increased. The decreasing similarity suggested the reinstatement of a gradually changing signal that was present during item encoding -- a neural contiguity effect. Joint EEG/MEG source localization found strongest 26-30 Hz activity in the posterior cingulate cortex, and this region was consistently located by an old-new contrast in the fMRI analysis. In sum, these results provide further insights into the neural dynamics underlying the reinstatement of temporal context in episodic memory.

Topic: LONG-TERM MEMORY: Episodic

E79 Word problems: An event-related potential study on remembering semantically related and unrelated words

Michael Weigl[1], Paula Mohr[1], Benjamin Palej[1], Julia Rafinski[1], Lukas Schmitt[1], Regine Bader[1], [1]Saarland University

Dual process models of recognition memory distinguish between familiarity, a feeling of 'oldness' and recollection, the remembering of contextual details. Event-related potential (ERP) studies identified the P300 at encoding as a reliable predictor of subsequent recollection-based recognition (subsequent memory effect, SME). However, previous research was equivocal on whether facilitation of or increased demands on semantic processing are beneficial for familiarity-based remembering. Thus, the present research investigated whether increases or decreases in the N400, a component associated with semantic processing, predict subsequent familiarity-based recognition. In an incidental study phase, participants saw three prime words followed by a target word. In order to contrast facilitated and demanding semantic processing, three conditions were realized: The primes were either semantically related with each other and the target (coherent condition), only related with each other but not the target (deviant condition), or unrelated with each other and the target (incoherent condition serving as a control condition). Despite an increased N400 in the deviant and incoherent condition as compared to the coherent condition, memory was poor and no reliable SME emerged in these conditions. In contrast, in the coherent condition, where recollection and familiarity estimates were highest, a frontocentral positive SME in the N400 time window differentiated between remembered or known words and forgotten words and was followed by a centroparietal P300 SME. These results suggest that both, subsequent familiarity- and recollection-based remembering profit from facilitated, but not from demanding semantic processing.

Topic: LONG-TERM MEMORY: Episodic

E80 An ERP study of the beneficial effects of gesture on associative memory formation

Stanley West[1], Brianna Cairney[1], Heather Lucas[1], [1]Louisiana State University

Co-speech gestures benefit language comprehension and memory. In the present study, we examined whether the memory benefits of gesture also extend to novel associations, such as pre-experimentally unrelated word pairs. EEG was recorded while participants watched videos of an actor reciting sentences that ended in unrelated verb-noun pairs (e.g., 'She thought about the driving apple'). Each verb was accompanied by either a matching iconic gesture (i.e., the steering of an imaginary wheel for 'driving'), a beat gesture (small, spontaneous hand movement), or no gesture. To examine the role of imagery in mediating effects of gesture on memory, participants were asked to provide trial-by-trial ratings of word pair imageability in addition to trying to commit the word pairs to memory. Memory was assessed via free recall. Relative to pairs presented with no gestures, pairs presented with iconic gestures were perceived as more imageable and better recalled. Moreover, ERPs elicited by the second words (nouns) of each pair differed according to whether or not a gesture had been paired with the preceding verb. In particular, nouns paired with iconic-gestured verbs elicited greater (more negative) amplitudes of the N700, a late frontal potential previously linked to mental imagery. Beat gestures also enhanced imageability ratings and modulated ERPs to the nouns, but these ERP effects were more posteriorly distributed and were not accompanied by an increase in pair recall. Overall, these data suggest that iconic, but not beat gestures facilitate memory for novel associations, and that these benefits may involve mental imagery.

Topic: LONG-TERM MEMORY: Episodic

E81, WITHDRAWN

E82 Time cell population from various delays show similar structures

Rui Cao[1], Stephen Charczynsk[1], Marc Howard[1], [1]Boston University

The sequential firing of 'time cells' after the presentation of a salient event can be used to decode the passage of time (Eichenbaum, 2014). Many studies have found time cells across a variety of brain regions and species. Strong empirical evidence from those studies suggests that time is not encoded at a constant rate but compressed as the delay increases. The goal of this study is to quantitatively describe the form of this compression by studying populations of time cells using datasets of extracellular recordings of single units in different brain regions from multiple species. Here we applied Hierarchical Bayesian modeling techniques to characterize the distribution of time field centers and the relationship between each time field center and its time field width. The model fitting results turned out to be similar across those data sets despite their heterogeneousness, especially in terms of the delay length. These preliminary results suggest the possibility of a unified model for time encoding in brain.

Topic: LONG-TERM MEMORY: Episodic

E83 Path integration using eye and hand movements

Anisha Khosla[1,2], Jennifer D. Ryan[1, 2], Morris Moscovitch[1, 2], [1]University of Toronto, [2]Rotman Research Institute, Baycrest

Although there is neuroimaging evidence suggesting that the entorhinal cortex performs similar computations on whole-body in navigable space and eye movements in two-dimensional space, behavioral evidence of the same is sparse. Humans track their current position in reference to the starting point of a journey using information from whole-body movements through the process of path integration. We tested if path integration, a process dependent on the entorhinal cortex, reflects how gaze and hand movements are integrated to update current position. We used novel eye tracking and tablet tasks in which participants followed a route guided by minimal visual or auditory cues. At the end of each route, participants were asked to revisit the starting point or another en route location. Consistent with previous studies of spatial path integration using whole-body movements, we found that participants used different strategies to update gaze or hand location depending on task demands. They either continuously updated their current position (continuous updating) or retroactively updated position using a map representation of the route (configural updating) as evidenced by the reinstatement of gaze or hand movement patterns from encoding. Due to higher working memory demands, participants made more errors and took longer to respond during continuous than configural updating. The use of comparable strategies to integrate whole-body, eye, and hand movements suggests that they rely on similar underlying processes. Our results align with recent work which demonstrates that visual space and navigable space are coded through analogous processes in the entorhinal cortex.

Topic: LONG-TERM MEMORY: Other

E84 Distinct event-related potential and EEG oscillatory mechanisms of memory dysfunction in Mild Cognitive Impairment

Jiangyi Xia[1], Ali Mazaheri[2], Katrien Segaert[2], David Salmon[3], Kimron Shapiro[2], Marta Kutas[3], John Olichney[1], [1]University of California, Davis, [2]University of Birmingham, United Kingdom, [3]University of California, San Diego

Reliable biomarkers of memory decline are critical for the early detection of Alzheimer's disease. Previous work has found three EEG measures, namely the event-related potential P600, suppression of oscillatory activity in the alpha frequency range (~10 Hz), and cross-frequency coupling between theta and alpha/beta activity, each to correlate strongly with verbal learning and memory abilities in healthy elderly and patients with Mild Cognitive Impairment or prodromal Alzheimer's disease (Olichney et al., 2008; Mazaheri et al., 2018). In the present study, we investigated whether these measures are complementary predictors of verbal memory. Single-trial correlation analyses showed that despite a similarity in their time-course and sensitivities to word repetition, the P600 and the alpha suppression components are minimally correlated with each other on trial-by-trial basis(generally $|rs| < .10$). This suggests that they are unlikely to stem from the same neural mechanism. Furthermore, event-related potentials constructed from bandpass filtered (delta, theta, alpha, beta, or gamma bands) single-trial data indicated that only delta band activity (1-4 Hz) was strongly correlated ($r = .94$, $P < .001$) with the traditional P600 repetition effect; event-related potentials in higher frequency bands were not. Importantly, stepwise multiple regression analyses revealed that the three event-related potential/oscillatory measures are complementary in predicting California Verbal Learning Test scores (overall R2's in 0.45-0.63 range). The present study highlights the importance of combining EEG event-related potential and oscillatory measures to better characterize the multiple mechanisms of memory failure in patients with Mild Cognitive Impairment or prodromal Alzheimer's disease.

Topic: LONG-TERM MEMORY: Other

E85 The different contribution of different associations to visual predictions

Shira Baror[1], Moshe Bar[1], [1]Gonda Multidisciplinary Brain Research Center

Numerous studies testify to the predictive account of visual perception, showing that learned associations are utilized to generate predictions regarding upcoming events. However, associations can vary in characteristics. Some activate one and some activate multiple associations, some trigger a single context and some multiple contexts, and the corresponding contribution to predictions is not fully explored.Addressing this gap, we examined how the number of associations an object triggers (i.e. associative specificity) and how the range of contextual schemes these associations construe (i.e. contextual specificity) guide predictions. Resource availability was also manipulated, to

test how situational factors influence predictions.Study one employed an associative version of the 'n-back' task. Results show that associative specificity uniquely facilitates visual predictions. Contextual specificity both enhanced predictions but also triggered conservative associativity criterions. Resource availability contributed only to sensitivity performance, and not the criterion, suggesting that maintaining predictions over time requires resources.Study two employed a contextual priming paradigm under different load conditions. Findings revealed that associative specificity facilitated object recognition and hindered non-object recognition in a correlative manner. Resource availability did not influence object-recognition accuracy, but a reaction-time priming effect emerged only under low load.While associative specificity facilitated object recognition here, contextual specificity may possibly enhance predictions during contextual scene processing. Our results also call to explore how selection or inhibition impact predictions when multiple associations are involved.To sum, we suggest that different associative characteristics differentially guide predictions, and that resource availability influences the way predictions are attended and maintained.

Topic: LONG-TERM MEMORY: Priming

E86 Semantic Memory in Preclinical Alzheimer's disease

Nathaniel Klooster[1], David Wolk[1], Anjan Chatterjee[1], [1]University of Pennsylvania

People with preclinical Alzheimer's disease (AD) display evidence of cerebral amyloid, but perform normally on neuropsychological assessment. Cognitive measures sensitive to subtle cognitive change during this stage of disease are needed and would have significant impact for screening and measuring outcomes in intervention studies.We tested the hypothesis that semantic richness changes early in the AD trajectory. Here, we assess productive and receptive semantic richness, using tests adapted from the psycholinguistic and language-learning literatures in older adults and relate performance to structural imaging and molecular PET imaging. The number of senses a word can take (e.g. pen: a writing instrument, to write a letter, an enclosure for animals, the University of Pennsylvania) is a measure of semantic richness used widely 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.The Word Associates Test (WAT) measures 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. Performance across tasks differentiates MCI patients from healthy participants. In healthy participants, integrity of MTL subregions vulnerable to early AD pathology, including perirhinal and entorhinal cortices predicts performance, and amyloid status in cognitively 'normal' adults shows a trend in predicting performance. These preliminary results highlight the necessity of the MTL for rich semantic knowledge and suggest that probing semantic memory shows promise in differentiating healthy aging from preclinical AD.

Topic: LONG-TERM MEMORY: Semantic

E87, WITHDRAWN

E88 Targeted Memory Reactivation for Multiplication Problems During an Afternoon Nap

Adrianna M. Bassard[1], Ken A. Paller[1], [1]Northwestern University

Learning new facts is a valuable memory ability relevant in many educational contexts. When one learns to multiply, for example, fact learning and skill learning are likely intertwined. Sleep, especially slow-wave sleep (SWS), can facilitate memory consolidation for many types of memory. After pairing sensory stimuli with newly learned information, Targeted Memory Reactivation (TMR) can influence which memories are strengthened over a period of sleep. Here we examined memory reactivation during an afternoon nap using a multiplication task. Twenty-one young adults trained on 30 multiplication problems from six classes (13s, 14s, 16s, 17s, 18s, and 19s) while hearing six different, corresponding sounds. At Test 1 (after ~20 min of training), accuracy averaged 88% (±11) correct, with a mean response time (RT) of 6.3 s (±1.5) on correct trials. During a nap, three of the sounds were softly presented during SWS. At Test 2 (after sleep), mean accuracy and RT were unchanged, with no difference in either between cued and uncued problems. Although the expected cueing benefit was not observed, delta power over the nap marginally correlated across subjects with the cueing benefit for accuracy [r(19) = 0.38]. As a secondary analysis, we compared these results with results from participants who stayed awake for 2 hrs between Tests 1 and 2. Although TMR did not produce behavioral changes in multiplication problem-solving, sleep physiology may have affected memory reactivation. Future research is needed with multiple types of memory to clarify which factors influence memory reactivation during sleep and its consequences.

Topic: LONG-TERM MEMORY: Skill Learning

E89 Data-driven classification of spectral profiles reveals brain region-specific plasticity

Christina Lubinus[1], Joan Orpella[2], Anne Keitel[3], Helene Gudi-Mindermann[4], Andreas K. Engel[4], Brigitte Röder[4], Johanna M. Rimmele[1], [1]Max-Planck-Institute for Empirical Aesthetics, [2]New York University, [3]University of Dundee, [4]University Medical Center Hamburg-Eppendorf

The human brain exhibits rhythms that are characteristic for anatomical areas and presumably involved in diverse perceptual and cognitive processes. Visual deprivation results in behavioral adaptation and cortical reorganization. Whether plasticity-related changes are accompanied by altered spectral properties of neural signals and whether certain brain areas are particularly targeted is unknown. With a recently introduced approach, we analyzed magnetoencephalography resting state data of congenitally blind and matched sighted individuals. First, using clustering procedures (k-means and Gaussian Mixture Models) we identified brain region-specific spectral clusters. Second, a classifier was employed testing the specificity of the spectral profiles within and the differences between groups. We replicated the previously reported finding of area-specific spectral profiles, indicated by high classification performance in the sighted. Additionally, we found high classification performance in the blind, suggesting that after deprivation-related restructuring, area-specific spectral profiles can be consistently identified. Crucially, in the cross-group classification (sighted vs. blind), several sensory (visual and auditory) and right frontal brain areas were classified worse compared to the control (within sighted classification) condition. Overall the spectral profiles of those brain areas showed increased neuronal power in higher frequency bands, possibly reflecting acceleration of the regionally prevalent brain rhythms in the blind compared to the sighted. We provide evidence that visual deprivation-related plasticity selectively alters the spectral profiles of right frontal and sensory brain areas, possibly reflecting increased temporal processing capabilities (auditory, frontal cortices) and changes in the visual inhibitory-excitatory circuits in the blind.

Topic: METHODS: Electrophysiology

E90 Applying multivariate empirical mode decomposition to the analysis of broad-band EEG microstates

King-Hang Matthew Ma[1], Tan Lee[1], Manson Cheuk-Man Fong[2], William Shiyuan Wang[2], [1]The Chinese University of Hong Kong, [2]The Hong Kong Polytechnic University

EEG microstates models spontaneous resting-state EEG as continuous transitions among a few quasi-stable scalp topographies that remain unchanged for 60-120ms. The microstates are extracted from band-passed EEG signals of 2-20Hz or 1-40Hz. Microstates are typically described as broad-band phenomena. A single microstate could model temporal dynamics of a broad range of time scales. The present study investigates a novel method of microstates extraction to examine the broad-band perspective. The data-driven noise-assisted multivariate empirical mode decomposition (NA-MEMD) was applied to decompose time-domain EEG into a set of intrinsic mode functions (IMFs). Each IMF carries information of the original signal at different time scales (~2-150Hz). IMFs can be combined to reconstruct the original signal.EEG microstates were extracted from healthy young (age 20.7 (1.56), n=22) and older adults (age 72.3 (3.34), n=24) utilizing 2-20Hz band-passed signals or reconstructed signals from different IMFs combinations. The proposed approach could recover the four traditional microstate classes from both subject groups while the existing method failed in the elderly group, recovering only two of four classes. Microstates extracted from IMFs of frequency range (~2-15Hz) explained 54% and 59% of total variances of young and old group respectively, which are higher than using existing method (53% and 56%). It is found that microstate classes A and B were more consistent across frequency ranges, while classes C and D were more frequency-specific. The proposed approach provides new insights on the frequency composition of EEG microstates.

Topic: METHODS: Electrophysiology

E91 Hybrid structure-function connectome predicts crystallised and fluid cognition

Elvisha Dhamala[1], Keith W Jamison[1], Sarah M Dennis[2], Raihaan Patel[3], M Mallar Chakravarty[3], Amy Kuceyeski[1], [1]Weill Cornell Medicine, [2]Sarah Lawrence College, [3]McGill University

Functional connectivity (FC) represents temporal dependency patterns between regional blood-oxygenation-level dependent activity in functional magnetic resonance imaging (MRI) time series, and structural connectivity (SC) represents the inter-regional white matter pathways estimated from diffusion-weighted MRI. SC and FC can be independently used to predict cognition, and show distinct patterns of variance in relation to cognition. No work identified has yet investigated whether SC and FC can be combined to better predict cognitive abilities. In this work, we use data from 785 healthy young adults to:1) predict crystallised and fluid cognition using SC, FC, and a hybrid structure-function connectome, and 2) quantify the most important pairwise structural and functional connections for cognitive prediction.FC explains 11.3%, 6.5%, 7.5%, and 12.0% of the variance in crystallised, early childhood, fluid, and total cognition, respectively, while SC explains 5.3%, 3.0%, 2.3%, and 7.1%, respectively. The hybrid connectome explains 12.5%, 8.2%, 8.3%, and 15.0% of the variance in crystallised, early childhood, fluid, and total cognition, respectively, and outperforms the independent use of SC for cognitive prediction. The most important FC features for cognitive prediction are primarily long-range inter-hemispheric cortico-cortical connections, while the most important SC features are primarily short-range inter-hemispheric cortico-subcortical and subcortical-subcortical connections. There is no correlation between the feature importance for FC and SC features, suggesting that while a given region-pair's FC might be important for cognitive prediction, the same region-pair's SC may not be important. Taken together, this suggests that the integration of multi-modal data is crucial to understanding the neurophysiological correlates of cognitive function.

Topic: METHODS: Neuroimaging

E92 Assessing brain-wide TMS-evoked responses depending on ocular and oscillatory state: a simultaneous TMS-EEG-fMRI project

Shanice Janssens[1], Alexander Sack[1], Felix Duecker[1], Teresa Schuhmann[1], Tom de Graaf[1], [1]Maastricht University

Complex cognitive functions rely on communication in/between widespread brain networks. Brain-wide signal propagation can be studied by using transcranial magnetic stimulation (TMS) as a system probe, and concurrent functional magnetic resonance imaging (fMRI) to measure local and network responses. Network responses depend on neurocognitive state, and moreover on momentary neuronal oscillations measured with electroencephalography (EEG). We applied an innovative simultaneous TMS-EEG-fMRI setup, in six participants, to study these mechanisms across two neurocognitive states: eyes open and closed. We applied TMS to right posterior parietal cortex, a strongly interconnected network hub and high-level association area. We used an MRI-compatible TMS coil and holder, along with two 4-channel MRI flex coils to create sufficient space for the TMS-EEG equipment. Supra- versus sub-threshold 15Hz TMS triplets were administered during fMRI acquisition gaps. Ocular state (eye closure) was cued by auditory tone, in complete darkness. We measured fluctuations in neuronal oscillations prior to TMS with EEG, within and between the two ocular states which were previously associated with different brain-wide connectivity patterns. As expected, supra- compared to sub-threshold TMS induced higher fMRI activation in bilateral auditory and sensorimotor areas, due to louder noise and stronger sensation of TMS. Ocular state modulated fMRI responses in motor and sub-cortical areas (such as thalamus). Future analyses will evaluate whether/how such effects depend on EEG-indexed oscillatory state at the time of TMS. These preliminary findings confirm the potential of our new simultaneous TMS-EEG-fMRI setup and open the door to the investigation of state-dependent brain-wide signal propagation.

Topic: METHODS: Neuroimaging

E93 Age-related differences in white matter: Comparing fixel-based and tensor-based analyses

Shannon Kelley[1], John Plass[1], Andrew Bender[2], Thad Polk[1], [1]University of Michigan, [2]Michigan State University

Older adults tend to perform worse on cognitive and behavioral tasks, and age-related changes in white matter (WM) may play a role. Most prior studies of age differences in WM have used diffusion tensor imaging (DTI), but typical DTI metrics can reflect multiple different biological factors, making interpretation challenging. New fixel-based analysis (FBA) techniques have been developed to address some of these concerns, but have not yet been applied in the domain of aging. Here, we used both DTI and FBA to analyze age differences in WM in a large sample of healthy older (n=45) and younger (n=25) adults, both at the whole brain level and in specific WM tracts. While the two methods provided partially consistent results, FBA more clearly delineated a (fronto-)limbic locus of age-related effects and provided additional insights into structural changes underlying them. DTI analysis provided less specific results, potentially reflecting decreased biological specificity of tensor-based metrics. These results demonstrate the power of FBA and provide novel insights into major WM differences associated with aging.

Topic: METHODS: Neuroimaging

E94 Using mobile EEG to assess brain health and performance

Olav Krigolson[1], [1]University of Victoria

In recent years it has become possible to use mobile electroencephalographic (mEEG) technology to collect research grade data (Krigolson et al., 2017). The recent advances in mEEG data quality and the ease of use have opened the

doors for a wide range of real-world applications for human neuroimaging in addition to allowing large scale data collection. Here, we present the results from a large sample size study (n = 1000) wherein we used a combination of event-related potentials (ERPs), time-frequency analysis (FFTs), and machine learning classifiers to examine relationships between neural data and cognitive fatigue. In this study, participants played two simple games on an Apple iPad using PEER research software ? a visual oddball task and a two-choice gambling task while mEEG data was recorded from a MUSE headband. In line with previous research, our results demonstrate that diminished ERP responses (P300, reward positivity) are associated with increased cognitive fatigue. Further, using a combination of multivariate regression and machine learning classifiers we were able to greatly increase the explained variance in our results (Discriminant Analysis Classifier with Bayesian Optimization, 91.6% accuracy) and come up with a more accurate prediction of cognitive fatigue level. Importantly, we demonstrate two key things here. One, we provide further evidence for the use and validity of mEEG in research. Two, we provide an important building block for cognitive fatigue detection capability ? something that obviously could have huge impact in a variety of real-world applications.

Topic: METHODS: Neuroimaging

E95 Brainstem Structural Alterations Correlates with Sleep Difficulty and Pain in Gulf War Illness Veterans

Yu Zhang[1], Andrei Vakhtin[1,2], Jessica Deitch[1], Jennifer Jennings[1], J. Wesson Ashford[1,2], Peter Bayley[1,2], Ansgar Furst[1,2], [1]WRIISC VA Palo Alto Health Care System, [2]Stanford University

Background: Gulf War illness (GWI) in veterans who served in the 1990-91 Persian Gulf War is manifested by multiple chronic symptoms, including pain, sleep problems, neuropsychiatric disorders, autonomic, gastrointestinal, and skin problems. Major reticular nuclei and circuits of the brainstem play key roles in regulating sleep-awake circle and pain control. The aim of this study was to find the brainstem neuro-correlates of the chronic sleep and pain syndromes in GWI veterans.Methods: We enrolled 26 GWI patients who meet both Fukuda/CDC and Kansas criteria for chronic multi-symptom illness (Age=51±5, 88% Male). Sleep quality was evaluated using the global Pittsburgh Sleep Quality Index (PSQI). Pain intensities were obtained with the Brief Pain Inventory (BPI). Structural and diffusion tensor MRI scans for all participants were post-processed to measure the white matter integrity of three dorsal brainstem circuits, as well as the volumes of the periaqueductal gray matter (PAG) and locus coeruleus (LC). Results: There was a significant correlation (R=-0.45, P=0.02) between worsening of the global PSQI and the integrity of the dorsal longitudinal fasciculi (DLF), a brainstem tract that interconnects hypothalamus, PAG, LC, and medial medulla. There was also a significant correlation (R=-0.40, P=0.04) between increasing pain levels, measured by the 'Pain-right-now' item from BPI, and the integrity of the DLF. Conclusion: These preliminary findings of the brainstem neuroanatomical correlates of chronic sleep disturbances and pain may improve the understanding of the brainstem neurotransmitter regularization system and its pathophysiological basis underlying the chronic multi-symptoms in GWI.

Topic: METHODS: Neuroimaging

E96 Default Mode Network Connectivity Response to Transcranial Magnetic Stimulation in Smokers: A Preliminary Evaluation

Nicholas Kearley[1], Nicole Petersen[1], Andrew Leuchter[1], Nathaniel Ginder[1], Reza Tadayon-Nejad[1], Jennifer Levitt[1], Jonathan Lee[1], David Krantz[1], Edythe London[1], [1]UCLA

Repetitive transcranial magnetic stimulation (rTMS) has been hailed as a promising therapy for a range of psychiatric disorders, including Tobacco Use Disorder (TUD). High frequency rTMS to the dorsolateral prefrontal cortex (dlPFC) has been the predominant therapeutic approach investigated for TUD, but advances in brain imaging have suggested other targets, such as the superior frontal gyrus (SFG) or posterior parietal cortex (PPC) may be equally or more efficacious. Therefore, 13 daily smokers received up to four sessions of neuronavigated 10Hz rTMS directed at the SFG, dlPFC, PPC, or visual area 5 (V5). Stimulation targets were selected based on individual intrinsic network connectivity, and stimulation sessions were separated by ?24 hours. Before and after rTMS, participants completed esting-state functional connectivity (RSFC) scans and self-reports of craving symptoms. The effect of rTMS on default mode network (DMN) connectivity depended on stimulation site, with dlPFC rTMS producing its maximum change in PCC-DMN connectivity, SFG and PPC rTMS both producing their maximum changes in precentral gyrus-DMN connectivity, and V5 rTMS producing its maximum change in amygdala-DMN connectivity. The magnitude of change in PCC-DMN connectivity corresponded to the magnitude of change in self-reported craving measured with both the Urge to Smoke (interaction p = 0.0036) and Shiffman-Jarvik Withdrawal Scales (interaction p = 0.0214). These findings suggest that high frequency rTMS to the dlPFC produces the largest changes to PPC-DMN connectivity, that these connectivity changes correspond to rTMS-induced craving relief, and that PPC-DMN connectivity changes may underlie the therapeutic action of dlPFC rTMS in smokers.

Topic: METHODS: Other

E97 Longitudinal structural effects of electroconvulsive therapy in major depressive disorder

Sophie B. Sébille[1], Christopher J. Funes[1], Sofia Uribe[1], Tracy Barbour[1], Kristen K. Ellard[1], Joan A. Camprodon[1], [1]Division of Neuropsychiatry, MGH, Boston

Major depressive disorder (MDD) affects around 10-15% of the worldwide population. Electroconvulsive therapy (ECT) can be used to treat MDD patients that have not responded to standard treatments. Despite ECT remarkable efficacy, we still have a restricted comprehension of its mechanisms of action and the way it relates to changes in clinical symptoms. We performed a longitudinal structural neuroimaging study in 17 MDD patients to compare whole-brain volumetric changes before and after ECT. We also explored the relationship between volumetric changes and changes in depression severity (categorical syndrome) and dimensional measures of positive and negative affect and suicide risk (QIDS, PANAS and CHRT). We found ECT-related bilateral increase volume for all subcortical regions. We reported ECT-related volume increase in parietal, temporal, occipital and insular cortices; and decrease in inferior frontal cortex, subparietal cortex and premotor regions. We found significance linear regressions between difference in clinical scores and difference in volume for several regions: right putamen with QIDS, superior occipital gyrus with PANAS-POS, parahippocampal gyrus with PANAS-NEG, superior occipital sulcus with PANAS-NEG, posterior-dorsal part of the cingulate gyrus with PANAS-POS, middle occipital gyrus with PANAS-POS, occipital pole with PANAS-NEG, superior segment of the insula circular sulcus with PANAS-POS and middle temporal gyrus with QIDS, PANAS-NEG and CHRT. These results indicate compelling and potentially specific clinical associations. Clarification of these correlations is required to gain a deeper and more granular understanding of MDD pathophysiology, the mechanisms of action of ECT and to use this information towards novel treatment development.

Topic: NEUROANATOMY

E98 Differences in left fusiform gyrus morphometry in adults with dyslexia: Voxel- and surface-based analyses

Gabrielle-Ann Torre[1], Ja Young Choi[2], Terri Scott[1], Yaminah Carter[1], Tyler Perrachione[1], [1]Boston University, [2]Harvard University

Dyslexia is a neurological disorder that specifically impairs the development of fluent and accurate reading skills. However, structural neuroimaging research has not converged on reliable neuroanatomical signatures of reading impairment. In a large sample of adults with dyslexia (n = 55) or typical reading skills (n = 52), we tested for whole-brain group differences in three neuroanatomical metrics: gray matter density, cortical thickness, and cortical surface area. We also performed whole-brain correlations in the dyslexia group between these metrics and standard neuropsychological assessments of phonological awareness, phonological working memory, reading accuracy, and reading fluency. No significant group differences were observed for gray matter density or cortical surface area. Cortical thickness significantly differed between adults with dyslexia and typical readers in a cluster in left fusiform gyrus (FDR $p < 0.05$) when controlling for age and sex. No continuous relationships between brain morphometry and reading skills were found. These results raise the possibility that prior reports of morphometry differences in dyslexia-particularly those outside of a core reading center in left fusiform gyrus-may not generalize to larger samples or disorder heterogeneity. Our observation of cortical thickness differences in left fusiform gyrus suggest this region may mature differently during reading development in adults with dyslexia, though whether this is a cause or consequence of the disorder is unclear. This is a preliminary report from a sample of more than 1000 brains of adults and children with and without dyslexia, where we are investigating neuroanatomical differences associated with dyslexia across the lifespan.

Topic: NEUROANATOMY

E99 The influence of reproductive stage on cerebellar network connectivity across adulthood

Hannah K. Ballard[1], Trevor B. Jackson[1], Jessica A. Bernard[1], [1]Texas A&M University

Resting state networks impacted in aging, particularly those involving the cerebellum, show sex-specific differences. As females are disproportionately affected by aging, a biological component may help explain sex differences in the trajectories of brain changes across adulthood. Specifically, hormone changes with menopause may play a critical role in aging. We were interested in evaluating the influence of reproductive stage, as well as age and sex more broadly, on cerebellar network connectivity. The data used for this investigation (n = 591 adults) was acquired from the Cambridge Centre for Ageing and Neuroscience (Cam-CAN) repository. We used raw data from structural and resting state magnetic resonance imaging (MRI), as well information regarding age, sex, and menopause-related variables. Crus I and II and Lobules V and VI were our cerebellar seeds. Reproductive stage of females was characterized using the STRAW+10 criteria. Results show that postmenopausal females (n = 123) have reduced cerebello-striatal and cerebello-cortical connectivity, particularly in frontal regions, as well as greater connectivity within the cerebellum, compared to reproductive females (n = 107). These differences begin to emerge across transitional stages of menopause. Further, results reveal sex-specific differences in connectivity between female reproductive groups and age-matched male control groups. This suggests that menopause, and associated hormonal fluctuations, may influence cerebellar network differences within aging females. Further, sex-specific differences in the aging brain may be related to these biological characteristics. Thus, differences in reproductive stage and the menopausal transition are important factors to consider when evaluating differences in cerebellar network connectivity across adulthood.

Topic: OTHER

E100 Two-way communication between dreamers and experimenters

Karen R. Konkoly[1], Ken A. Paller[1], [1]Psychology Department, Northwestern University

Dreams are emblematic of human sleep, but they have yet to be adequately explained. In part, this is due to the limited options available for peering into dream experiences. Mapping neural measures onto dreams is problematic when those dreams are recounted after waking. Retrospective dream reports are subject to distortion and rapid forgetting. Here, we describe a method to overcome these obstacles through two-way communication between dreamers and experimenters. To demonstrate proof-of-concept, we presented softly spoken math problems to participants during lucid REM sleep, and they provided answers using covert physiological signals such as eye movements. We confirmed REM sleep using standard polysomnographic methods. Thus far, 3 out of 8 participants who had lucid dreams correctly answered problems during REM sleep. Results document that sleeping individuals can have sufficient abilities for veridical perceptual analysis, maintaining information, computing simple answers using working memory, and expressing volitional replies. Dreamers can thus be capable of interacting and exchanging information with other individuals. In this way, the mental content experienced by the dreamer can be interrogated to characterize the phenomenological experiences and cognitive abilities of dreaming.

Topic: OTHER

E101 A Possible Effect of the PICMOR Intervention Program on Regional Brain Volume in Older Adults

Hikaru Sugimoto[1], Mihoko Otake-Matsuura[1], [1]RIKEN Center for Advanced Intelligence Project

Photo-Integrated Conversation Moderated by Robots (PICMOR) is a social activity-based intervention program for older adults that has been developed to enhance their cognitive functions. PICMOR offers a moderated group conversation with robotic supports, in which participants are prompted by a robot to talk about their daily life using photos they prepared beforehand, and answer questions about the topic asked by others; alternatively, they are required to listen carefully to others and ask them questions. To investigate the effect of PICMOR on cognitive functions in older adults, we previously conducted a randomized controlled trial. Here we conducted a voxel-based morphometric analysis for structural magnetic resonance imaging (MRI) data from the participants and examined a possible difference in brain structures between the intervention group (INT) and the control group (CONT). Although the possible differences cannot be fully attributed to the effect of PICMOR because we lack comparable MRI data from before the intervention, we aimed to provide directions for future research examining the intervention effects. We found larger volume in INT than in CONT in several regions, such as the right parahippocampal gyrus/ hippocampus, superior frontal gyrus, postcentral gyrus, and left posterior middle temporal gyrus. In contrast, no regions showed greater volume in CONT than in INT. The present findings suggest that PICMOR has a beneficial effect on regional brain volume. Further investigation will be needed to confirm this possible effect in future research by collecting longitudinal data through the intervention period and making comparisons with the data from the two groups.

Topic: OTHER

E102 Directional brain-to-brain oscillation coupling reflects music ensemble leadership

Andrew Chang[1], Philip Chrapka[1], Dan Bosnyak[1], Laurel Trainor[1], [1]McMaster University

Coordinating with others is essential for humans during many daily activities, ranging from working on the same task to performing music in an ensemble. However, the neural oscillatory representations of interpersonal coordination are unclear, and past research suffers from two major limitations. First, studies on isolated individuals makes it unclear whether the findings generalize to interpersonal settings. Second, most hyperscanning studies have only examined similarity across coactors' brains, which cannot exclude the confound that both brains receive similar sensory input during coordination, or assess directional coordination among coactors. The current study aimed to overcome these limitations. We measured EEG in two professional string quartets in the LIVELab concert hall as a real-world example of interpersonal coordination. We experimentally manipulated leadership, assigning a different musician as leader on each short performance, and here we report EEG analyses. We focused on the source signals generated from four regions of interest, specifically, auditory cortex, visual cortex, dorsal and ventral lateral prefrontal cortex (lateral PFC), and supplementary motor area (SMA). Preliminary analyses using partial directed coherence showed that followers influenced leader more than leader influenced followers or followers influenced each other, especially the couplings involving SMA, lateral PFC and auditory cortex. These couplings might reflect interpersonal sensorimotor predictions and adaptations. Together, we have shown that interpersonal coordination can be represented in EEG activities and that it reflects directional influences between coactors.

Topic: PERCEPTION & ACTION: Audition

E103 Hemispheric Specialization in Auditory Rhythm Processing

Daniel Comstock[1], Alejandra Santoyo[1], Ramesh Balasubramaniam[1], [1]University of California - Merced

Previous research suggests the cerebral hemispheres may have specialized roles in processing rhythms, with the left hemisphere specializing in faster rhythms and the right hemisphere specializing in slower rhythms. Evidence for hemispheric specialization includes the findings that synchronized tapping with the right hand is more precise than with the left to faster rhythms (Repp, 2005; Ivry, 1998), while the left hand is more precise with slower rhythms (Pflug et al. 2017). More recently, amplitude modulation in the beta band was shown to preferentially represent faster rhythms in the left auditory cortex while engaged in a synchronized tapping task, while slower rhythms are represented in the right auditory cortex (Pflug et al. 2019). To further tease out the role of rhythm processing in sensorimotor synchronization with regards to hemispheric differences, we recorded EEG while subjects listened to 3 different rhythms (fast, slow, metered) while either tapping with their left hand, tapping with their right hand, or listening without tapping. Initial analyses in the non-tapping condition reveal greater gamma and beta suppression in the left hemisphere for each of the 3 rhythms in the time/frequency domain, and greater mu suppression in the spectral domain in the left hemisphere for the faster rhythm. While the hemispheric differences seen in our initial analysis in the gamma and beta bands do not show a preference between faster and slower rhythms, the mu suppression in the left hemisphere aligns with the hypothesis of hemispheric specialization for rhythms of different tempos.

Topic: PERCEPTION & ACTION: Audition

E104 The effect of aperiodic but predictable temporal regularity on pitch discrimination

Jesse Pazdera[1], Andrew Chang[1], Elger Baraku[1], Dan Bosnyak[1], Laurel Trainor[1], [1]McMaster University

Temporal regularities are common in many auditory signals, including speech and music. It has been shown that periodic or isochronous temporal regularities enable temporal prediction, which facilitates perceptual performance. However, auditory tempo often accelerates or decelerates in a predictable way in music and speech, creating an aperiodic yet still predictable temporal pattern. A few previous studies have investigated this effect with accelerating and/or decelerating sequences, but as the tempo changed in a fixed regular fashion for all trials, an effect of temporal prediction might be confounded with a memory effect. The present study investigates whether aperiodic-predictable temporal regularity facilitates auditory perception as does periodic regularity. Participants were presented with a tone sequence composed of six tones of the same pitch followed by a seventh (target) tone that differed in pitch. The tone sequence was either linearly accelerating or decelerating, or steady. To control for the memory effect, the final target onset time was either matched or mismatched to the trajectory of the sequence with equal likelihood. Participants were asked to tap along with the sequence, and then judge whether the target was higher or lower in pitch. Preliminary analyses using signal detection theory showed a trend for perceptual improvement, in that discrimination sensitivity was higher when the target onset time matched with the regularity of the tone sequence, most prominently in accelerating sequences. Further analyses will examine associations between perceptual performance, temporal precision of tapping, and neural oscillatory activities.

Topic: PERCEPTION & ACTION: Audition

E105 Potential of Receptive Music Intervention on Mild Cognitive Impairment: A Resting-State fMRI Study

Diana Wang[1], Alex Belden[2], Maiya Geddes[3,4], Suzanne Hanser[5], Manoj Bhasin[6], Roger Burtonpatel[2], Psyche Loui[2], [1]Harvard University, [2]Northeastern University, [3]Brigham Women's Hospital, [4]Harvard Medical School, [5]Berklee College of Music, [6]Emory University

Music-based interventions have become increasingly adopted for Alzheimer's Disease (AD) and Mild Cognitive Impairment (MCI). Previous research shows that music engages reward-related regions through functional connectivity with the auditory system. Here we characterize intrinsic connectivity of the auditory and reward systems at different stages of dementia. Using resting-state fMRI data from Alzheimer's Database Neuroimaging Initiative, we tested functional connectivity within and between auditory and reward systems in older adults with AD, MCI, and age-matched controls (N=108). Seed-based correlations were assessed from regions of interest (ROIs) in the auditory network (aSTG, pSTG, Heschl's Gyrus) and reward network (nucleus accumbens, caudate, vmPFC). MCI and AD individuals showed lower functional connectivity in the auditory network compared to controls. In contrast, MCI individuals showed higher functional connectivity than controls and AD individuals in the reward network. Furthermore, graph theory analyses showed that MCI individuals had consistently high between-network connections as well as within-network clustering within the reward network relative to controls and AD individuals. AD individuals had significant between-network connections and clustering within the reward network; however functional connectivity, degrees, and betweenness centrality were all lower in AD than in controls or MCI. Together, the auditory and reward systems show preserved between-network connectivity in MCI relative to AD. These results suggest a potential for music listening as an intervention to make an early difference in MCI individuals due to the preservation of functional connectivity

in reward-related regions and between auditory and reward networks at that early stage of neurodegeneration.

Topic: PERCEPTION & ACTION: Audition

E106 What's next? Timing-based anticipation in children with Autism Spectrum disorder

Shlomit Beker[1], John J. Foxe[2], Sophie Molholm[1], [1]Albert Einstein College of Medicine, [2]University of Rochester

Information in the sensory environment tends to be highly predictive of upcoming events, allowing for online planning and decision-making. The neural processing of expected stimuli is significantly facilitated compared to that of non-expected stimuli. In individuals with autism spectrum disorder (ASD), reduced behavioral flexibility, insistence on sameness and rigidity of routines are prevalent symptoms. In recent years, data from behavioral, physiological and computational modeling suggest that children and adults with ASD have diminished capacity to form expectations about upcoming stimuli based on prior events, while the neural mechanisms are still unknown. Here, we test the integrity and flexibility of neural oscillations when sensory stimuli are presented, through entrainment and contingent negative variation (CNV), which are critical for preparing for upcoming, temporally predictable, events. We record high-density electroencephalography and measure behavioral responses from children with ASD (n=31) and Typically Developing (TD) age- and sex-matched controls (n=20), while presented with to a train of isochronous events. Results show that while both groups showed highly comparable evoked responses to the sensory stimuli, children with ASD had reduced neural entrainment to the rhythm of the cues, and altered anticipation to their occurrence. Our results outline neural processes that may underlie impaired event anticipation in children with autism, and support the notion that perception of external events in autism is influenced more by their mere sensory appearance, as measured by evoked responses, and less by their temporal predictability, as measured by later electrophysiological components. ââ?¬Æ'

Topic: PERCEPTION & ACTION: Development & aging

E107 The Effect of Context on Human Mirror System Integration in Action Understanding

Brandon Hager[1], Jennifer Gutsell[1], [1]Brandeis University

The accurate perception of complex motor actions is believed to be dependent on sensorimotor integration with visual and prefrontal areas, and the context of the action. In action intention understanding, the mirror system is involved in the perception?action matching process while the mentalizing system is purported to underlie higher-level intention inference. The current study used electroencephalography to assess how sensorimotor neural processing is affected by different levels of context during interactive gameplay in 43 HC. Sequential brain microstates were extracted during which we analyzed sensorimotor mu (8?13 Hz) suppression, an index of neural mirror system activation, and the multiscale entropy (MSE) of that same signal to capture the information content, and indirectly, the functional connectivity, within the region and band. We found significantly differing levels of mu suppression across levels of participant involvement in gameplay, with a linear increase over time windows, while actively playing RPS, only (F(5.98, 297.54)=4.115, p

Topic: PERCEPTION & ACTION: Motor control

E108 Age-related declines in manual dexterity are associated with visuomotor tracking ability and white matter integrity

SHULAN HSIEH[1], Zai-Fu Yao[2], Meng-Heng Yang[1], [1]National Cheng Kung University, [2]University of Amsterdam

Previous studies have reported that measures of manual dexterity might help identify individuals at higher risk of impairment of cognitive function among older adults. However, how age-related decline in manual dexterity are associated with tasks that involved cognitive and motor functions, and how these performance declines are associated with brain structural changes remain unclear. Here, we report an average 1.8-year follow-up in a group of 96 right-handed participants (age 20â?'80 years). All participants underwent behavioral assessments including Grooved Pegboard Test, Trail-Making Test, and Stop-Signal Task. The brain structural images acquired by magnetic resonance imaging were implemented to investigate the age-associated brain structural-correlates among manual dexterity, and tasks involving both cognitive and motor functions. We applied Spearman's Rank correlation, surface-based morphometric and tract-based spatial statistics analyses to assess the association among behavioral performance, grey matter density, and white matter integrity, respectively. We found that only manual dexterity of the dominant hand was associated with age-related declines in both baseline and follow-up testing sessions. Correlation results suggest that age-related manual dexterity reductions were associated with performance measure declines on motor function, especially visuomotor tracking ability. The brain structural-behavioral correlation suggests that early age-related declines in manual dexterity associated with decreased white matter integrity and can be observed in both baseline and follow-up sessions. We highlight the role of manual dexterity underlies cognitive decline that may involve more of visuomotor tracking ability and the performance variability of manual dexterity is a likely consequence of individual differences in white matter integrity.

Topic: PERCEPTION & ACTION: Motor control

E109 Intracranial stereotactic EEG study of crossmodal influences in human auditory cortex

Jyrki Ahveninen[1, 2], Iiro P. Jääskeläinen[3], Hsi-Jun Lee[4, 5], Hsiang-Yu Yu[6, 7], Cheng-Chia Lee[6, 7], Chien-Chen Chou[6, 7], Seppo P. Ahlfors[1, 2], Wen-Jui Kuo[7], Fa-Hsuan Lin[4, 5], [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Aalto University School of Science, [4]Sunnybrook Research Institute, [5]University of Toronto, [6]Taipei Veterans General Hospital, [7]National Yang Ming Univ.

Crossmodal visual influences occur already at early stages of human auditory cortex (AC) processing. The mechanisms and role of these effects are still unclear. A more conservative hypothesis is that crossmodal visual influences modulate sound processing, without directly activating human AC neurons. However, single-unit studies in other mammals report visually triggered AC firing patterns, which may even carry information of the non-auditory stimulus. Here, we examined crossmodal influences on human AC processing by using intracranial stereotactic EEG (SEEG). Simple auditory (300-ms noise burst), visual (checkerboard), and audiovisual (noise burst + checkerboard) stimuli were presented to ten patients who had depth electrodes implanted in or near ACs for presurgical monitoring. These depth electrode locations were determined by clinical criteria only: one patient was implanted with bilateral, five with left-hemispheric, and four with right-hemispheric SEEG electrodes. Hypotheses were tested based on 50-200 Hz high broadband gamma (HBG) activity, a putative correlate of local firing activity. In addition to conventional signal analyses, we employed inverse modeling of the intracranial source currents to facilitate anatomically normalized group analyses. HBG activity was very robust after unimodal auditory but weak after unimodal visual stimuli

in superior temporal AC areas. However, HBG activity was significantly increased to auditory stimuli that were coupled with a visual stimulus. Evidence for visually induced HBG was found only beyond ACs. Our results suggest that visual inputs modulate coinciding sound processing but do not trigger robust suprathreshold activation patterns in human ACs.Supported by: R01DC017991, R01DC016765, R01DC016915; Acad. Finland 276643, 298131, 308431.

Topic: PERCEPTION & ACTION: Multisensory

E110 How action modulates the body model

Lara Coelho[1], Connor Way[1], Claudia Gonzalez[1], [1]University of Lethbridge

The knowledge of where bodies are in space is referred to as position sense. Recently, it has been found that the representation of the body that underlies this ability (the body model) is distorted. Adult humans overestimate hand width and underestimate finger length. How is it possible for us to interact with our surroundings using a distorted representation of the hand? One possibility is that haptic information modulates the body model. A study from our lab found that when participants relied on haptic information alone, they had more accurate representations. However, when we navigate in our environments we typically rely on visual information. Therefore, we investigated if increased haptic information reduced the distortions of the body model. We asked participants to place their hands underneath a covered tabletop (no vision of the hands) and to estimate where they believed ten landmarks (the tips and knuckles of each finger) were located. Prior to every estimation the participant tapped the target finger five times to the beat of a metronome. The results depict that the participants who tapped their fingers made significantly more accurate estimates of hand width, but not of finger length. It appears thus, that increased haptic information modulates the body model and this modulation is specific to the effector involved in the action. We discuss these results in relation to how somatosensory information influences body representation. Specifically, it appears that haptic information is most relevant for the body model.

Topic: PERCEPTION & ACTION: Multisensory

E111 Hebbian associative plasticity shapes the motor resonance properties of the Mirror Neuron System

Giacomo Guidali[1], Nadia Bolognini[1], [1]University of Milano-Bicocca

Hebbian associative plasticity has been implied in the formation of the association between sensory and motor representations of actions in the Mirror Neuron System (MNS); however, such an inductor role still needs empirical support. To address this issue, we have assessed whether a novel non-invasive paired associative stimulation (PAS) protocol can induce the formation of atypical (i.e., absent in normal conditions), visuo-motor associations, in turn reshaping motor resonance following Hebbian learning. Twenty healthy participants underwent our novel mirror-PAS protocol (m-PAS) during which they were exposed to repeated pairings of transcranial magnetic stimulation (TMS) pulses, applied over the right primary motor cortex (M1), time-locked with the view of index-finger movements of the right (ipsilateral) hand. In two different sessions, the inter-stimulus interval (ISI) between the onset of the visual action stimulus and TMS pulse was varied following the chronometry of motor control (25 ms) or that of MNS activation (250 ms). Before and after each m-PAS session, motor resonance was assessed by recording Motor Evoked Potentials (MEPs) induced by single-pulse TMS applied to the right M1, during the observation of both contralateral and ipsilateral index-finger movements or static hands. m-PAS successfully induced new ipsilateral motor resonance responses, indexed by an atypical facilitation of cortico-spinal excitability by the view of ipsilateral (i.e., right) hand movements. Crucially, this effect occurred only if the associative stimulation followed the chronometry of motor control (ISI of 25 ms). The present findings provide empirical evidence that Hebbian associative plasticity shapes the visual-motor matching properties of the MNS.

Topic: PERCEPTION & ACTION: Other

E112 Formalizing Medial Temporal Lobe involvement in perception: From psychological constructs to function approximation

Tyler Bonnen[1], DanielL. K. Yamins[1], Anthony Wagner[1], [1]Stanford University

The Medial Temporal Lobe (MTL) is well recognized for its role supporting memory-related behaviors. Yet there is an enduring debate surrounding the involvement of the MTL in perception. Unfortunately, synthesizing results across studies has been stymied by informal, descriptive accounts of stimulus properties (e.g. 'feature ambiguity'). Here we adopt a combination of meta-analytic, computational, and behavioral approaches in order to formalize the involvement of the MTL in perception. We focus exclusively on, perirhinal cortex (PRC), substructure within the MTL, and it's role in concurrent visual discrimination ('oddity') tasks. After a meta-analytic review, we collect stimuli presented to PRC-lesioned subjects from all relevant and available published studies. In these experiments, we expect PRC-lesioned behaviors to reflect the pattern of performance supported by a linear readout of the Ventral Visual System (VVS). We parametrize this null model of perirhinal function with a computational proxy for the VVS: a task-optimized convolutional neural network, validated on multielectrode array data from macaque inferior temporal cortex. With this model, we identify experiments within the literature that may not be diagnostic of PRC's involvement in perception: a linear readout of the VVS should be sufficient to enable ceiling performance on these tasks. With the remaining experiments, we observe a striking correspondence between model and PRC-lesioned behaviors (r>.9). Critically, there is a divergence between PRC-intact and PRC-lesioned behavior (p

Topic: PERCEPTION & ACTION: Vision

E113 Cardiac phase modulates endogenous and exogenous ERPs and HEP predicts awareness at the visual threshold

Juliane Britz[1], Viviana Leupin[1], Joanna Moret[1], [1]University of Fribourg

We can investigate neural correlates of consciousness by experimentally dissociating sensation and perception (e.g., sensory threshold stimuli are consciously perceived in 50% of trials) and by measuring the response of the brain to different perceptual outcomes of the same stimulus. Such differences in perceptual awareness can arise from i) evoked brain responses for different perceptual outcomes and ii) from the pre-stimulus differences in brain activity. The brain is inextricably connected with the body, and cyclic variations of bodily signals like e.g. the cardiac phase and the response of the brain to the heartbeat (HEP) before stimulus onset can influence perceptual awareness: baroreceptor activity during the systolic phase interferes with sensory stimulus processing, and the HEP differs for stimuli subsequently seen or not. We presented subjects with stimuli (Gabors overlaid with random-dot-noise) at the sensory threshold and compared i) the ERPs and ii) the HEP for the same stimuli when consciously seen and not. We found that ERPs for seen and unseen differed as a function of cardiac phase: the P1 reflecting early sensory processes was modulated during systole and the VAN reflecting cognitive processes was modulated during diastole. The HEP also differed between the conditions: amplitude, topographic and source space differences indicated that the default-mode-network is recruited in response to the heartbeat for subsequently unseen stimuli and that the saliency-network is recruited for subsequently seen stimuli. Taken together, we can show that the cardiac cycle and the HEP can influence conscious awareness at the visual threshold.

Topic: PERCEPTION & ACTION: Vision

E114 Uncovering a scene-defining feature using converging stimuli-based, behavioral and neural approaches

Ruu Harn Cheng[1], Daniel Dilks[1], [1]Emory University

Our ability to recognize places, or 'scenes', is remarkable. Not surprisingly, there are cortical processes specialized for scene recognition. However, it remains unknown how humans recognize scenes from non-scene stimuli, such as faces and objects. Here, we hypothesize that, just like faces always have two eyes above a nose, above a mouth, there also exists some scene-defining visual features that enable the human brain to recognize scenes. To identify a potential scene-defining feature, we analyzed thousands of naturalistic scene images and found that, across most scenes, there is a vertical asymmetry in luminance, with the upper half brighter than the lower half. Next, we asked if this vertical luminance asymmetry is not only a common scene feature, but also necessary for engaging human visual scene processing. We predicted that if vertical luminance asymmetry is necessary to engage scene processing, then a 90-degree image rotation that disrupts the vertical luminance asymmetry of a scene will impair scene recognition. Consistent with our hypothesis, we found people are worse at recognizing scenes that are rotated away from their upright, canonical orientations (90-degree, 180-degree, 270-degree rotation), while object recognition is unaffected by image rotation. Similarly, using functional magnetic resonance (fMRI), we found that the cortical scene processing system shows a diminished response to rotated scene images, whereas the cortical object processing system does not differentiate objects across different orientations. Taken together, these results provide converging stimuli-based, behavioral, and neural evidence that vertical luminance asymmetry is a scene-defining feature that enables human visual scene processing.

Topic: PERCEPTION & ACTION: Vision

E115 Opposite lateralization for face recognition and gender perception

Ana Chkhaidze[1,2], Matthew Harrison[2], Zhiheng Zhou[3], Samantha Lee[2], Lars Strother[2], [1]UCSD; [2]University of Nevada, Reno, [3]University of California, Davis

The perception of boundaries between stimuli existing along a graded continuum of physical properties is referred to as categorical perception (CP). Divided field studies of color and shape perception suggest a relationship between left-lateralized CP in these cases, and cerebral laterality for language. Unlike color and shape processing, face recognition is associated with right-lateralized circuits in the visual cortex and beyond. We used a divided field method to study two different kinds of face perception: (1) gender discrimination and (2) identity recognition. In four experiments, observers performed a visual search task on arrays of faces split between the left visual field (LVF) and the right visual field (RVF). The search required visual discrimination of faces by virtue of their identity, gender, or both. Our results showed categorical face perception effects in all three types of tasks. Crucially, however, hemifield biases for categorical perception of gender were different from the categorical perception of identity. We found that the well-known LVF advantage for face recognition showed modulation by categorical versus non-categorical face perception when the change was happening across gender. While for identity categories, we found that the CP effect was stronger in the RVF. Our findings show that categorical effects on face recognition may depend on opponent cerebral laterality for language and the visual processing of faces.

Topic: PERCEPTION & ACTION: Vision

E116 Unimpaired novel object recognition in developmental prosopagnosia

Regan Fry[1], Jeremy Wilmer[2], Joseph DeGutis[1], [1]Department of Psychiatry, Harvard Medical School, [2]Wellesley College

The classic debate over the face specificity of prosopagnosia was recently revived by a meta-analysis that found 42-80% of developmental prosopagnosics (DPs) to have mild to major object recognition deficits (Geskin and Behrmann, 2017). However, nearly all studies used real-world objects (e.g., cars) where recognition depends on object-specific expertise, raising the question of whether impairment in a single object category is representative of general object abilities. Recently, recognition tests using novel objects have shown to correlate highly with general object abilities. No studies to our knowledge have tested DPs using novel object memory tests (NOMTs), and the majority of studies have tested fewer than 20 DPs. In the current study, we tested 30 DPs and 30 age- and gender-matched controls (TD) on a NOMT ('Ziggerins') and the Cambridge Face Memory Test (CFMT). DPs were impaired on the CFMT (DP:38.3, TD:59.4, p

Topic: PERCEPTION & ACTION: Vision

E117 Patients with hemispherectomies evince intact visual recognition behaviors

Michael C. Granovetter[1], Leah Ettensohn[1], Marlene Behrmann[1], [1]Carnegie Mellon University

Cortical resection is an efficacious treatment for pharmacoresistant epilepsy. For markedly intractable epilepsy, a hemispherectomy--resection or disconnection of an entire cerebral hemisphere--may be performed to alleviate a patient's seizures. Prior studies have reported moderate maintenance or recovery of post-operative cognitive behaviors in resection patients. However, to date, visual recognition abilities of patients with full hemispherectomies have not been systematically investigated. Here, 16 hemispherectomy patients aged 8- to 38-years-old (5 right, 11 left) performed a visual discrimination task. Pairs of stimuli (words in one block, faces in another) were consecutively presented for brief intervals, and participants reported whether images were identical or different. Stimuli were presented at central fixation for patients (who were all hemianopic) and in the left or right visual fields for controls (such that images would likely be most immediately registered in a single hemisphere). Remarkably, accuracy for 15 of 16 patients with left and right hemispherectomies were comparable to age-matched controls viewing stimuli in their left and right visual fields, respectively, as determined by the Crawford & Howell individual subject analysis method. This was verified with a mixed effects analysis showing no effects of stimulus category (words versus faces) or group (patients versus controls) on accuracy. A mixed effects analysis did reveal longer reaction times for the right resection patients than controls viewing words in the right visual field, but only among participants less than 15-years-old. Altogether, these findings suggest that patients with complete hemispherectomies are able to maintain or recover critical visual recognition behaviors.

Topic: PERCEPTION & ACTION: Vision

E118 Division of Labor and Coordination of the Face Network in Developmental Prosopagnosia and Controls

Xian Li[1, 2], Joseph Arizpe[1, 2], Mike Esterman[1, 2], Joseph DeGutis[1,2], [1]Boston Attention & Learning Lab, [2]Harvard Medical School

Successful face recognition relies on the coordination between face-selective regions (e.g., fusiform face area-FFA, occipital face area-OFA), though the computations performed and interactions between these regions is debated. To further characterize these regions and their interactions, we examined 23

developmental prosopagnosics (DPs, 9 with mild/major face perception impairment-mFPI vs. 14 non-impaired) and 23 controls. Using a faces/scenes/objects/bodies dynamic localizer, we defined individual's bilateral FFAs and OFAs and examined their face-selectivity (differential activation for faces vs. scene) during the localizer, as well as functional connectivity (FC) during resting-state. In the dynamic localizer, while DPs with mFPI showed reduced selectivity in OFA, perceptually-normal DPs showed FFA reduction. Across all subjects, OFA face-selectivity correlated with both face perception and face memory abilities, while FFA only correlated with face memory. Moreover, FFA, but not OFA, was associated with holistic processing. Together, these selectivity results suggest that the OFA is important for earlier perceptual processing whereas the FFA is involved more in integration of face parts. On the other hand, when examining resting-state fMRI, face network FCs were found predictive of both face perception and face memory across all subjects, and was reduced in DPs, but no difference was found between the DP subgroups. Notably, face network FCs were not associated with the face-selectivity during task. Overall, this study indicates that while face-selective area activation can reflect the division of labor in hierarchical facial processing, the face network FC at rest may reflect more general coordination of these regions for effective information transfer.

Topic: PERCEPTION & ACTION: Vision

E119 Dissociable Systems for Recognizing Places and Navigating through them: Causal and Developmental Evidence.

Stephanie Wahab[1], Frederik Kamps[2], Sama Radwan[2], Daniel Dilks[2], [1]Medical College of Georgia, [2]Emory University

Humans recognize a place or 'scene' in a fraction of a second and almost simultaneously navigate that scene flawlessly and effortlessly. Functional MRI evidence suggests that human visual scene processing is supported by at least two functionally distinct systems; visually-guided navigation, including the occipital place area (OPA), and scene categorization, including the parahippocampal place area. It is unknown, however, whether these systems arise along differential timelines in typical development and whether they are causally dissociable ? possibilities that would greatly strengthen the claim that these systems are distinct. Here we tested navigation and categorization abilities in typically developing children and adults with Williams syndrome (WS), a genetic disorder involving cortical thinning of the OPA. During the categorization task, participants were shown rooms and indicated whether they were in a bedroom, kitchen, or living room. During the navigation task, participants imagined walking through the room and indicated whether they could leave through a door on the left, center, or right by following a path on the floor that only connects to one of the three doors. We found that i) navigation and categorization develop along differential timelines in typical development, with navigation maturing more slowly across childhood than categorization; and ii) that WS adults are selectively impaired in navigation relative to mental-age matched controls (i.e., typical developing 7 year olds). Taken together, our results provide the first developmental and causal evidence for dissociable visually-guided navigation and scene categorization systems, and further suggest that this distinction may have a genetic basis.

Topic: PERCEPTION & ACTION: Vision

E120 The Primacy of Color in Visual Perception

Brian Zhang[1], Marjan Persuh[1], [1]BMCC, City University of New York

The phenomenon of change blindness suggests that visual experience is sparse and limited by attention and working memory capacity. Iconic memory experiments, however, suggest that our visual experience is rich and that we are aware of many details of our environment. To circumvent the involvement of memory, we developed a methodology that directly measures the richness of visual experience without reliance on memory. A circular array of either color patches, geometric objects or different orientations, with set sizes of two, five or eight, was briefly displayed to participants. On half of the trials, one of the randomly selected items was present twice and participants were asked to report repetition. Because the repeated item was not known in advance, the task estimated the content of perceptual experience. With a set size of two, performance was at ceiling for all features; however, with a set size of five, accuracy for color was significantly different from both orientation and shape. With a set size of eight, accuracy for color still remained high, whereas accuracies for other features dropped to chance levels. We further explored perception of color in a second experiment by increasing the number of simultaneously presented items to sixteen. Accuracy was above chance even for a set size of twelve and only dropped to chancel level when sixteen colors were displayed. Our results demonstrate that the richness of visual experience depends on specific features and that our perception of color is superior to our perception of orientation and shape.

Topic: PERCEPTION & ACTION: Vision

E121 Resolving the credit assignment problem in cortico-basal ganglia pathways

Matthew Clapp[1], Catalina Vich[2], Kendra Noneman[3], Jonathan Rubin[4], Timothy Verstynen[1], [1]Carnegie Mellon University, [2]Universitat de les Illes Balears, [3]Boise State University, [4]University of Pittsburgh

When selecting actions within a volatile or noisy context, mammals are capable of flexibly modifying their decision policy to efficiently balance explorative and exploitative behavior. The cortico-basal ganglia-thalamic (CBGT) pathways, organized into parallel action channels, are ideal for the feedback-driven management of this behavioral trade-off via dopaminergic (DA) plasticity. DA error signals modulate the balance of direct (D) and indirect (I) pathways, with rewarding outcomes favoring the D pathway and aversive outcomes favoring the I pathway. Action selection is driven via cross-channel competition influenced by the within-channel balance of D and I pathway weights. Previous models have shown how DA can alter the D/I pathway balance to learn action-value contingencies using simplified cortico-striatal networks with simple, local selection rules. Selection in real CBGT networks, however, happens downstream and temporally distant from striatal dynamics. It is unclear how DA plasticity in the striatum manages this credit assignment problem. Here, we imbued a fully-spiking model of the CBGT network with a biologically-plausible DA spike timing dependent plasticity rule, with DA signals produced in accordance with the network's selected actions. This network was simulated in the context of a 2-choice value-based decision task with varying levels of environmental volatility and noise. Our model was found capable of quickly learning the most rewarding action in a stable environment by sustaining activity in the selected channel until movement execution, as observed in motor planning circuits. The network appropriately alters its behavior when the most rewarding action changes identity, dynamically learning new action-outcome contingencies.

Topic: THINKING: Decision making

E122 Bifocal tDCS stimulation of the right and left DLPFC leads to asymmetrical effects on judgment and decision-making

Michael Lundie[1], Lauren Kim[1], Harshith Dasara[1], Daniel Krawczyk[1], [1]The University of Texas at Dallas

Investigations of the neural correlates of reflective judgement and decision-making have revealed the importance of the dorsolateral prefrontal cortex (DLPFC) in attentional control and regulating impulsivity. Edgecumbe et al. (2019) determined that bifocal transcranial direct current stimulation (tDCS) of the right DLPFC facilitated performance on the cognitive reflection test (CRT),

a common indicator of reflective processing. Building upon these findings in the present study, we collected data from a series of randomized, within-subjects trials measuring the behavioral effects of anodal tDCS stimulation on judgment and decision-making across the following three conditions: left DLPFC, right DLPFC, and sham stimulation. Each stimulation condition was counterbalanced and spaced at least one week apart to attenuate residual effects of tDCS. We determined that stimulation of the left DLPFC significantly reduced accuracy on the CRT in comparison to right DLPFC and sham stimulation conditions. On measures of inhibition indexed by a visual stop-signal task, no significant effect of stimulation was observed. On a financial framing task, however, we identified that the right DLPFC stimulation condition significantly reduced susceptibility to the framing effect compared to left DLPFC and sham conditions. These findings provide evidence for both the potential benefits and hinderances of using tDCS to enhance reflective processing by modulating activity in the DLPFC.

Topic: THINKING: Decision making

E123 Similarity-based episodic sampling processes in decision-making: A role of the hippocampus in memory-guided decisions

Seokyoung Min[1], Sanghoon Han[1], [1]Yonsei University

Our decisions are often guided by past experiences. Recently, several researchers have begun to focus on the role of episodic memory in value-based decision-making to address the limitations of the reinforcement learning framework. Although these studies have investigated how the values of single past episodes contribute to decisions, it is unclear whether and how they contribute to the valuation of novel stimuli that never repeats. Using a novel experimental paradigm combined with model-based fMRI, we investigated whether episodic memory could guide novel decisions based on similarity between the present and past experiences. Participants viewed a trial-unique image and made decisions on whether to accept or reject each novel gamble. Of importance, we assigned reward probabilities for all stimuli to be unique while similar images had similar values, and the same images were never repeated. We found that the outcome values of the five most similar past stimuli had a significant effect on the choice, and the effects were higher for the more similar stimuli. Next, we fit a computational model from the case-based decision theory to the behavioral data. Model-based fMRI analysis revealed that trial-by-trial expected values were associated with the activity of the ventromedial prefrontal cortex and the hippocampus, and the reward prediction errors were correlated with the activity of the ventral striatum and the hippocampus. Our findings provided empirical evidence that similarity plays a key role in enabling episodic memory to guide value-based decision-making and the hippocampus plays a critical role in this memory-guided decision process.

Topic: THINKING: Decision making

E124 Effects of Lysergic Acid Diethylamide in Representation-Mediated Learning in a Rat Model

Maxine Robinette[1], Leah Fleming[2], Jane Taylor[2], [1]California State University, Long Beach, [2]Yale University

Hallucinations are perceptual experiences of stimuli not externally present, a symptom among psychotic disorders, and can be elicited by lysergic acid diethylamide (LSD). Sensory conditioning has also shown to induce hallucinations, particularly in people prone to hallucinations, where an absent stimulus is perceived by presenting a cue previously paired with it. In animals, the ability to bring up strong, sensory representations of cues through presentation of a paired stimulus has been used to model this phenomenon. We used a representation-mediated taste aversion behavioral paradigm (RMTA). Rats received flavor (sucrose/maltodextrin) and odor pairings, then one odor was devalued with an injection of lithium chloride. Later, we tested whether its associated flavor was also devalued. We optimized this protocol such that rats show strong aversion to the odors directly paired with nausea, but don't show an aversion to the paired flavor. Forty-two male Sprague-Dawley rats underwent RMTA and were administered with either LSD or saline on the odor-LiCl training days. We then determined whether LSD increases the extent to which the representation of the flavor is elicited and therefore devalued. A three-way mixed ANOVA revealed a significant main effect for flavor-type (F=13.084, p=.0006). Regardless of lithium-chloride, sucrose was overall preferred. Additionally, a significant interaction was shown between the lithium-chloride pairing condition and flavor (F=3.962, p

Topic: THINKING: Decision making

E125 Flexibility and Predictions in Autism: Findings from EEG, pupillometry, behavior, and computational modeling

SEYDANUR TIKIR[1], Dylan Festa[1], Michael J Crosse[2], Juliana Bates[1], Ruben Coen-Cagli[1], Sophie Molholm[1], [1]Albert Einstein College of Medicine, [2]Google

In stable and predictable environments, the brain generates expectations with high confidence; whereas this confidence is lowered in volatile and unstable environments. Thus, the brain not only makes predictions but also assigns an expected error rate according to environmental volatility. Individuals with autism resist even trivial changes in everyday life, leading us to hypothesize impaired ability in flexibly tuning the confidence of predictions based on changes in volatility. To assess the use of environmental statistics in making and adjusting predictions, adults with (N=21) and without (N=20) autism performed a task in which they responded to the completion of a pattern of three sequentially presented shapes. Across blocks of ~120 pattern initiations, the probability of pattern completion varied between 100%, 86%, 66%, and 33%. The ability to infer a change in the probability of pattern completion was assessed with electroencephalography (P3 and CNV responses), reaction time, and pupil size. Modulation of P3 and CNV by volatility was significantly diminished in the autism group. Further, Bayesian modeling of subject belief trajectories discriminated between the groups. We also presented a passive auditory oddball paradigm in which the probability of a deviant tone was 4%, 8%, or 16% in different blocks. In contrast to our findings above, preliminary analyses of the mismatch negativity (MMN) suggest that the brain is able to calculate stimulus statistics in autism. Taken together, these data suggest that the specific problem with predictive processing in autism is not in registering environmental statistics, but in applying the statistics to making predictions.

Topic: THINKING: Decision making

E126 Visualizations of God: Differences in strength of religious belief influence representations of God.

Emily Dyke[1], Adam Weinberger[1], Kathryn Johnson[2], Thomas Dameris[1], Ariana Mastrogiannis[1], Adam Green[1], [1]Georgetown University, [2]Arizona State University

Is God represented similarly in the brains of believers and nonbelievers (i.e., do believers and nonbelievers hold consistent sets of representations in mind, but believe differently in the reality of what they are representing), or are differences in belief associated with fundamentally different God representations? In order to study neural representational similarity of God visualizations, this pilot study collected data in a large, online sample concerning participants' religious beliefs. Participants completed a number of self report questionnaires, which indicated the type and strength of their religious beliefs. Participants were also provided with an open-ended prompt in which they were asked to describe how they visualize God. Responses were coded to indicate the extent to which visualizations were abstract, anthropomorphic, or impersonal. Results indicated that participants with

stronger religious belief held more anthropomorphic representations of God relative to both moderate and non-believers, who were more likely to describe God as being abstract or impersonal. This study is the first to our knowledge to identify differences in deistic representation based on strength of religious belief. It provides the empirical framework for an ongoing investigation of the neural basis of God representation. In particular, this research utilizes representational similarity analysis to measure the similarity of God representations both within and between groups of believers. Based on this pilot research, we are testing the hypothesis that believers' representations are a) more similar to each other than to representations of nonbelievers, and b) more similar to representations of anthropomorphic entities than to abstract representations.

Topic: THINKING: Other

E127 The relationship between creativity and individual semantic network properties

Marcela Paola Ovando Tellez[1,4], Yoed Kenett[2], Mathias Benedek[3], Emmanuelle Volle[4], [1]Institut du Cerveau et de la Moelle épinière, [2]University of Pennsylvania, [3]Institute of Psychology, University of Graz, [4]Sorbonne University UMRS

The associative theory of creativity suggests that creative abilities rely, at least in part, on the organization of semantic associations in memory. Recent research has demonstrated that semantic network methods allow exploring the properties and organization of semantic associations and testing this hypothesis. The aim of the current study was to investigate the properties of semantic networks and relate them to creative abilities at the individual level, using graph theory. Individual semantic networks were estimated using relatedness judgments of pairs of words. Thirty-five words were selected based on French association norms and controlled for the theoretical semantic distance between them and for linguistic properties. Topological properties of the estimated individual semantic networks were measured by several graph metrics which were correlated with individual creativity scores. The theoretical semantic distance between words correlated with the relatedness ratings given by the participants, indicating the validity of our approach. Importantly, we observed a significant correlation between semantic network metrics and creativity as measured by creative achievement and creative task performance. These findings replicate and extend previous similar results and suggest that exploring semantic network properties is a valuable approach to study creativity.

Topic: THINKING: Other

E128 Overlapping neural responses to symbolic math and formal logic in the intra-parietal sulcus

Marina Bedny, Yun-Fei Liu[1], Shipra Kanjlia[2], [1]Johns Hopkins University, [2]Carnegie Mellon University

Symbolic math (e.g. 17 ? 3) and formal logical thinking (e.g. if X then Y) depend on distinct neural mechanism from natural language and both recruit the intraparietal sulci (IPS) (Monti et al., 2009, PNAS; Amalric and Dehaene, 2018, Phil. Trans. R. Soc. B). Do these culturally derived symbol manipulation systems depend on overlapping neural resources? While undergoing fMRI, participants (n=12) performed matched language, logic and math tasks. On language trials, participants reported whether two sentences, one in active and one in passive voice, have the same meaning (e.g. 'The child that the babysitter chased ate the apple' vs 'The apple was eaten by the babysitter that the child chased'). On symbolic math trials, participants reported whether X has the same value across two equations (e.g. 'X minus twenty-five equals forty-one' vs 'X minus fifty-four equals twelve'). On formal logic trials, participants reported whether two logical statements are consistent (whether one statement being true implies the other also being true) (e.g. 'If either not Z or not Y then X' vs 'If not X then both Z and Y') Consistent with prior findings, language activated left-lateralized perisylvian networks. By contrast, math and logic activated left-lateralized IPS and dorsolateral frontal areas more so than the language task. Responses to math and logic were highly overlapping, both in the IPS and in prefrontal cortex. These findings suggest that part of the IPS response to symbolic math is related to formal symbol manipulation.

Topic: THINKING: Problem solving

E129 A meta-analysis study on the process of deductive and inductive reasoning using Log-Gaussian Cox Processes

Minho Shin[1], Hyeon-Ae Jeon[1], [1]DGIST, Daegu, Republic of Korea

Reasoning is a cognitive process of inferring conclusions from a given situation. Two different kinds of reasoning, deductive and inductive reasoning, were usually studied separately to examine brain regions essential to each reasoning process. Previous studies lacked a consensus on brain regions in charge, including a debate on whether inferior frontal gyrus is a core region of deductive reasoning or not. Researchers conducted coordinate-based meta-analyses to resolve the issue of inconsistent activation patterns and to compensate for low statistical power from a small sample size. However, they focused on limited types of reasoning and used conventional kernel-based methods like Activation Likelihood Estimation which make no explicit assumption on the model structure. Alternatively, we conducted a coordinate-based meta-analysis study using coordinates from 53 studies, applying an explicit spatial model called Log-Gaussian Cox Process to estimate predictive intensity maps of reasoning processes. This approach enabled us to investigate core regions of each type of reasoning and similarity of their activation pattern. From estimated posterior predictive maps of reasoning processes, we found that prefrontal cortex and posterior parietal cortex are mostly engaged in both deductive and inductive reasoning, but with different activation patterns such as higher activations in left inferior frontal gyrus during deductive reasoning process compared to inductive reasoning. Therefore, we suggest that the two types of reasoning are supported via distinct neural mechanisms.

Topic: THINKING: Reasoning

Session F

Tuesday, March 17, 8:00–10:00 am, Exhibit Hall C

F1 Distractor Reactivation with Age: Evidence for Cluttered Memory Representations

Tarek Amer[1], Joan Ngo[2], Lynn Hasher[2], [1]Columbia University, [2]University of Toronto

Reduced attentional control with age has been associated with the processing of and subsequent memory for task-irrelevant information. Although there is evidence that such irrelevant information is maintained in memory, the nature of the memory representation requires further study. Here, we present direct evidence that, relative to young adults, older adults store simultaneously presented target and irrelevant information as cluttered, bound memory representations. In particular, in a 3-stage implicit reactivation paradigm, we demonstrate that re-presenting a target item (as a partial cue) that was previously paired with a distractor spontaneously reactivates the previously associated distractor, such that it becomes more accessible than an unreactivated distractor in a subsequent implicit memory task. This study provides evidence that reduced attentional control influences both the processing and representation of incoming relevant and irrelevant information.

Topic: ATTENTION: Development & aging

F2 The frontal aslant tract (FAT) white matter microstructure differentiates young children with ADHD from typical controls

Anthony Dick[1], Dea Garic[1], Paulo Graziano[1], [1]Florida International University

Attention-deficit/hyperactivity disorder (ADHD) is typically diagnosed in early childhood, and is characterized by deficits in executive function (EF) and in motor coordination. The neurobiology of ADHD with respect to EF in young children is not well understood, though identifying biosignatures of EF deficits in ADHD could serve as indicators of treatment response, as well as inform development of future treatments. To this end, we conducted a diffusion-weighted imaging (DWI) study in 196 4-7-year-old children (69% male, Mage = 5.7 yrs, with (n = 100) and without (n = 96) a diagnosis of ADHD). We mapped a recently-defined fiber pathway known as the frontal aslant tract (FAT). Given its connectivity profile connecting the right inferior frontal gyrus with the pre-SMA/SMA, and its previous association with EF in children (Garic et al., 2019), Dick and colleagues (2019) proposed that the right FAT might be involved in the planning, sequencing, and inhibitory control of potentially conflicting motor plans for manual movements. Results of the DWI study were in line with that prediction. We found that group status (ADHD vs Control) moderated the significant association between right FAT microstructure and performance on a motor sequencing task requiring inhibitory control (i.e., the Head-Toes-Knees-Shoulders task; $p < .05$). Group status did not moderate the significant association between microstructure and performance on typical EF tasks (Flanker and Dimensional Change Card Sort). Thus, 1) the right FAT is a potential biosignature of early ADHD diagnosis, but 2) only for tasks that require inhibitory control over sequenced movements.

Topic: ATTENTION: Development & aging

F3 Potential biomarker for ASD: Reduced pupil responses to repeated multisensory stimuli in young children with autism

Jonathan Doyon[1], Ashley Darcy-Mahoney[1], Chynna Golding[1], Sarah Shomstein[1], Gabriela Rosenblau[1], [1]George Washington University

Autism spectrum disorder (ASD) is characterized by hypersensitivities to sensory stimuli which may result from deficits in habituation, i.e., encoding temporal regularities in the environment and adapting predictions accordingly. Here, we investigate whether changes in pupil dilation-decreases of pupil diameter (PD) over time-are a useful biomarker for attenuated habituation to multisensory stimuli in young children with ASD. Neurotypical (n = 27, M = 44.58 mos., SD = 14.14) and ASD (n = 7, M = 50.37 mos., SD = 15.76) participants viewed repeated audio-visual stimuli of varying complexity: from discrete beeps with continuous optic flow field to naturalistic movies. PD changes were tracked with the remote Eyelink 1000 plus tracker that allows free head movement. We extended preprocessing pipelines in the PsychoPhysiological Modeling toolbox to clean data and correct for blinks, saccades, and system artifacts. Preliminary analyses indicate larger average PDs for the ASD group relative to the neurotypical group over time, reflecting an attenuated habituation response. PD trajectories also show nonlinear (quadratic) structure across trials. A significant interaction between group and trial, reflected a faster habituation response in the neurotypical group. Significant group differences in habituation were modulated by stimulus complexity: group differences in habituation were smaller for more complex stimuli. These results provide preliminary evidence that pupillary responses can measure habituation differences between neurotypical and ASD groups. Our results also suggest that exploring stimulus dynamics and complexity through computational modeling may yield a mechanistic account of habituation deficits in ASD.

Topic: ATTENTION: Multisensory

F4 Multiple task set boundaries constrain the congruency sequence effect

Lauren Grant[1], Daniel Weissman[1], [1]University of Michigan

Control processes that adapt to recent events can operate more effectively in some contexts (e.g., ignoring a bench while jogging) than in others (e.g., ignoring a cupcake while dieting). However, the nature of these contextual boundaries remains unclear. Prior findings suggest that different sensory modalities can serve as boundaries for a popular behavioral measure of adaptive control called the congruency sequence effect (CSE). However, modality changes are often confounded with changes involving the stimulus-response (S-R) mapping. Thus, we investigated whether modality changes, S-R mapping changes, or both reduce the CSE in two experiments involving a cross-modal, prime-probe task. In this task, a 1150 ms inter-stimulus-interval (ISI) separates an initial prime from a subsequent congruent or incongruent probe. In Experiment 1, participants responded to the prime (during the ISI) and then to the probe after it appeared, such that only the common sensory modality (visual or auditory) in which these stimuli appeared could change across consecutive trials. In Experiment 2, participants responded only to the probe, such that both the sensory modality and the S-R mapping (e.g., 'respond to the probe' followed by 'do not respond to the prime') could change across consecutive trials. We observed a reduced CSE when only the sensory modality changed in Experiment 1 and no CSE when both the sensory modality and the S-R mapping changed in Experiment 2. These findings suggest that (1) the sensory modality in which task stimuli appear and (2) the S-R mapping can serve as 'task set' boundaries for the CSE.

Topic: ATTENTION: Other

F5 WITHDRAWN

F6 Effects of cognitive training on neural measures of attention, working memory, and resting-state connectivity

Hannah Morgan[1], Teague Henry[1], Cassie Ford[1], Kathleen Gates[1], Joseph Hopfinger[1], [1]University of North Carolina at Chapel Hill

Over the past few years, there has been a rise in both online cognitive training products that aim to improve cognitive abilities and debates concerning the efficacy of cognitive training. Whereas some studies suggest that cognitive training is generalizable to other tasks ('far transfer'), others have found only improvements in tasks highly similar to the trained tasks ('near transfer'). In the current study, we investigated the transfer effects of cognitive training on core cognitive networks and resting-state brain networks. Participants (N=53) completed fMRI and behavioral measures before and after six weeks of online cognitive training or six weeks of other prescribed online games. Behavioral measures showed no robust effects of training on measures of fluid intelligence, working memory, or executive control. However, in task-based fMRI analyses of the tasks that mirrored the cognitive training ('near transfer'), the cognitive training group showed more efficiency in the dorsal attentional network on the attention task; no such improvement was observed on the working memory task. In addition to examining task-based activations, we examined potential changes in functional connectivity during rest ('far transfer'), by utilizing graph-theory measures, including integration (global efficiency) and segregation (local efficiency and modularity). In the analyses of higher-order cognitive networks, there was a trending decrease in modularity for the cognitive training group after completing the training. Separate analyses of sensory-processing networks, showed no significant changes in connectivity with training, suggesting that cognitive training did not impact overall resting-state connectivity within or across sensory-processing networks.

Topic: ATTENTION: Other

F7 RAGNAROC: A computational model to describe why attentional capture only occurs sometimes

Chloe Callahan-Flintoft[1], Brad Wyble[2], Gabriella Larkin[1], Michael Geuss[1], Alfred Yu[1], Chou Hung[1], [1]US Army Research Lab, [2]Pennsylvania State University

The human visual system is often presented with a dense array of information from our complex and dynamic environment. Reflexive spatial attention is thought to be a collection of mechanisms by which the brain prioritizes some information over others for enhanced processing. This form of attention has been shown to be guided by both the bottom-up saliency of stimulus (Theeuwes, 1994) and one's top-down control settings (Folk, Remington, & Johnston, 1993). Here, we present the Reflexive Attention Gradient through Neural AttRactOr Competition (RAGNAROC), as framework by which to understand how the brain mediates between these two factors. The model uses hierarchical neural circuits specifically adapted for rapid, parallel decision making to simulate how locations of the visual field compete for attention. The result of this competition is an excitatory attractor state established at attended locations and suppression applied to others. The current work demonstrates how the model is able to account for seemingly conflicting results in the literature (i.e. how some experimental paradigms show evidence of attentional capture while others show evidence of suppression to salient distractors) by simulating both behavioral and electrophysiological patterns found in experimental data. Finally, with the introduction of augmented reality, it is now possible for artificial intelligence systems to direct a user's visual attention to task relevant locations or potential threats. RAGNAROC demonstrates how certain displays may in fact encourage the suppression of information rather than its enhancement by generating explicit predictions of users' eye movement patterns when information is overlaid on a dynamic scene.

Topic: ATTENTION: Spatial

F8 NSF Funding Opportunities for Cognitive Neuroscience

Kurt Thoroughman, NSF

F9 Contiguous locations increase reliability of parietal maps

Summer Sheremata[1], Young Seon Shin[1], [1]Florida Atlantic University

Reducing the correlation of stimulus positions protects visual retinotopic maps from artifacts known to affect properties such as the size of the spatial representation. Outside of visual cortex, however, it is not clear what properties are necessary to demonstrate map structure. In the parietal cortex spatial attention increases map reliability. While it is not clear what properties of spatial attention drive these effects, one possibility is that presenting stimuli in contiguous spatial locations serves as a spatial cue with which the stimulus can be tracked. In this experiment, we used the population receptive field (pRF) method while presenting stimuli at contiguous or discontiguous spatial locations to determine whether stimulus presentation affected the properties of spatial representations in parietal cortex. We compared the first and last runs of each stimulus presentation to estimate reliability of size and preferred location estimates. As predicted by known properties of spatial attention, contiguous spatial presentation led to greater reliability of spatial representations across parietal cortex. However, greater reliability also occurred with larger pRF sizes for contiguous as compared to discontiguous presentations. These results demonstrate contiguous stimulus presentations allow demonstrating parietal retinotopic map structure more reliably that may be collected with fewer runs despite changes in individual pRF properties.

Topic: ATTENTION: Spatial

F10 Neurodevelopment of Monetary and Social Reward Anticipation in Children and Adolescents

Tongran Liu[1], Di Wang[1], Jiannong Shi[1], [1]Institute of Psychology, Chinese Academy of Sciences

We investigated the development of monetary and social reward processes in children, adolescents and adults by employing adapted incentive delay tasks with event-related potential (ERP) recordings. The behavioral results showed that both monetary and social rewards could motivate participants' response speed, and they had higher accuracy under monetary reward condition than that under social reward condition. Individuals' behavioral performances increased with age. For the ERP data, the cue-P3, target-P2, target-P3 and feedback-related negativity (FRN) components were investigated to identify reward motivation, emotional arousal, attention allocation and feedback processing. Children and adolescents showed higher motivation (larger cue-P3) to rewards than adults. Adolescents' emotional responses to reward (target-P2) were more sensitive to social rewards than children and adults and were effectively regulated by different magnitudes of social rewards. Children showed stronger emotional reactivity for monetary rewards than for social rewards. All the age groups had higher accuracy and stronger attentional control (larger target-P3) under monetary reward condition than that under social reward condition. The present study shed the light on the neurodevelopment of reward processes from children, adolescents to adults, and varied reward process stages demonstrated different age-related and reward type-related characteristics.

Topic: EMOTION & SOCIAL: Development & aging

F11 Lateral Prefrontal Cortex-Amygdala Functional Connectivity at Rest Predicts Reappraisal Success Less in Later Adulthood

Parker Longwell[1], Youna Choi[1], Holly Laws[1], Bruna Martins-Klein[1], [1]University of Massachusetts, Amherst

Reappraisal - reinterpreting a situation to change emotional response - is an effective emotion regulation strategy that relies on cognitive control network activity, including engagement of lateral prefrontal cortex (LPFC), to attenuate amygdala activity. Greater LPFC-amygdala functional connectivity predicts instructed reappraisal task success, and daily use of reappraisal for younger adults. Greater resting-state functional connectivity (RSFC) of LPFC-amygdala is associated with cardiac biomarkers of successful emotion regulation for younger, but not older adults, but the relationship of RSFC and reappraisal task success across the lifespan has yet to be investigated. Participants from the Cambridge Center for Aging Neuroscience database (N=299, 51% Female, 18-88 years, M= 54.4, SD= 18.6) completed an 8-minute resting-state fMRI scan, and an emotion regulation task. On each trial, participants either viewed or reappraised a negative film and reported post-regulation positive affect. RSFC across bilateral amygdala and right LPFC was calculated with Matlab's CONN Toolbox. Regression analyses revealed main effects of greater curvilinear age (B= 0.004, SE= 0.001, p< 0.001), and greater negative right LPFC-amygdala RSFC with positive affect (B= -0.419, SE= 0.159, p=0.009). A significant interaction was found between Age x RSFC, in which right LPFC-amygdala RSFC was less predictive of positive affect with increasing age (B= 0.009, SE= 0.004, p=0.022, R2 = 0.700). Findings suggest that LPFC-amygdala RSFC can predict regulation ability in younger, but not older adults. Future research should explore if older adults rely on differing neural networks, and examine effects of task-based connectivity can predict reappraisal success in later life.

EMOTION & SOCIAL: Development & aging

F12 fMRI of aesthetic experiences with landscape videos

Ilkay Isik[1], Edward A. Vessel[1], [1]Max Planck Institute for Empirical Aesthetics

Humans regularly derive pleasure from visual experiences, even when not associated with primary rewards. Such 'aesthetic' experiences with artworks, performances or natural settings unfold in time, yet most of what is known about the psychological and neural basis of such experiences comes from studies with static images (paintings, photography, landscape). Previous imaging studies with artworks suggest that aesthetically pleasing experiences modulate activity not only in subcortical reward regions (ventral striatum), but also in portions of the ventral visual pathway and the default-mode network (DMN). We investigated behavioral and neural responses to temporally extended, aesthetically engaging stimuli (videos), using fMRI in combination with continuous behavioral ratings. Participants (n=26) were scanned as they viewed 40 video clips of landscapes (30 s) and indicated their moment-to-moment liking, as well as a final summary rating at the end of each clip. Category-selective visual regions in ventral occipitotemporal cortex (e.g. Parahippocampal Place Area, Fusiform Face Area) were identified using a functional localizer scan, and core regions of the DMN were identified using a 'rest' scan, in each individual. A parametric regression analysis of the fMRI data using overall ratings as regressors revealed sensitivity to aesthetic appreciation in several scene selective regions (Parahippocampal Place Area, Retrosplenial Cortex and Occipital Place Area) as well as ventral striatum and inferior frontal sulcus, but not in the DMN. These results suggest that aesthetically pleasing landscape videos may modulate a wider network of higher-level visual regions than their static counterparts and rely less on top-down information for their aesthetic appeal.

Topic: EMOTION & SOCIAL: Emotional responding

F13 A critical role of the rTPJ in empathic and prosocial responses to sad and fearful events: a 1-Hz rTMS study

Shin Ah Kim[1], Jae Hyun Kim[1], Sang Hee Kim[1], [1]Korea University

The right temporo-parietal junction (rTPJ) plays a critical role in perspective-taking and understanding others' emotional states. Although functional neuroimaging studies also highlighted activations in the rTPJ during prosocial decision-making, the direct relationship between the rTPJ and prosocial decision has been less frequently investigated. The present study aimed to investigate the causal role of the rTPJ in eliciting empathy and prosocial intention by temporarily disrupting neural activity in the rTPJ using low-frequency repetitive transcranial magnetic stimulation (rTMS) techniques. Nineteen healthy adults participated in two sessions of 1-Hz rTMS and sham stimulation over the rTPJ, separated by 1 week. Following each stimulation, participants viewed a series of video clips made of excerpts from movies or tv dramas, which were divided into 3 emotional categories: fearful, sad, and neutral. Both fearful and sad clips depicted characters who suffered from threatening events, such as house on fire, and sad events, such as family separation, respectively. At the end of each video clip, participants rated empathic concern, personal distress, and helping intention, elicited by each clip. Results revealed that rTMS disruption of the rTPJ resulted in significant reduction of empathic concern and helping intention in response to sad clips relative to sham stimulation to the rTPJ. No 1-Hz rTMS dependent changes were found for fearful clips. These results suggest potentially different roles of rTPJ-dependent perspective-taking in generating empathic responses and prosocial motivations for others experiencing sad and fearful events.

Topic: EMOTION & SOCIAL: Emotional responding

F14 Predicting Depression from Speech Recordings: A Machine Learning and Feature Selection Approach

Siamak Sorooshyari[1], Thomas Van Vleet[2], Alit Stark-Inbar[2], Heather Dawes[3], Deanna Wallace[3], Morgan Lee[3], Michael Merzenich[2], Edward Chang[3], Mor Nahum[4] [1]UC Berkeley, [2]Posit Science, [3]UC San Francisco, [4]Hebrew University of Jerusalem

Features of recorded speech have been shown to be predictive of depression severity. However, little consensus exists on the appropriate combinations of voice features that should be used to successfully identify depression. The current study sought to find the voice features most relevant for an accurate classification of depression. Voice recordings and depression ratings (PHQ-9 scores) were remotely collected from 49 adult participants. Prosodic, phonetic and spectral voice features were extracted using two software packages: Praat and openSMILE. A support vector machine (SVM) was trained on various combinations of the voice features, and their accuracy in depression classification was evaluated. A leave-one-out (LOO) cross-validation analysis was used to assess the predictive capability of our methodology. Comparison between the performance attained with Praat and openSMILE showed that the optimal Praat set yielded nearly equivalent performance to the optimal openSMILE set using a significantly fewer number of features. The results support the importance of pruning the feature space prior to training a machine learning algorithm, as a larger number of features does not necessarily result in superior classification. Collectively, these results provide encouraging evidence for remotely recorded speech as an effective means of predicting depression.

Topic: EMOTION & SOCIAL: Emotional responding

F15 Reframing anxiety: how domain anxieties affect performance on cognitive tasks framed as domain-specific

Griffin Colaizzi[1], Richard Daker[1], Ariana Mastrogiannis[1], Adam Green[1], [1]Georgetown University

Educationally relevant anxieties have been shown to impact performance in specific educational domains. For example, math anxiety is associated with underperformance in and avoidance of math and careers that involve math (Hembree, 1990; Dowker et al., 2016). Creativity anxiety (i.e., anxiety specific to creative thinking) has recently been shown to exist across diverse content domains, affecting creative thinking and performance in everything from music to science, and predicts individual differences in creative achievement (Daker, Cortes, Lyons, and Green, 2019). We hypothesized the negative performance effects associated with domain anxieties could be ameliorated by reframing problems as being unrelated to the domain of an individual's anxiety. To test this hypothesis, we paired administration of three cognitive measures that are not strongly tied to math or creativity, with instructions indicating that the task was either math-related, creativity-related, or neutral. We predicted that individual differences in domain-specific anxiety would interact with instruction type such that individuals would perform worse when a task was described as relevant to their anxious domain and better when it was not. In addition to measuring task performance, we collected physiological measures of anxiety (autonomic arousal) using psychophysiology apparatus. Consistent with our prediction, we found impacts of both the type and level of individual anxiety and effects of instruction type on both behavioral and physiological outcomes. These findings have potential implications for education, as educators might effectively ameliorate domain anxieties by changing how a topic is presented or framed for students.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

F16 Does Threat of Shock Distinctively Modulates Reactive and Proactive Cognitive Control?

Salahadin Lotfi[1], Richard Ward[1], Madeline Rech[1], Maryam Ayazi[1], Christine Larson[1], Hanjoo Lee[1], [1]University of Wisconsin-Milwaukee

The Dual Mechanism of Control theory proposes two distinct mechanisms to regulate goaldriven behavior: (a)proactive control(PC) aimed at preemptively modulating the processing of the target stimulus, and (b)reactive control(RC) aimed at adjusting attentional control in response to the unexpected stimulus. Using a context manipulation design of a modified Flanker task in a two-phase study, we examined behavioral and neural correlates of PC and RC under safe and threatening conditions. In safe conditions, we found evidence of both modes across three different domains: 1)Behaviorally, PC was dominantly activated during high distraction, resulting in faster reaction time(RT) compared to RC. 2)The ERN's amplitude (as an index of cognitive effort arising from conflicted errors) was highest in PC compared with RC, attesting that PC preemptive mode of attention control was in operation in anticipation of forthcoming distractors with larger cognitive efforts. 3)And prestimulus frontalmidline Theta band activities (an index of preparative efforts for top-down attention control) was largest for PC, to facilitate distractors filtering. Taken together, relative to RC, although PC is cognitively more demanding as shown by neurophysiological evidence, its recruitment can significantly benefit behavior in safe conditions. Adding the threat of shock, we found evidence of enhanced accuracy and reduced RT across both RC and PC with magnified ERN amplitudes for all conditions, indicating that cognitive effort was increased for both modes. Prestimulus Theta was equally similar for RC and PC, highlighting the heightened anxious state has broad impacts on both modes of cognitive control

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

F17 Decreased Inhibitory Control Activity in Veterans with Post-Traumatic Stress Disorder (PTSD) during Emotion Regulation

Bruna Martins-Klein[1], Jasmeet P. Hayes[2], [1]University of Massachusetts-Amherst, [2]The Ohio State University

Emotion dysregulation and hyperarousal are core deficits of Post-Traumatic Stress Disorder (PTSD). Reappraisal and suppression are two well-studied emotion regulation strategies that decrease amygdala activation to emotionally intense stimuli. However, little is known regarding the neural activity involved for these regulatory strategies in PTSD. In this study, we explored neural differences use of reappraisal and suppression in PTSD with fMRI. Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) Veterans with PTSD (n=15) and trauma-exposed controls (n=18) underwent fMRI during an emotion regulation task. Veterans viewed negative images, and were cued to passively view or actively regulate their emotion via detached reappraisal or suppression of facial expression, and rated post-regulatory intensity. We found that the PTSD group had lower activity than the controls during both strategies (relative to passive viewing) in regions of the right putamen, right Inferior Frontal Gyrus (IFG), and Supplementary Motor Cortex (SMA). No significant self-reported differences were found across groups in intensity ratings. Findings also showed a significant association between greater activity in the right putamen and emotion regulation success (more positive post-regulatory emotion ratings). Results support that patients with PTSD have difficulty recruiting brain regions that support emotion regulation and inhibitory control. A potential consequence of this decreased control activity is failure to inhibit salience regions of the brain associated negative emotion and expression, such as the amygdala and insula. Future studies should determine whether failure of regulatory brain regions observed in this study is a reliable biomarker of emotional dysregulation and emotional hyperarousal in PTSD.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

F18 Joint Effects of Self-Referencing and Emotion on Memory in Aging and aMCI

Nishaat Mukadam[1], Katelyn Parisi[1, 2], Eric Fields[1, 2], Ryan Daley[2], Andrew Budson[3], Elizabeth Kensinger[2], Angela Gutchess[1], [1]Brandeis University, [2]Boston College, [3]VA Boston Healthcare System

Memory decline is a common occurrence in cognitively healthy older adults (OAs) and is even more prominent in people with amnestic mild cognitive impairment (aMCIs). Certain types of information, such as information that is related to the self (self-reference effect) or that which is emotional (emotional enhancement effect), can enhance memory performance, but there has been little work considering the joint influence of these processes, particularly with aMCI. In our study, 28 OAs and 22 aMCIs participated in an incidental encoding task where they read a series of emotionally valenced (positive or negative) or neutral sentences in a first-person or third-person frame. They later completed recall and recognition tasks for these sentences. Both self-referencing (first-person frame) and emotion increased memory performance in the recall and recognition tasks among both groups. Although both groups similarly benefitted from emotion on the recall task, the effects differed by valence on the recognition task. OAs exhibited better memory for both positive and negative information over neutral information whereas aMCIs showed enhanced memory for positive information only. These results suggest that emotion can boost memory both when information is self-referential and when it is not, although memory in aMCI may benefit most from positive emotional content.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

F19 Aversive Distracter Words and Working Memory Filtering

Richard Ward[1], Sofia Mattson[1], Joseph Kornkven[1], Salahadin Lotfi[1], Han-Joo Lee[1], Christine Larson[1], [1]University of Wisconsin - Milwaukee

Threatening stimuli attract attention, even when they are task-irrelevant. Prioritization of this threatening information can yield negative consequences on downstream cognitive systems. For example, prior evidence shows that threatening stimuli are inefficiently filtered from working memory, and that this effect is enhanced in individuals with anxious traits. Based on previous literature demonstrating that negative words also attract attention, we aimed to investigate the effects this attentional bias has on working memory filtering. We recorded the contralateral delay activity (CDA), an event-related potential that indexes the number of items retained in working memory, as participants completed a lateralized change detection task using word stimuli. This task contained four main conditions: one target, two targets, one target and one neutral distracter, and one target and one aversive distracter. The two distracter conditions allow for assessment of the ability to filter task-irrelevant distracter stimuli. Our current results (n = 18) revealed no differences in filtering efficiency across both behavioral and CDA measures. Despite the lack of group level filtering effects, we observed individual differences in filtering of aversive words as a function of self-reported intolerance of uncertainty (IUS). Specifically, individuals with higher scores on the IUS unfairness subscale showed reduced filtering efficiency of aversive. In contrast, individuals with higher scores on the IUS negative subscale showed increased filtering efficiency for aversive words. These results suggest that individual differences in IUS may modulate one's ability to efficiently filter aversive distracter words from working memory.

Topic: EMOTION & SOCIAL: Emotion-cognition interactions

F20 Neural Differences in Hypoactive Sexual Desire Disorder: An ERP Microstate Study

SungJun Cho[1], Wasuwat Siewsrichol[1], Stephanie Cacioppo[1], [1]University of Chicago

The top-down neurofunctional model of hypoactive sexual desire disorder (HSDD) proposes that specific cognitive processes such as self-inspection and personal evaluation interfere with sexual desire of patients prior to or during their sexual activities (Cacioppo, 2017). Supporting this model, recent neuroimaging studies comparing controls and HSDD patients show stronger neural activation in self-referencing neural network of patients. However, limited studies have been done on identifying neural differences between pre- and post-menopausal HSDD patients. ERP data from HSDD-diagnosed premenopausal (PREM; n=20) and postmenopausal women (POSTM; n=10) were recorded while participants performed Desire Intention Task (DIT). Two common and three discrete microstates, with maximum threshold of 11x10^(-12) pA/m, were measured for between-group analysis of PREM and POSTM using Chicago Electrical Neuroimaging Analysis (CENA). PREM had an additional microstate compared to POSTM with mean GFP (graded field power)=2.66µV and standard deviation=0.27µV. Activated brain regions of corresponding microstates were further source reconstructed into 3-dimensional spatiotemporal image from ERP time series and analyzed by power spectral analysis and Freesurfer's Desikan-Killiany atlas. Both groups revealed high activation in superior temporal gyrus (self-other mental association) and fusiform gyrus (face and body processing), consistent to Cacioppo et al. (2017). Activation in PREM showed close association with prefrontal cortex and bilateral temporal lobes. Both microstate analysis and source localization suggest PREM patients tend to overthink about their sexual desire and associated decisions more than POSTM. Conversely, POSTM lacked extra microstate that is highly involved with prefrontal cortex and showed distributed activation across occipital, temporal, and parietal lobe.

Topic: EMOTION & SOCIAL: Other

F21 Cortisol and Experiences of Discrimination Modulate Medial Temporal Lobe Structures in Older Adults

Michael Rosario[1], Amara Ayoub[1], Razan Alotaibi[1], Karin Schon[1], [1]Boston University School of Medicine

The medial temporal lobes (MTL) are modifiable by experience. Animal models have shown structural changes in the amygdala and hippocampus associated with environmental enrichment and chronic stress. These MTL regions modulate the hypothalamic-pituitary-adrenal (HPA)-axis, which regulates the stress response. Experiences of discrimination (EoD; e.g., sexism, racism, ageism) are chronic psychosocial stressors that affect physical and mental health. Cumulative stress may alter the body's ability to regulate the physiological stress response. Limited insight exists on the impact of chronic EoD on the MTL in older adulthood. Previous research has shown aberrant amygdala activity related to EoD, however, structural brain changes have not been examined. We collected salivary cortisol from 30 participants (55-86 years, 56% female, 16% African American) to evaluate HPA-axis function. T1-weighted structural MR images captured on a 3T Philips Achieva were analyzed using FreeSurfer's automatic segmentation to evaluate relationships between EoD scores and left and right hippocampus and amygdala volumes. Multiple regression models showed a striking association between left amygdala volume and salivary cortisol (ug/dL) ($p < .0003$, $t(24) = 4.282$) and left amygdala volume and EoD scores ($t(24) = -4.073$, $p < 0.0004$). Additionally, the results showed an association between salivary cortisol and right hippocampal volume ($t(24) = 2.915$, $p < 0.00759$). Our results extend previous work to structural MTL integrity in the aging brain and suggest structural changes in the MTL associated with cumulative psychosocial stress could underlie cognitive deficits seen in older adulthood. Future research will examine associations with MTL-dependent episodic memory performance.

Topic: EMOTION & SOCIAL: Other

F22 Normalizing Anomalies with Mobile Exposure (NAME): A novel intervention for reducing implicit biases

Nadir Bilici[1], Clifford Workman[1], Stacey Humphries[1], Roy Hamilton[1], Anjan Chatterjee[1], [1]University of Pennsylvania

This pre-registered study used a smartphone-based intervention to test the hypothesis that implicit biases are attributable to a lack of exposure to the groups targeted by such biases. We predicted that exposure to people with facial anomalies would reduce implicit biases, and that this reduction would be greater than reductions for people of color (POC) since exposure to POC is more common than to facial anomalies. Forty participants completed Implicit Association Tests (IAT) before and after an exposure intervention (to anomalous faces or to POC, N=20 per intervention). In the first IAT, participants associated faces with and without anomalies with good and bad words. In the second, faces were either white or POC. In the intervention (twice per day over 5 days), they saw 10 faces. Then, they saw an additional face paired with a story about a time this person behaved prosocially. Finally, participants rated their feelings and indicated whether they found it easy to take the person's perspective. Across all participants, there was a significant main effect of time. For the anomalous faces intervention, there was an additional main effect of bias-type (anomalous or POC), with steeper reductions in implicit biases against anomalous faces than POC. Dispositional empathy (perspective taking) predicted the magnitude of reduction in implicit biases against anomalous faces but not POC. For the POC intervention, no main effects or interactions were significant. These results demonstrate the specificity of the Normalizing Anomalies with Mobile Exposure (NAME) intervention in reducing implicit biases against people with facial anomalies.

Topic: EMOTION & SOCIAL: Person perception

F23 Validating an fMRI task for assessing theory of mind in clinical populations: Neural response to and clinical correlates

Emily Dudek[1], Bridget Shovestul[1], Abhishek Saxena[1], J. Steven Lamberti[1], David Dodell-Feder[1], [1]University of Rochester

Theory of mind (ToM)-the ability to infer the mental states of others-is foundational for our ability to successfully navigate the social world. When impaired, our social lives are negatively impacted. Indeed, ToM and its neural basis is impaired in psychiatric disorders involving social functioning deficits, most notably, schizophrenia. Due to ToM's impact on functional outcomes, these social impairments have become targets for intervention. In order to understand the mechanisms contributing to these deficits and assess the impact of interventions, it is necessary to have validated measures to assess these neural impairments and their improvements over time. Despite hundreds of neuroimaging studies investigating the theory of mind network, few tasks have been empirically validated and made efficient for fMRI. Recently, the 'Why/How Task' (Spunt & Adolphs, 2014), in which participants are asked yes/no questions about social and nonsocial photos, has been shown to be one such task for localizing theory of mind regions. Here, we present findings from the first clinical application of the Why/How Task in a sample of people with schizophrenia compared with healthy controls. Using a priori regions of interest, preliminary results show hyperactivation among people with schizophrenia in regions such as the right and left temporoparietal junction and the ventromedial prefrontal cortex. Additionally, we find that the extent of these differences correlate with aspects of social ability. These findings demonstrate the clinical validity and utility of the Why/How Task for use in clinical studies of social dysfunction and its treatment.

Topic: EMOTION & SOCIAL: Person perception

F24 Effects of interactive social context on visual attention to social partners

Ashley Frost[1], Nohely Gonzalez[1], Brynna Pechous[1], Katherine Warnell[1], [1]Texas State University

Social neuroscience research involving eye-tracking predominantly examines attention to static faces or prerecorded dynamic stimuli. Recent evidence suggests that live context influences gaze behavior, but few studies have directly compared how different social contexts alter social attention. This study used a well-controlled within-subjects design to compare gaze across three contexts: (1) face-to-face, (2) webcam-based interactions, and (3) prerecorded videos. In all contexts, participants (N=52) were eye-tracked during a two-turn interaction with a confederate where participants spoke freely for one minute on a pre-selected neutral topic before listening to the confederate speak for one minute about a similar topic. Participants also completed measures of personality and anxiety. We hypothesized that context would influence attention to the social partner's face and that more naturalistic contexts would better predict real-world traits. A three-way repeated measures ANOVA found significant main effects for context (live, webcam, prerecorded), speaker role (talker, listener), and region (eyes, mouth). Overall, participants looked at the eyes roughly three times more than the mouth, engaged in more face-looking when listening than talking, and showed the most attention to their partner's face in the live condition. No interaction terms were significant. Increased eye-looking in contingent (i.e., webcam, live) but not video interactions related to increased extraversion. In contrast, social anxiety related to reduced eye-looking in only webcam and video exchanges. Our systematic comparison between contexts underscores the importance of naturalism in social neuroscience and suggests that the clinical utility of eye-tracking measures may be improved by considering contingent, face-to-face paradigms.

Topic: EMOTION & SOCIAL: Person perception

F25 Perspective taking reduces group biases in neural motor resonance

Jeremy Simon[1], Yanyi Jiang[1], [1]Brandeis University

Similar neural circuits are activated during movement and the observation of movement and this motor resonance is thought to support action understanding and social coordination. Previous research shows that group biases can restrict motor resonance to the ethnic ingroup, with potential negative consequences for intergroup encounters and relations. We tested whether an empathic mindset can alleviate such group biases in motor resonance. Participants (n = 48) were told to adopt either an objective mindset or an empathic mindset while writing about a racial outgroup member and were then shown videos of ingroup and outgroup members performing a simple motor movement while electroencephalographic (EEG) recordings were taken. Motor resonance was measured as suppression of mu-wave oscillations (8-13 Hz) above left sensorimotor areas (electrode C3). Mindset and target group membership interacted such that participants resonated most with outgroup targets whose perspectives they took, suggesting that taking the perspective of an ethnic outgroup member can reduce group biases in motor resonance, potentially fostering an intuitive understanding across groups. In addition, participants taking the perspective of an outgroup member were less prejudiced and prejudice moderated the effect of group on resonance. Higher prejudice participants actually resonated more with outgroup targets, perhaps because outgroups' motivational relevance increases with prejudice. These results suggest that attitudes do influence group biases in resonance and that taking an empathic mindset can affect both attitudes and neural motor resonance.

Topic: EMOTION & SOCIAL: Person perception

F26 Large-scale Network Connectivity as a Predictor of Age: Evidence Across the Lifespan from the Cam-CAN Dataset

Meghan D Caulfield[1], Irene P Kan[1], Evangelia G. Chrysikou[2], [1]Villanova University, [2]Drexel University

Changes in the functional architecture of the brain-particularly increased coupling between executive cognitive control regions (EC) and the default mode network (DMN)-have been recently theorized to underlie shifts in cognitive abilities between young and older adults (Spreng & Turner, 2019). A prioritization of fluid cognition in young adulthood progressively gives its place to crystalized knowledge and an emphasis on semantic cognition in older adulthood, shifts that take place along with changes in functional connectivity between EC and DMN areas. In line with this model, here we used a large cohort (N = 530) of participants from the Cam-CAN database (18 - 88 years old) to examine whether resting-state functional connectivity between executive and default mode networks predicts participant age. In extension of past work, we further examined how connectivity between EC, DMN, and salience network regions impacts the hypothesized increased connectivity between EC and DMN areas as a result of aging. A series of multiple regression analyses revealed that connectivity between dorsolateral and ventromedial prefrontal cortex and parietal regions, including the precuneus, accounted for a significant portion of age variability and that the inclusion of the salience network improved the models' explanatory power. Follow-up analyses by age cohort further highlighted that these relationships dynamically change across the lifespan. We discuss these findings in the context of the default-executive coupling hypothesis for aging and propose avenues for future research in refinement of this model.

Topic: EXECUTIVE PROCESSES: Development &aging

F27 Age-related decline in resting state brain signal variability: Cause and Consequences

Poortata (Pia) Lalwani[1], Douglas Garrett[2], Thad Polk[1], [1]University of Michigan, Ann Arbor, [2]Max Planck UCL Centre for Computational Psychiatry & Ageing

Brain signals as measured by fMRI vary considerably from moment-to-moment even in the absence of any task and this variability declines with age. However, there are significant individual differences in the brain signal variability. What are the behavioral consequences of these differences and what is their neurochemical basis? Based on computational and animal research we hypothesized that individual differences in GABA (the brain's major inhibitory neurotransmitter) might play a critical role. In order to investigate this hypothesis, we recruited 50 older and 50 young adults and measured 1) brain signal variability using resting-state fMRI, 2) GABA levels using MR Spectroscopy in the bilateral ventrovisual, auditory and somatosensory cortex, and 3) behavioral performance on standardized fluid processing tasks from the NIH toolbox. We also pharmacologically manipulated GABA activity in a subset of our sample by administering lorazepam (a benzodiazepine, known to potentiate GABA activity). We found that whole-brain signal variability was significantly lower in the older adults and was significantly associated with their fluid processing ability. GABA levels in the visual, auditory and somatosensory cortex were also reduced in the older group and were associated with brain signal variability even after controlling for age and tissue-composition. Finally, potentiating GABA activity with lorazepam significantly increased brain signal variability relative to a placebo. These results are consistent with the hypothesis that age-related declines in GABA levels cause age-related declines in brain signal variability which in turn contribute to individual differences in fluid processing abilities among older adults.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F28 Dimensional Label Learning: A Building Block for Later Dimensional Attention

Kara Lowery[1], Bhoomika Nikam[1], Aaron Buss[1], [1]University of Tennessee

Previous research suggests learning labels for visual features is a building block of dimensional attention, known as the dimensional label learning (DLL) hypothesis. A model of the dimensional change card sort task (DCCS) investigated this hypothesis by demonstrating that strengthening label-visual feature associations (increased frontal-posterior connectivity) led to better performance. Our goal was to explore this hypothesis longitudinally from 33- to 45-months of age. We investigated activation while children performed dimensional label (DL) tasks for colors, shapes, embedded shapes and three task types (production, comprehension, matching). We used functional near-infrared spectroscopy (fNIRS) to measure from left frontal, left temporal-parietal, and right parietal regions previously implicated in dimensional attention. Clusters were thresholded at a value of F=7.54, p

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

F29 Contributions of task set inertia and task set preparation on voluntary task selection

Joseph M Orr[1], Michael J Imburgio[1], [1]Texas A&M University

Most theories describing the cognitive processes underlying task switching allow for contributions of active task-set reconfiguration and task set inertia. Manipulations of the Cue-to-Stimulus-Interval (CSI) are generally thought to influence task set reconfiguration, while Response-to-Cue (RCI) manipulations are generally thought to influence task set inertia (i.e., proactive interference from the previous task-set). However, these theories do not adequately account for the processes underlying voluntary task selection, because a participant can theoretically prepare for an upcoming trial at any point. To this end we used drift diffusion models to examine the contributions of reconfiguration and task set inertia in 216 undergraduate students who performed either cued or voluntary task switching paradigms. In both paradigms, CSI manipulations primarily affected preparation on switches; however, longer CSIs did also facilitate preparation on repeats, suggesting CSI manipulations might influence general task set preparation rather than just reconfiguration. In the voluntary condition, RCI manipulations also facilitated preparation (captured by model parameters) when CSI was short. In both paradigms, RCI manipulations also affected task set inertia, and these effects were primarily on repeat trials. The results suggest that drift diffusion models can measure contributions of inertia and preparation to task switching performance, including identifying preparation that occurs outside of the CSI in voluntary switching. The results also suggest that reductions in switch cost caused by reduced inertia might be more related to impeding repeat performance rather than facilitating switch performance. Future work should attempt to link these effects to related brain networks.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

F30 Neural Processes Underlying Context-Sensitive Cognitive Flexibility Adjustments

Audrey Siqi-Liu[1], Tobias Egner[1], Marty Woldorff[1], [1]Duke University

Adaptive behavior requires finding, and adjusting to, an optimal tradeoff between focusing on a current task-set (cognitive stability) and updating that task-set when the environment changes (cognitive flexibility). Such dynamic adjustments of cognitive flexibility are observed in cued task-switching paradigms, where switch costs (the slowing in response time for switch relative to repeat trials), decrease as the proportion of switch trials in a block increases. However, the neural underpinnings of this block-proportion switch effect are not well understood. Here, we recorded 64-channel EEG as participants switched between letter and digit categorization tasks based on a cue preceding each trial. We investigated event-related potentials (ERPs) time-locked to the cue and to the target to reveal the neurocognitive processes that culminate in the observed final response-time differences that characterize the block-proportion effect. The cue-locked analyses replicated some previous findings of an early, anterior, switch-related ERP negativity. Crucially, this switch-related negativity was larger in the high-switch-proportion blocks, suggesting it may be associated with the recruitment of control processes to reduce switch costs. Our novel target-locked analyses found that repeat trials elicited larger attention-shift-sensitive N2pc's compared to switch trials, indicating that the detection of and orienting to the relevant target may be easier on repeat trials. This effect was mainly driven by low-switch-proportion blocks and diminished in high-switch-proportion blocks, along with the behavioral advantage for repeat trials. These results provide insight into the series of top-down and bottom-up control processes that are recruited during the implementation of effective control of cognitive flexibility.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

F31 Changes in the Nature of Associations between Internalizing Symptoms and Inhibitory Control from 3 to 5 Years of Age

Caroline Howell[1], Brenna Martinez[1], Helen Day[1], Sophia Merelas[1], Rosalind J. Wright[2], Michelle Bosquet Enlow[1], [1]Boston Children's Hospital, [2]Mount Sinai Hospital

Emotional and cognitive functioning may bidirectionally influence each other over childhood, with the nature of the association changing with development. The goal of this study was to test associations among internalizing symptoms, specifically anxiety and social withdrawal, and executive functioning, specifically inhibitory control, in a sociodemographically diverse cohort (N=114) of children at 3.5 and 5 years of age. At both ages, children completed a Go/No-go task to assess inhibitory control, and their mothers completed the Child Behavior Checklist (CBCL), which provided measures of child anxiety and withdrawal symptoms. Across ages, inhibitory control scores showed moderate stability, whereas anxiety and withdrawal symptoms showed relatively low stability. At 3.5 years of age, increased anxiety and withdrawal symptoms were each associated with poorer inhibitory control, specifically as reflected in the inhibition of incorrect responses (sensitivity ranxiety= -0.217, rwithdrawn= -0.209; percent correct NoGo ranxiety= -0.212, rwithdrawn= -0.231). At 5 years of age, these associations were no longer significant and trended toward the positive direction; moreover, the differences in the correlation coefficients at 3.5 vs 5 years of age were significant for the associations of both anxiety and withdrawal symptoms with inhibitory control. These findings suggest that the nature of the association between internalizing symptoms and inhibitory control may change over early childhood. These findings have implications for how we conceptualize the development of inhibitory control in early life and how this executive functioning ability may relate to internalizing difficulties across early childhood.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

F32 Reward prediction error is modulated by cooperation in group task

Chikara Ishii[1], Jun'ichi Katayama[1],[1]Kwansei Gakuin University

Computation of reward prediction error (RPE) is a vital processing for adaptive survival. The present study investigated the process in a time-estimation task with three people using simultaneous EEG recording. In experiment 1, we compared groups of three participants with individual participants. The task

was to accurately estimate one second intervals and participants were rewarded with 10 JPY per trial, if the majority (at least two out of three) responded correctly (otherwise they lost 10 JPY). Consequently, the performance of an individual would affect the amount of rewards of all members in the group. For individual condition, responses by other members were simulated by a computer. A visual indicator displayed who responded correctly, and EEG was recorded from outcome onset for all participants. Epochs were averaged over outcome (correct, error) and trial type (uniform, majority, minority) within subjects, and between condition (group, individual). Difference FRN (error ? correct ERP) for uniform-trial (i.e., all collect or error) was larger than those for majority- and minority-trials in the group condition, but not in the individual condition. In experiment 2, we investigated whether the effect was driven by group cooperation or simply the presence of others. Here, participants' individual performance did not affect others' reward. Difference FRN for all trial types did not differ with each other. These results suggest that the presence of others' is not enough to modulate the RPE.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

F33 Neurophysiological Responses in Prefrontal Regions Differ Between Musicians and Non-Musicians

Benjamin Schwartzmann[1], Prabhjot Dhami[2], Sylvain Moreno[1], Faranak Farzan[1], [1]Simon Fraser University, [2]University of Toronto

Neuroscience research has shown that musical training is associated with extensive structural and functional neuroplasticity. Differences between musicians and non-musicians have been found in several areas of the brain, including motor-related cortices, as well as in areas involved in executive functioning, particularly the frontoparietal regions. However, how musical training may influence the neurophysiology of these specific regions has yet to be investigated. Here, we used transcranial magnetic stimulation (TMS) in conjunction with electroencephalography (TMS-EEG) to examine neurophysiological differences between musicians and non-musicians. Single pulse TMS-EEG was employed to assess cortical reactivity in bilateral dorsolateral prefrontal cortex, bilateral motor cortex, and bilateral intraparietal lobule. More specifically, we focused on the N100 and P200 TMS-evoked potentials (TEPs), which have been shown by prior literature to be indices of cortical inhibition and excitability. To gain insight into whether these neurophysiological measures are linked to inhibitory control, we correlated these TEPs with behavioral performance scores on an inhibitory control-related task. We also investigated how the neurophysiological correlates of inhibitory control might differ between musicians and non-musicians. We specifically examined the N2 and P3 event-related potentials (ERPs), which are neurophysiological responses occurring during successful inhibitory control. Musicians were found to exhibit differences in neurophysiological-related inhibition and excitability measures in the prefrontal regions, but not in motor-related cortices and parietal cortices. Musicians were also found to exhibit greater negativity of the N2 ERP, suggesting that musical training may alter the neural correlates of inhibitory control.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

F34 Neural correlates of response inhibition in young children

Lauren Wade[1], Carolyn Rasmussen[1], Elizabeth daSilva[1,2], Columbus Bennett Bertenthal[1], [1]Indiana University, [2]Purdue University

In this study, we examined the amplitude of the N2 event-related potential during a Go-NoGo task to better understand the emergence of response inhibition during the late toddler/early preschool period. Twenty-one 3-year-olds (M= 38.4 months, SD = 2.09 months; 10 males) completed a Go-NoGo task while electroencephalography was continuously recorded from a 64-channel EGI sensor net. Accurate, artifact-free trials were retained for analysis; on average, participants contributed 63 Go trials and 25 No-Go trials. Parents also completed the Child Behavior Questionnaire (Rothbart & Bates, 2006) to assess individual differences in temperament between children. N2 amplitudes were analyzed across frontal, central, and parietal clusters along the midline and in the left and right hemispheres. The N2 amplitude was larger for NoGo compared to Go trials across frontal and central sites, $F(1,20) = 5.46$, $p = 0.03$, particularly in the right hemisphere, $F(2,40) = 3.34$, $p < 0.05$. The magnitude of the N2 difference between Go and NoGo trials in the frontal right region was negatively associated with parental reports of toddler's inhibitory control, $r(18)= -0.55$, $p = 0.02$; children with lower inhibitory control showed more negative N2 amplitudes and a larger N2 difference between trial types. These results extend previous research supporting the N2 as a neural marker of response inhibition (e.g. Buss et al., 2011, Lamm et al., 2006, Hoyniak & Petersen, 2019) by 3-year-olds and suggest that parental reports of children's temperament are associated with differences in neural processing.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

F35 The Central Executive Network in Schizophrenia: A Meta-Analysis of Structural and Functional MRI

Katrina Daigle[1], Malvina Pietrzykowski[1], Abigail Waters[1], Lance Swenson[1], David Gansler[1], [1]Suffolk University

The neural structural and functional architecture of executive functions (EF) are of considerable interest given the strong clinical utility of EF as transdiagnostic predictors of adaptive functioning. Importantly, there is a gap in the meta-analytic literature assessing this relationship in neuropsychiatric populations, the concordance between structural and functional architecture, and the relationship of neuropsychological assessment of EF. Given the core EF deficits and neural abnormalities observed in individuals with Schizophrenia (SCZ), this serves as a useful population from which to understand this relationship. We conducted a meta-analysis of published studies (k=529) to elucidate the relationship between EF and central hubs of the central executive network (CEN) in vivo for structural (k=127; N=8) in SCZ (n=229) adults, and for functional (k=402; N=4) in SCZ (n=104) adults. To calculate mean effect sizes and confidence intervals (CIs) for the relationship between both functional and structural and neuropsychological assessment measures of EF, random effects modeling was used. Results revealed concordance in the brain behavior relationship between functional and structural measures such that larger size (r=.57, 95% CI=.26-.75) and greater BOLD activation (r=.54, 95% CI= .21-.99) were both associated with better performance on measures of EF. These results indicate that, when assessing the relationship between brain and EF behavioral performance, both structural and functional imaging, when taken in the CEN, are similarly predictive of EF performance. Findings are impactful in the context of methodological decisions in multi-modal neuroimaging research.

Topic Area: EXECUTIVE PROCESSES: Other

F36 Learning Preferences as an Index of Individual Differences in Cognitive Flexibility

Hayley O'Donnell[1], Evangelia G Chrysikou[1], [1]Drexel University

Recent findings suggest that when solving problems involving cognitive flexibility (CF), individuals who approach a learning task using exploration, outperform those who approach the task using exploitation. Based on these data, we hypothesized that CF is a function of individual differences in learning preference and task demands. In an initial behavioral study, healthy native English speakers were administered three CF tasks that incorporated (i) shifting, (ii) divergent thinking, or (iii) both shifting and divergent thinking elements. Participants' response selection history on a reward-based learning

task, which could be approached either through exploitation or exploration, was used to determine each participant's learning style and predict CF performance. As CF has been linked to prefrontal cortex (PFC) activation, in a second study we used a similar paradigm to examine whether modulation of PFC with noninvasive brain stimulation would produce measurable effects on CF that would be mitigated by individual learning preferences. While completing a CF task and a control task, participants underwent high-definition transcranial direct current stimulation (tDCS), a noninvasive brain stimulation approach involving small electric currents (1.5mA) through a 4x1 electrode montage over the left-lateral PFC. Participants received either excitatory, or inhibitory, or sham stimulation. We show that different CF task components (i.e., whether the task involved divergent thinking) interact with participants learning preferences as measured by the independent learning task and that such effects are altered by modulation of PFC activity. We discuss how learning preferences might capture individual differences in CF.

Topic Area: EXECUTIVE PROCESSES: Other

F37 Selectively Reinforcing the Speed-Accuracy Trade-Off in Decision Making

Jonas Simoens[1], Senne Braem[1], Tom Verguts[1], [1]Ghent University

Recent theories on cognitive control suggest that control functions are subject to the same reinforcement learning principles as other forms of behavior, and thus, can be conditioned by reward feedback. We investigated this idea on a well-studied control function, namely the regulation of one's speed-accuracy trade-off (i.e., 'caution') in decision making, which can be quantified by the drift diffusion model parameter boundary separation. As such, across two experiments, participants performed a random moving dots task, over the course of which their boundary separations were estimated and selectively reinforced on a trial-by-trial basis. Specifically, participants in the increase group were reinforced to increase their boundary separations, while participants in the decrease group were reinforced to decrease their boundary separations. While participants were unaware of this reinforcement learning rule, as assessed in a post-experiment questionnaire, their behavior did change accordingly. In the first experiment, we found the expected changes in boundary separations when comparing the first and last learning blocks, but not when comparing the neutral pre- and post-learning phases. Therefore, in a second experiment, we added random reward feedback to the pre- and post-learning phases, to make them more comparable to the learning phase. In this second experiment, we did find the expected changes in boundary separations when comparing the pre- and post-learning phases. Taken together, these findings support the idea that abstract control functions can be conditioned by reward.

Topic Area: EXECUTIVE PROCESSES: Other

F38 Neuronal Networks Supporting Working Memory Shift With Stress

Alana Campbell[1], Sarah Glier[1], Austin Ferguson[1], Andrea Baldelli-Pelletier[1], Mae Yefimov[1], Peter Mucha[1], Aysenil Belger[1], [1]University of North Carolina at Chapel Hill

Adolescence is a critical window for the development of neuronal networks supporting higher order cognition, in particular working memory (WM). The limited capacity of WM may be modulated by stress exposure. Yet the influence of stress on WM networks in adolescents is both not well understood, and critical for healthy development. Atypical stress-WM interactions impart risk for psychiatric illness. The goal of this study was to map neuronal network features in theta(4-8Hz) and alpha(8-12Hz) frequency bands using EEG. Adolescents at low and high familial risk for psychiatric illness (n=56) completed an n-back task (n = 0,1,2) before and after a social stressor while we recorded ongoing EEG and heart rate variability. We found an interaction between stress and n-back load in neural oscillatory theta activity for both power and synchrony (p

Topic Area: EXECUTIVE PROCESSES: Working memory

F39 Enhanced cortical activity after n-back working memory training: An event-related potential source localization study

Thomas Covey[1], Janet Shucard[1], Xuedi Wang[1], David Shucard[1], [1]University at Buffalo

Working memory (WM) is a core cognitive ability that involves the short-term maintenance and manipulation of information. There is some evidence (though mixed) that targeted training of WM can potentially enhance neural activity underlying cognition. We previously found that WM training resulted in improved cognitive performance and enhancement of N2 and P3 event-related potential (ERP) component amplitude. Here, we seek to extend these findings by identifying the cortical activity that is associated with these training-related ERP effects. Participants (n = 19) completed twenty sessions of adaptive, at-home n-back training (visual-letter stimuli, 25-30 minutes per session). Before and after training, participants completed a visual letter 3-back task, during which electroencephalographic (EEG) data were obtained. ERPs were derived from the EEG data. Cortical source activity was estimated using the local autoregressive average method, within the N2 (200-250 msec post-stimulus) and P3 (350-550 msec post-stimulus) time windows. Posttest vs. pretest activity was examined with paired t-tests (for 66 gyri, Benjamini-Hochberg corrected p-values). Within the N2 time window, parietal, occipital, and cingulate regions had significantly greater activity at posttest compared to pretest. This is suggestive of training-related enhancement of interference control and WM storage mechanisms, which are engaged by cingulate cortex and posterior-parietal regions, respectively. Within the P3 time window, prefrontal cortical areas (and additional regions) had significantly greater activity at posttest compared to pretest, suggesting enhanced executive control. These findings provide insight into the neural correlates of training-related improvements in WM.

Topic Area: EXECUTIVE PROCESSES: Working memory

F40 Sensory modality and information domain modulate behavioral and neural signatures of working memory interference

Justin Fleming[1], Michelle Njoroge[2], Abigail Noyce[2], Tyler Perrachione[2], Barbara Shinn-Cunningham[3], [1]Harvard University, [3]Carnegie Mellon University, [2]Boston University

Recent evidence from functional magnetic resonance imaging has revealed interleaved sensory-biased regions in the lateral frontal cortex that are preferentially recruited during either visual or auditory attention and working memory (WM). These regions participate in sensory-biased cortical networks that can be flexibly recruited depending on information domain. Spatial auditory WM tasks recruit the visual-biased network, while temporal visual WM tasks recruit the auditory network. Using electroencephalography (EEG) and a WM interference paradigm, we assessed the behavioral costs and neural signatures of recruiting the same versus the complementary network during WM retention. Participants (N=20) were asked to remember spatial or temporal properties of auditory or visual stimuli. To explore effects of network interference, a second auditory task was sometimes presented during the retention period; this interfering task emphasized either spatial or temporal processing. Performance on the interfering task was worst when auditory information was being held in WM, reflecting a cost of increased load on the auditory network. In contrast, no behavioral costs of switching between the visual and auditory networks were observed. Neurally, we identified time-frequency-channel regions of interest (ROIs) in which the interfering tasks

significantly altered oscillatory power. ROIs were found during the retention and probe task phases in the theta (4-7 Hz) and alpha (8-12 Hz) frequency bands. Within these ROIs, we observed differential signatures of WM depending on whether the sensory modality and information domain matched between the two tasks. These results help quantify the relative costs of loading one cognitive network versus switching networks mid-task.

Topic Area: EXECUTIVE PROCESSES: Working memory

F41 Neural Mechanisms underlying Discrimination of Pitch Intervals: Effects of Interval Deviation and Interval Size

Fong Yi Guo[1], Chen-Gia Tsai[1], [1]NTU

A pitch interval is determined by the frequency ratio of two pitches. Past studies have demonstrated the perception of the pitch interval is categorical. However, a few musicians are able to discriminate fine differences (less than a semitone) between an out-of-tune interval and a standard interval. Notably, the discrimination threshold of interval deviation has been found to increase along with the interval size. The aim of the present study was to examine the effects of interval size and interval deviation on neural activity during discrimination of pitch intervals. Twenty-nine trained participants (22.8±2.4 years old, 2 left-handed, 19 females) underwent an fMRI experiment, in which they were asked to determine whether heard intervals were larger than the standard intervals showed on screen. We used a factorial design with factor Deviation (semitone versus quartertone) and Size (minor second and minor sixth). Behavior data and fMRI data were subjected to 2x2 ANOVA. We observed significantly better performances for the larger interval deviation and smaller interval size. The main effect of interval deviation revealed that the 'tonal loop' or sensorimotor network displayed stronger activity for the smaller deviation. The main effect of interval size revealed that the sensorimotor network and occipitoparietal regions (including the intraparietal sulcus, superior parietal lobule, precuneus, and primary visual cortex) displayed stronger activity for the larger interval size. This finding suggests that occipitoparietal regions implicated in amodal spatial processing and general magnitude processing play a key role in discrimination of pitch interval with larger sizes.

Topic Area: EXECUTIVE PROCESSES: Working memory

F42 Cross-frequency coupled entrainment of EEG activity by transcranial alternative current stimulation

Byoung-Kyong Min[1,2], Ji-wan Kim[1,2], Hyun-Seok Kim[1], [1]Korea University, [2]Inst. for Brain & Cognitive Engineering

Transcranial current stimulation is a potent neuromodulation technique used to enhance human cognitive function in a non-invasive manner. In this study, we investigated whether a cross-frequency coupled transcranial alternative current (CFC-tAC) stimulation improved working-memory performance. Eighteen participants were recruited for a tAC-treated group, and eighteen age-sex-matched controls also participated in this study as a sham group. Participants were instructed to perform a modified Sternberg task, where a combination of letters and digits was presented in three different workload conditions (3, 5, and 7 items to be encoded) before and after the tAC or sham stimulation. The stimulation group was treated with CFC-tAC stimulation for 20 mins (input channel: F3, return channels: Fp1, Fz, F7, and C3). In the present study, we analyzed parietal delta-phase/frontal high-gamma-amplitude cross-frequency coupling (CFC) of electroencephalographic data to find neural correlates for the enhancement of working-memory performance by tAC-treatment. We observed significant CFC differences between the tAC-treated and sham groups in the most difficult task condition (i.e., 7-workload). Since low-frequency phase and high-frequency amplitude coupling reflects large-scale communication during cognitive processing, this finding may reflect tAC influenced functional connectivity between frontal and parietal regions, resulting in performance-enhancement of working memory. Our observations provide neural correlates for the enhancement of working-memory performance by the CFC-tAC non-invasive stimulation.

Topic Area: EXECUTIVE PROCESSES: Working memory

F43 Microstructure in the posterior parietal cortex supports working memory function in 9-10-year-old children

Ilke Oztekin[1], Paulo Graziano[1], Anthony Dick, [1]Florida International University

Research on Attention-Deficit/Hyperactivity Disorder (ADHD) implicates the critical role of executive function processes. An important and widely recognized component of executive function is working memory (WM), and an impaired WM function is commonly observed in ADHD, although the specificity of these deficits at a mechanistic level and their underlying neurobiology are still lacking. The current investigation leveraged the Adolescent Brain Cognitive Development (ABCD) study (https://abcdstudy.org) to evaluate individual differences in the microstructure of key regions that support WM across two tasks (NIH toolbox list WM, and emotional n-back tasks, see Casey et al., 2018; Garavan et al., 2018) and how they modulate ADHD-related effects in WM performance. Our analyses indicate that neurite density in the left ventrolateral prefrontal cortex (VLPFC) and bilateral posterior parietal cortex (PPC) regions predicted performance in the list WM task. Neurite density in the right VLPFC, the right PPC, and the right hippocampus predicted performance in the n-back task. The data further indicate that neurite density in the PPC, namely the intraparietal sulcus region differed across individuals with ADHD and healthy developing children. The PPC, in particular the intraparietal sulcus, has been frequently observed during WM operations. Notably, this region has been previously implicated for its importance in supporting focus of attention during WM operations (Öztekin et al., 2009; Cowan et al., 2011). The current set of results complement previous WM research, and provide further insight into our understanding of ADHD related deficits in working memory and their underlying neural substrates.

Topic Area: EXECUTIVE PROCESSES: Working memory

F44 An investigation of verbal vs. tonal working memory using non-invasive brain stimulation

Mark Stern[1], Kaitlyn Fleming[1], Daniel Reinhuber[1], Kara Broussard[1], Karla Reyes-Fierros[1], Carmen Westerberg[1], Logan Trujillo[1], Rebecca Deason[1], [1]Texas State University

Working memory (WM) allows for the maintenance and manipulation of different types of information. Evidence for clear differences in working memory for auditory and visuospatial information exists, but it is unclear whether there are further distinctions between different types of auditory stimuli like verbal and musical information. Anodal transcranial direct current stimulation (tDCS) is thought to increase neural excitability, which has the potential to influence cognition. However, the influences of tDCS on cognition have been mixed. This study used tDCS to help determine whether neural dissociations exist between musical and verbal WM, if tDCS can enhance musical WM, and the influence of tDCS on verbal and tonal long-term memory (LTM). Participants (N = 67) completed a verbal 2-back task, a tonal 2-back task, and a LTM test in which memory for stimuli presented in the WM tasks was tested and confidence was assessed. Participants were randomly assigned to three tDCS conditions: no stimulation, sham, or stimulation. Stimulation occurred for twenty minutes over the left supramarginal gyrus and then participants completed both WM tasks and a LTM assessment. We failed to find enhancing effects of tDCS on WM or LTM performance. Tonal WM task accuracy was higher than for the verbal WM task, but no difference in performance was found in the LTM test. Participants were more confident on

musical stimuli judgments compared to verbal stimuli in the LTM test. Musical and verbal information may be processed differently in WM, but similar effects do not appear to extend to LTM.

Topic Area: EXECUTIVE PROCESSES: Working memory

F45 Intrinsic and Task-Related Neural Differences in Adults with Dyslexia

Ola Ozernov-Palchik[1], Sara Beach[1], Tracy Centanni[2], Sheeba Arnold[3], John D. E. Gabrieli[1], [1]MIT, [2]Texas Christian University, [3]Northeastern University

Developmental dyslexia is a persistent difficulty in learning to read. Numerous neuroimaging studies have demonstrated functional and structural atypicalities in left-hemispheric occipitotemporal, temporoparietal, and inferior frontal regions in dyslexia. Because reading relies on integration across these anatomically distant brain regions, studying resting state functional connectivity (RsFc) correlates of dyslexia can provide further insights about the underlying mechanisms of reading deficit in this disorder. The current study implemented a whole-brain seed-to-voxel RsFc analysis to compare intrinsic differences in RsFc in adults (mean age: 26 years; 22 female) with (Dys, N = 24) and without (Typ, N = 20) dyslexia. Additionally, the two groups were compared on a functional in-scanner naturalistic reading task and on behavioral measures. All neuroimaging results were thresholded at a voxel-wise $p < 0.001$ and cluster extent $p < 0.05$ FWE corrected. Dys performed below Typ on reading (p's < 0.05), but not on cognitive (p's > 0.1). measures. On the fMRI reading task, group comparisons demonstrated hypoactivation in the canonical left hemispheric occipitotemporal and prefrontal regions in Dys. There was stronger connectivity between left and right hemispheric occipitotemporal regions, using a the left occipitotemporal seed, in Dys, suggesting reduced left lateralization of the putative visual word form region. In Typ there was greater RsFc between bilateral putamen and cingulate, parahippocampal, and sensorimotor regions. Increased connectivity of basal ganglia has been implicated in range of cognitive and executive functions. These results suggest intrinsic and task-specific differences in dyslexia in both reading-specific and in domain-general neural networks.

Topic Area: LANGUAGE: Development & aging

F46 Musical expertise offsets age-related decline in audiovisual speech in noise perception: Evidence from fMRI

Lei Zhang[1], Yi Du[1], [1]Chinese Academy of Sciences

Musical training involving intensive multimodal interaction is suggested to offset age-related decline in speech in noise (SIN) perception. Although it is evident that lip movements facilitate speech encoding, no study has investigated whether musical training improves audiovisual SIN perception in older adults and its underlying neural mechanisms. In this fMRI study, 24 young non-musicians (YNM), 24 older non-musicians (ONM) and 25 older musicians (OM) with normal hearing discriminated syllables in speech-spectrum noise at three SNRs (-8, 0, 8 dB) with visual valid (VV) and visual invalid (VI) information. OM outperformed ONM except at -8 dB SNR but performed worse than YNM in all VI conditions. With visual information, OM outperformed ONM and equalized YNM except at -8 dB SNR. OM generally showed larger visual benefit than ONM. For BOLD activity, musical expertise lessened the aging effect that ONM, OM and YNM showed gradually increasing activation in bilateral transverse/superior temporal gyrus (TTG/STG) and left precentral/postcentral gyrus. OM showed greater activation in multimodal areas including bilateral angular gyrus (AG) than ONM and YNM. PPI analysis showed stronger functional connectivity from bilateral TTG/STG to bilateral premotor cortex and inferior temporal gyri in older adults than YNM. Moreover, OM showed stronger connectivity from right AG to bilateral insula/Broca's area and premotor cortex and from left AG to right insula. Our findings suggest that musical training strengthened visual benefit on SIN perception in older adults through mitigating age-related decline of brain activity in auditory regions and enhancing activity in multimodal areas and sensorimotor integration.

Topic Area: LANGUAGE: Development & aging

F47 Images support novel word learning paired with novel meaning: An EEG study

Daisy Lei[1], Yushuang Liu[1], Janet Van Hell[1], [1]The Pennsylvania State University

According to the complementary learning systems theory, novel words are initially encoded as episodic memory traces in the hippocampal system, separate from one's existing lexicon (Davis & Gaskell, 2009). After a period of consolidation (e.g. overnight sleep), these memory traces gradually become lexicalized and achieve stable and longer-term neocortical representations. To study whether the lexicalization of novel words can be expedited by integrated learning of verbal definitions and images (relative to verbal definitions learning only, Bakker et al., 2015), monolinguals were trained on two unique lists of novel words, one on Day 1 and another on Day 2. Both lists were tested using an EEG recorded semantic priming task on Day 2 and Day 8. Lexicalization of the novel words was studied by examining the N400 and LPC time windows. Day 2 ERP data show that, only for novel words learned on Day 1 but not for novel words learned on Day 2, novel words preceded by semantically related primes elicited an enhanced positive LPC response relative to novel words preceded by unrelated primes. Also, an N400 semantic priming effect emerged for novel word learned on Day 1 in the Pz channel. Day 8 ERP data indicate a more widespread LPC semantic priming effect for Day 1 novel words. This suggests that only novel words learned the day before and not on the day of testing demonstrate lexicalization and consolidation, in line with the complementary learning systems theory.

Topic Area: LANGUAGE: Lexicon

F48 Cortical Sources of Visuo-spatially complex Hindi Language: a QEEG Study

Prashant Tayade[1], Ankit Gurjar[1], Suriya Prakash[1], Simran Kaur[1], Ratna Sharma[1], [1]All India Institute of Medical Sciences

Hindi language written in Devanagari script (orthography) has visuospatial complex features that increases neurocognitive load on the brain cortical areas. Dyslexic children face difficulty in reading due to the presence of this complex feature in the language. However, no literature is available reporting cortical sources of visuospatial complexity of Hindi language using Quantitative Electroencephalography (QEEG).This study aimed to identify the cortical sources during the presentation of visuospatially complex meaningful Hindi words using QEEG. Twenty healthy volunteers (23.7 ± 3.1 yrs.) were presented 30 complex words (with vowels diacritics and ligature consonants). EEG data were recorded during the task and source localization was performed using sLORETA. The current study showed significant ($p = 0.05$; $t = 1.169$) activation in Superior and middle frontal gyrus, inferior parietal lobule, cingulate gyrus and deactivation in anterior cingulate, and medial frontal gyrus during the presentation of complex words. Superior and middle frontal gyrus could be associated with the top-down control of visual attention during complex language processing. Inferior parietal lobule activation might represent the translation of the orthographic symbols to phonemic representation. Cingulate cortex along with inferior parietal lobule activation could be responsible for an accurate ambiguity resolution in complex language processing. Medial frontal cortex deactivation which has previously been implicated in action selection and outcome in complex cognitive tasks such as

language might be due to the higher demand involved in the processing of complex language.

Topic Area: LANGUAGE: Lexicon

F49 Examining the neurocognitive basis of reading fluency in children with dyslexia & comorbid dyslexia/ADHD

Noor Z. Al Dahhan[1], Olivia Meegoda[2], Kelly Halverson[1], Carrie Peek[3], Dayna Wilmot[1], Tracy M. Centanni[4], Rachel Romeo[1], Andrea Imhof[1], Karolina Wade[1], Anila D'Mello[1], John D. E. Gabrieli[1], Joanna A. Christodoulou[2], [1]McGovern Institute for Brain Research, [2]MGH Institute of Health Profession, [3]Boston Children's Hospital, [4]Texas Christian University

Dyslexia and attention-deficit/hyperactivity disorder (ADHD) are among the most common neurodevelopmental disorders, affecting 15% of school-aged children. The comorbidity of dyslexia and ADHD is striking, with 25-40% of children with one diagnosis meeting the diagnostic criteria for the other. However, limited research has examined the neurocognitive mechanisms underlying the reading challenges present in these populations. We examined the neurocognitive processes underlying fluent reading in three groups of children (ages 6-13 years old): typically developing (TD; n = 15), dyslexia (RD; n = 13), and comorbid dyslexia/ADHD (RD+ADHD; n = 8). Participants completed an fMRI task in which they read aloud stories while being recorded. In-scanner behavioral performance revealed that RD and RD+ADHD groups showed reduced accuracy and slower rate compared to TD. Compared to TD, there was reduced left-hemisphere activation during story reading in both RD and RD+ADHD. Within the left-hemisphere reading network, compared to TD there was comparable hypoactive recruitment of the inferior frontal gyrus and fusiform gyrus for RD and RD+ADHD. RD+ADHD differed from TD in the middle temporal gyrus and angular gyrus, whereas RD differed from TD in the superior temporal gyrus and supramarginal gyrus. There were no brain activation or in-scanner performance differences between RD and RD+ADHD in contrast to predictions of the 'cognitive subtype' hypothesis positing that RD with ADHD would show more severe deficits than RD alone when reading text. Overall, these findings further our understanding of the neurocognitive processes supporting reading, and how these processes compare in RD and RD+ADHD.

Topic Area: LANGUAGE: Other

F50 Child and adult cortical selectivity for English and American Sign Language using fMRI

Halie Olson[1], Hilary Richardson[1], Jorie Koster-Hale[1], Naomi Caselli[2], Rachel Magid[1], Rachel Benedict[2], Jennie Pyers[3], Rebecca Saxe[1], [1]MIT, [2]Boston University, [3]Wellesley College

Our goal was to determine whether the same cortical regions are selective for language in American Sign Language (ASL) speakers and English speakers, in both children and adults. d/Deaf and hearing adults and children listened to or watched stories while undergoing functional magnetic resonance imaging (fMRI). Participants included hearing English-speaking adults (n=24), signing adults (n=36, 29 d/Deaf, 7 hearing children of d/Deaf adults (CODA)), English-speaking children (n=96, age range 5-12 years), and signing children (n=24, 20 d/Deaf, 4 CODA, age range 6-12 years). For each participant, we extracted the contrast value for English stories > foreign language (English speakers) and ASL stories > non-signs (ASL speakers), within the top-50 voxels per parcel per participant, in parcels from the Brainnetome atlas. Next, we calculated the correlation of the language effect size across parcels (i.e. which regions showed relatively smaller or larger language responses), comparing each individual to a group average. We found that adult ASL speakers activate a consistent set of regions for language comprehension, but these were significantly different from the regions activated by English. We further tested whether delayed access to sign language impacted these results by splitting the ASL speakers into separate groups of native signers and delayed signers.

Topic Area: LANGUAGE: Other

F51 Behavioral and Neural Signatures of Novel Language Learning

Eleonora Rossi[1], Merel Keijzer[2], Judith Kroll[3], [1]University of Florida, [2]University of Groningen, [3]University of California, Irvine

This study asked whether novel and short-term but intensive language training induces early signatures of behavioral and neural change. We examined two different contexts of linguistic immersion to assess these consequences. Two groups of native English speakers learned Dutch via a commercial software for a period of 10 consecutive days (1hr/day). Critically, the immersed group was located in The Netherlands, where Dutch is spoken but where virtually everyone also speaks English, and the non-immersed in the US. Participants (n=21) completed a linguistic and cognitive battery pre and post training, and a semantic categorization task while EEG was recorded. Preliminary behavioral results revealed that both groups successfully learned Dutch vocabulary, suggesting rapid encoding of new linguistic information. The EEG data were analyzed in the time and frequency domains (Time Frequency Representation -TFR-). Results comparing the EEG signal before and after training reveal the rapid emergence of the N400 component at a post-test, indicating ease of lexical access in long term memory. Critically, the N400 component was more prominent for the immersed group than for the non-immersed group. Preliminary results for the TFR analysis showed a decrease in beta oscillations suggesting new lexical memory consolidation. Taken together, the data offer evidence that both neural and behavioral signatures are visible in the earliest stages of novel language learning.

Topic Area: LANGUAGE: Other

F52 L1 Morphological Typology Influences Patterns of Neural Activation for L2 Inflectional Processing: An fNIRS study

Danyang Wang[1], Sarah Wang[1], Benjamin Zinszer[1], Li Sheng[1], Kaja Jasinska[1], [1]University of Delaware

Inflectional morphology is a persistent problem in L2 learners and serves as a clinical marker for language disorders. This study investigated how cross-linguistic differences in L1 morphological typology impact bilinguals' neural responses to processing L2 inflections. Languages differ in morphological typology along a continuum: synthetic to analytic. Spanish (synthetic) has a complex inflectional system, while Mandarin Chinese (more analytic) lacks inflection but uses a rich compounding process. Left inferior frontal gyrus (L-IFG) is involved in processing inflected words, while left middle temporal gyrus (L-MTG) is involved in lexical-based semantic processing such as compounding. We hypothesized that English (L2) inflectional morphemes would evoke more L-IFG engagement in Spanish bilinguals (rich inflection) and more L-MTG engagement in Mandarin bilinguals (rich compounding). While undergoing functional near-infrared spectroscopy (fNIRS) neuroimaging, Spanish-English bilingual (n=19), Mandarin-English bilingual (n=20), and English monolingual (n=20) adults completed a picture-sentence judgment task targeting the third person singular -s. English monolinguals showed significantly higher accuracy than the bilingual participants. No behavioral differences was found in accuracy or response time between the two bilingual groups. Preliminary fNIRS analysis revealed that Chinese-English bilinguals showed greater activation in areas including left MTG and anterior prefrontal cortex compared to English monolinguals. Conversely, Spanish-English bilinguals showed greater activation in L-IFG as well as dorsolateral and medial prefrontal cortex than English monolinguals. Results supported our hypotheses and suggested that L2 learners process inflectional

morphology differently from L1 learners, and the differences in brain activations were linguistically principled on the typological features of their L1.

Topic Area: LANGUAGE: Other

F53 White matter pathways support dual routes for pre-reading in early childhood

Yingying Wang[1], [1]University of Nebraska-Lincoln

Reading is a complex cognitive process involving decoding and comprehending of the printed texts and is critical for individuals to acquire knowledge. Reading is related to academic success. Learning to read requires transformation from print to speech and print to meaning, which involves multiple functional brain regions connected through white matter pathways. Research has shown that changes of white matter are sensitive measures to use for early identification for children at-risk for reading difficulties. Multiple white matter pathways have been linked to language or reading. This study presents the white matter characteristics of two pathways in pre-readers. 19 typically developing children, between the age of five to seven, were scanned. Our results demonstrate the brain-behavior correlation using white matter data from pre-readers. High fractional anisotropy (FA) of posterior arcuate fasciculus tract is correlated with high raw scores of phonological awareness (PA), while high FA of posterior left inferior fronto-occipital fasciculus tract is correlated with high verbal IQ. PA tests the phonological ability and verbal IQ examines the semantic skill. Our findings suggest white matter microstructure changes before formal reading instructions start and white matter tracts also have different traits (e.g., AF as dorsal pathway correlates with phonological processing, while IFOF as ventral pathway correlates with semantic processing), which is already present in pre-readers (age 4:6 ? 6:9 years: months).

Topic Area: LANGUAGE: Other

F54 Acoustic entrainment of speech supports comprehension under moderate noise, but degrades under more severe adversity

Benjamin Zinszer[1], Qiming Yuan[2], Zhaoqi Zhang[2], Bharath Chandrasekaran[3], Taomei Guo[2], [1]University of Delaware, [2]Beijing Normal University, [3]University of Pittsburgh

Daily life demands comprehending speech under noisy conditions, like conversation in a noisy restaurant. Multivariate temporal response function (mTRF) modeling identifies electrophysiological signals that entrain to continuous speech, providing evidence that cortical entrainment of an acoustic signal reflects directed attention to that speech. Entrainment degrades under noise, predicts comprehension, and increases for non-native listeners. We test the hypothesis that listeners modulate cortical entrainment of speech under different adverse conditions, reflected by an increase in entrainment under moderate noise or second language but decrease under severe noise. Twelve Chinese-English bilinguals in Beijing underwent EEG while listening to 60 minutes of an audiobook recorded in both Mandarin and English. Twelve additional participants are being recruited. After each one-minute track, participants answered two comprehension questions. Half of the tracks were presented in Mandarin and the other half were presented in English (on separate days), counterbalanced between subjects. In each language, speech was mixed with three levels of noise: none, moderate, and severe. We estimated cortical entrainment for each track using mTRF and performed a linear mixed-effects regression, controlling for comprehension accuracy. Contrary to our prediction, we found that entrainment of the non-native language was significantly lower than the native language (B=0.02, p

Topic Area: LANGUAGE: Other

F55 Distinct neural signatures of semantic retrieval and event updating during discourse comprehension

Trevor Brothers[1,2], Sophie Greene[1], Gina Kuperberg[1,2], [1]Tufts University, [2]Massachusetts General Hospital

Currently, there are multiple competing accounts of the functional significance of the N400 component of the event-related brain response. Some previous studies have linked this neural response to the difficulty of retrieving semantic information associated with incoming words from memory, but it is unclear to what extent this ERP response may also reflect the updating of prior discourse information. To help distinguish the neural mechanisms underlying semantic retrieval and event updating, we developed a set of discourse scenarios with critical words that were either highly informative or uninformative (e.g. 'The way things were going, no one expected it to happen. It left all of the onlookers completely speechless. After the touchdown/commotion?'). As confirmed by offline ratings, only informative continuations were useful for re-interpreting information in the prior context. These critical words were carefully matched on lexical characteristics, predictability, and semantic association with the preceding context. Contrary to the predictions of some accounts, this novel informativeness manipulation produced no differences in the amplitude of the N400, and instead produced a long-lasting frontal positivity, beginning approximately 250ms after word onset. When semantic predictability was manipulated in a separate set of discourse scenarios, this produced clear differences in the N400, which differed in both polarity and scalp distribution from the effects of informativeness. Finally, the magnitude of the informativeness effect correlated significantly with participants' offline comprehension accuracy. These findings provide evidence for two distinct neural signatures associated with semantic retrieval and retroactive event updating during reading comprehension.

Topic Area: LANGUAGE: Semantic

F56 Bilateral Frontal Aslant Tract Association With Verbal Fluency in Young Children With and Without ADHD

Attention-deficit hyperactivity disorder (ADHD) is a disorder typically diagnosed in early childhood, and is characterized, in the majority of children, by deficits in executive function (EF). There is a well-known comorbidity between ADHD and speech-language disorders (McGrath et al, 2008; Efron & Sciberras, 2010). In this study, we examined the relationship between a recently discovered bilateral language pathway, the Frontal Aslant Tract (FAT), and phonemic and semantic scores on the NEPSY in 196 children with (n=100) and without (n=96) ADHD using diffusion weighted imaging. The FAT is a long association fiber pathway (Catani et al, 2012) in the frontal lobe that is thought to play an important role in verbal fluency and speech production (Dick, Bernal, & Tremblay, 2014). The FAT is most commonly thought to connect the inferior frontal gyrus (pars opercularis (Op) and pars triangularis (Tri)) to pre-supplementary motor area (pre-SMA) and supplementary motor areas (SMA) (Broce et al., 2015; Catani et al, 2013). The left FAT (preSMA_Op segment) predicted higher NEPSY total phonemics scores for the control group (B=0.23, p

Topic Area: LANGUAGE: Semantic

F57 A graded effect of real-world plausibility on the N400 evoked by lexically unpredictable words

Sophie Greene[1], Trevor Brothers[1,2], Elizabeth Weber[1], Santiago Noriega[1], Gina Kuperberg[1, 2], [1]Tufts University, [2]Massachusetts General Hospital

It is well established that the N400 varies with the semantic probability of a word. However, because most studies have used cloze as a proxy for semantic probability, it has been difficult to characterize N400 differences on

words that might vary in their semantic predictability (based on real-world knowledge) but that are lexically unpredictable. We measured electroencephalogram (EEG) as participants read highly constraining discourse scenarios that included lexically unpredictable words (

Topic Area: LANGUAGE: Semantic

F58 WITHDRAWN

F59 The P600 as a measure of Implicit Knowledge in Artificial Grammar Learning

Sarah Alam[1], Yael Arbel[2], [1]Harvard University, [2]MGH Institute of Health Professions

The P600 is an event-related potential associated with the processing of syntactic violations and various studies have implicated the P600 as a measure of implicit grammatical knowledge. This project used two versions of an Artificial Grammar Learning (AGL) paradigm to investigate the effects of explicit and implicit learning on the elicitation of the P600. In a 'No Suppression' version of the AGL task, participants were passively exposed to grammatically correct strings in the training phase and asked to judge the grammaticality of string in the testing phase. Stimuli consisted of strings of 2-6 shapes (circle, square, diamond, hexagon). In a 'Suppression' version of the task, participants were instructed to repeat a sentence out loud during the training phase as grammatically correct strings were shown on the screen. Stimuli consisted of strings of 2-6 abstract symbols. This secondary task aimed to occupy the participants' phonological loop by eliminating their ability to rehearse and memorize the incoming strings, thereby decreasing their ability to engage in explicit learning strategies. In the testing phase, participants were similarly asked to judge the grammaticality of strings. Using the P600 as a neurophysiological indicator of grammar learning, participants' EEG data were analyzed to see if P600 elicitation was sensitive to grammaticality of strings, accuracy in participants' judgments of grammaticality, or suppression of explicit learning strategies. While no accuracy differences were found between the suppression and the no suppression conditions, amplitude differences in the P600 were found between the two conditions.

Topic Area: LANGUAGE: Syntax

F60 Evaluating Morpho-Syntactic Aspects of the Neural Working Memory Circuit

Emily Wood[1], William Matchin[1], [1]University of South Carolina

A phonological working memory (WM) loop (Baddeley, 1974; 2003) is commonly thought to support sentence comprehension. However, psycholinguistic research suggests the existence of a WM architecture more specific to sentences (Lewis et al., 2006: Caplan & Waters, 1999). We tested whether anterior portions of the inferior frontal gyrus might underlie a sentence-specific WM system (Fedorenko et al., 2011; Matchin, 2017) by performing an fMRI study in 20 healthy, right-handed, native English speakers comparing the subvocal rehearsal of three conditions matched for number of syllables: (i) meaningless speech sequences (phonological condition, e.g. ninyo pobset), (ii) meaningful words without structured syntax (semantic condition, e.g., hermit dogma), and (iii) jabberwocky phrases with minimal semantic content but syntactic structure (syntactic condition, e.g. , these clopes this pand), using a standard perceive and rehearse paradigm used previously to localize sensorimotor WM circuits (Venezia et al., 2015), subtracting out perception-related activation, localizing the rehearsal process. Preliminary analyses reveal that all three conditions produce similar activation in the inferior frontal and precentral gyri (Hickok & Poeppel, 2007; Buchsbaum et al., 2011), without preferential activation for syntactic rehearsal in anterior portions of the inferior frontal gyrus. However, we did identify stronger activity for syntactic rehearsal in bilateral supplementary motor area (SMA). The SMA has been previously implicated in prosodic processing during comprehension and timing during production (Kotz et al., 2016). Suggesting that the neural architecture involved in WM depends on the nature of the internal content of the stimulus, which for phrases and sentences crucially involves prosodic information.

Topic Area: LANGUAGE: Syntax

F61 Test-retest consistency of hippocampal subfield volume measures in a developmental sample

Roya Homayouni[1], Qijing Yu[1], Sruthi Ramesh[2], Ana Daugherty[1], Noa Ofen[1], [1]Wayne State University, [2]NYU Long Island School of Medicine

The hippocampus (Hc) is composed of cytoarchitectonically and functionally distinct subfields: subiculum, cornu ammonis sectors (CA1-3) and dentate gyrus (DG). Limited evidence on humans and animals suggests differential maturation rates across the Hc subfields. While longitudinal studies are essential in demonstrating differential developmental changes across Hc subfields, a prerequisite for interpreting meaningful longitudinal effects is establishing test-retest consistency of Hc subfields volume measures obtained in different time points. Here, we examined test-retest consistency in Hc subfields in two independent developmental samples. Sample 1 (n=28, ages 7-20 years, mean=12.64, SD=3.35) underwent MRI twice with a one-month delay. Sample 2 (n=27, ages 8-17 years, mean=11.90, SD=2.78) underwent MRI twice with a two-year delay. Specialized high-resolution T2-weighted MR images (0.4×0.4×2 mm3) were collected and manually traced using a reliable longitudinal manual demarcation protocol. In both samples, we found excellent consistency between Hc subfield volumetric measures in the two visits, assessed by two-way mixed intra-class correlation (ICC(3) single measures?0.87). Bland-Altman plots further indicated that volumetric differences between the two time points (Visit2?Visit1) were not significantly different from zero (|t|?1.86, p?0.07). Moreover, difference values were not related to the mean values in the two visits in any subfield (|Pearson's r|

Topic Area: LONG-TERM MEMORY: Development & aging

F62 Concept organization in adults and young children

Erika Wharton-Shukster[1], Bradley Buchsbaum[2], Emily Onyshko[1], Amy Finn[1], [1]University of Toronto, [2]Baycrest Hospital

Knowledge is organized by connecting related concepts together, but it is likely that, as more knowledge is gained across development, the structure of this organization will change. Yet, little is known about how knowledge structure changes from childhood to adulthood. Do adults and children organize concepts differently? Research on false memory suggests that consistency in structure increases with age, with adults demonstrating stronger, predictable connections while preschool-aged children demonstrate idiosyncratic organization (Brainerd et al., 2008). However, studies addressing this directly have been inconsistent in their findings and have only included older children (Dubossarsky, De Deyne, & Hills, 2017; Zortea et al., 2014). Further, some false memory studies suggest that children and adults differ on which concepts are centralized in an organizational network (Carneiro et al., 2007), yet this has not been addressed directly. To characterize concept organization in adults and young children, we had 100 adults and 100 4- and 5-year-olds perform a free association task with 25 word cues. Analyses revealed that adults were more consistent in their responses, with children providing more responses per cue and a higher percentage of idiosyncratic responses. Importantly, consistent responses within an age group were also more likely to be consistent across age groups. These consistent responses also had more connections and were more centralized in each respective network. These findings suggest that as knowledge is acquired, it is structured in an

increasingly organized fashion that is shared across individuals. However, the foundation for this knowledge structure is present even in early childhood.

Topic Area: LONG-TERM MEMORY: Development & aging

F63 Memory after hippocampal vs parahippocampal damage

Georgios P.D. Argyropoulos[1], Carola Dell'Acqua[2], Emily Butler[1], Clare Loane[3], Adriana Roca-Fernandez[1], Azhaar Almozel[4], Nikolas Drummond[5], Carmen Lage-Martinez[6], Elisa Cooper[5], Richard N. Henson[5,7], Christopher R. Butler[8], [1]University of Oxford, [2]University of Padua, [3]KCL, [4]Cardiff University, [5]University of Cambridge, [6]University Hospital Marqués de Valdecilla, [7]MRC CBU, [8]Imperial College London

It is highly disputed whether familiarity is dissociable from recollection at the neurofunctional level within the medial temporal lobes (MTL). According to 'dual-process' models, the former relies on the parahippocampal gyrus, especially the perirhinal cortex (PRC), whereas the latter relies on the hippocampus (HPC). We sought to assess this dissociation in the recognition memory of patients with different profiles of MTL damage. We recruited an exceptionally rare patient with focal PRC damage, along with 8 patients with atrophy in the HPC, which extended to various degrees in parahippocampal structures. Of those 8 patients, only one showed additional PRC atrophy. Healthy controls (n=15) and patients (n=9) participated in 3 custom-made tests of visual recognition memory: 2 paradigms used confidence ratings and different response deadlines to assess recollection and familiarity for faces, scenes, and words; 1 paradigm assessed source and item memory. Both patients with PRC damage showed impaired item memory and familiarity, especially for faces. However, the patient with additional HPC atrophy also showed impaired source memory and recollection. Patients with HPC but no PRC damage showed impaired recollection and source memory, which correlated with the extent of their HPC atrophy. Their familiarity and item memory estimates were associated with the volume of entorhinal, PRC, and parahippocampal cortices in a material-specific fashion. This double dissociation provides strong evidence in support of dual process models of recognition memory, whereby familiarity and item memory rely on the parahippocampal gyrus, whereas recollection and source memory rely on the HPC.

Topic Area: LONG-TERM MEMORY: Episodic

F64 Disassociations in the specificity of functional networks centered on hippocampus and VTA following exposure to novelty

Emily Cowan[1], Matthew Fain[1], Ian O'Shea[2], Vishnu Murty[1], [1]Temple University, [2]Northeastern University

Our memory systems are selective, prioritizing memory for salient changes in the environment. The ability to detect novelty is therefore critical for the formation of adaptive memories. Exposure to novelty has been shown to facilitate memory consolidation, processes that are mediated by both the VTA and hippocampus (Wang & Morris, 2010). While these regions are known to work in concert, it is unclear whether they support systems-level consolidation within specific task-relevant regions or more diffusely across large-scale memory networks. Participants completed resting-state scans prior to and following exposure to novel scene images (N=37). We examined changes in hippocampal and VTA functional coupling with both targeted task-relevant ROIs, and broad scale posterior medial and anterior temporal (PMAT) memory networks (Ritchey et al., 2014). Following exposure to novelty, hippocampal coupling with task-relevant regions in parahippocampal cortex was increased (pre vs. post-encoding rest: p=0.04), but there were no differences in coupling with either large-scale network (pre vs. post-encoding rest: PM: p=0.62, AT: p=0.38). In contrast, following exposure to novelty, VTA coupling with parahippocampal cortex did not significantly differ from pre-encoding rest (p=0.7), but coupling with both large-scale networks was enhanced (PM: p=0.05, AT: p=0.003). Together, this double dissociation suggests that consolidation mechanisms for the hippocampus and VTA may act on different spatial scales, supporting a model by which the hippocampus targets reactivation of specific memory traces whereas the VTA facilitates information processing across large-scale networks.

Topic Area: LONG-TERM MEMORY: Episodic

F65 Visual imagery absence in Aphantasia is associated with a reduced capacity to remember the past and imagine the future

Alexei Dawes[1], [1]University of New South Wales

Visual imagery is a cognitive tool thought to play an instrumental role in supporting episodic construction processes such as autobiographical memory and future prospection. Some individuals, however, lack the ability to voluntarily generate visual imagery altogether ? a congenital condition termed 'aphantasia'. Recent findings using objective measures of sensory imagery strength suggest that aphantasia is a condition defined by the veritable absence of visual imagery, rather than poor metacognitive awareness of imagery. Across two studies, we investigated the impact of visual imagery absence on both subjective and objective measures of episodic memory and future prospection. In Study 1, we employed a large sample, self-report design to demonstrate that compared to participants with normal visual imagery ability, aphantasic participants report less vivid and phenomenologically rich episodic memories and imagined future events. In Study 2, we extended these findings by assessing objective episodic construction performance in an independent sample of aphantasic participants using an adapted form of the Autobiographical Interview. Aphantasic participants exhibited a reduced capacity to generate episodic events compared to participants with visual imagery, both when remembering the past and imagining the future. These alterations were predominantly driven by a deficit in episodic details and a reduction in perceptual language use, and were mirrored by significantly lower self-rated event vividness. It is argued that individual differences in visual imagery ability must be accounted for when investigating episodic memory performance. Overall, our data suggest that visual imagery may act as a normative representational format for remembering the past and imagining the

Topic Area: LONG-TERM MEMORY: Episodic

F66 Reward-related memory benefits cannot be explained by post-encoding rehearsal

Matthew Fain[1], Arielle Tambini[2], Vishnu Murty[1], [1]Temple University, [2]University of California Irvine

Previous research shows periods of post-encoding rest are known to facilitate consolidation of reward-related memory (Murayama & Kitagami, 2014; Patil et al., 2016; Murty et al., 2017). However, the mental operations that contribute to memory consolidation during these rest periods are relatively unknown. Periods of post- encoding rest may allot an opportunity to rehearse valuable information or, alternatively, an opportunity for quiescence which enables incidental memory replay. In this study, we systematically manipulated rehearsal of high-value information using a post-encoding reward incentive structure. Subjects first completed a reward-motivated encoding task where they were instructed to make associations for image and word pairs ? each of which was categorized as either high or low reward. To manipulate rehearsal after encoding, we either encouraged rehearsal of high-reward pairs before an incentivized memory test (n=32) or immediately administered an incentivized memory test prior to a period of rest (n=31) using a between-subjects design. After a 24-hour memory test, we found that item memory (Hits-FA) was greater for high-reward versus low- reward items (p=0.03), and there were no differences in reward-related memory enhancements between groups (p=0.8).

Similarly, associative memory was greater in the high-reward versus low-reward conditions (p=0.02), and again there were no differences for reward-related memory enhancements between groups (p=0.5). These findings suggest that rehearsal of high-value material during a post-encoding period does not provide more reward-motivated memory benefits when juxtaposed with endogenous consolidation processes occurring during post-encoding rest.

Topic Area: LONG-TERM MEMORY: Episodic

F67 Changes in neural activity across repeated retrievals of autobiographical memories

Lauri Gurguryan[1], Mathilde Rioux[1], Signy Sheldon[1], [1]McGill Univeristy

Research using laboratory-based measures of episodic memory have documented changes in neural activity, particularly within the hippocampus, across repeated retrievals of a memory. However, less is known about how this repetition effect manifests during naturalistic forms of memory such as autobiographical remembering. To address this knowledge gap, we ran an fMRI experiment in which twenty-four participants retrieved pre-selected autobiographical memories at four time points within a single testing session. Using a multivariate analytic approach (Partial Least Squares), we established a pattern of neural activity across the brain that dissociated between early (first retrieval) and later rehearsals (third and fourth retrievals) of the same memory. Early rehearsal was associated with activity within the autobiographical memory network that included medial temporal lobe regions (e.g., bilateral parahippocampi and anterior hippocampi). Later rehearsals were associated with distributed activity within the parietal cortices (e.g., bilateral inferior parietal lobules). A subsequent analysis examined repetition effects within the hippocampus ? a structure critical for constructing autobiographical memory representations. This analysis revealed that repeatedly retrieving an autobiographical memory was associated with a decrease in hippocampal activity that was restricted to anterior regions. These data indicate that initially retrieving an autobiographical memory requires the autobiographical memory network to construct a mental representation of the remembered event more so than subsequent retrievals. Our findings further suggest that the anterior hippocampus plays a critical role during initial memory construction. Altogether, these data show how the neural mechanisms of autobiographical memory change as a function of what has already been recalled.

Topic Area: LONG-TERM MEMORY: Episodic

F68 Mnemonic discrimination in visual congruence context

Ariana Hedges-Muncy[1], Todd Winn[1], Brock Kirwan[1], [1]Brigham Young University

The relationship of objects and their contexts is at the core of explicit memory, converging on hippocampal processing. To further explore the effect of surrounding visual context on memory, this experiment added congruent and incongruent contextual information to stimuli in the mnemonic similarity task (e.g., a shopping cart against a grocery store or a gorilla against a classroom, respectively). We scanned 77 participants using fMRI during both the study and test phases of the MST with the addition of eye-tracking to control for attention. For the study phase, participants were shown images of everyday objects against either congruent or incongruent backgrounds and were asked whether the foreground object was likely or unlikely to be found in the given background. For the test phase, participants were shown images where the object was either exactly the same or similar to the previously studied object. Though we did not find difference in activation during study between congruencies, we did find more activation during study for congruent items compared to incongruent items when the participant had a subsequent false alarm to the stimuli in the right medial entorhinal cortex (t(74)=2.21; p=0.03). Additionally, there was more activation in the left lateral entorhinal cortex for congruent items that preceded a correct rejection in the test phase compared to incongruent items (t(76)=2.52; p=0.014). During test, there was more activation in the left entorhinal cortex for incongruent stimuli than congruent (t(299)=-2.21; p=0.03).

Topic Area: LONG-TERM MEMORY: Episodic

F69 Musical rhythm orchestrates neural activity and influences stimulus processing at specific moments in time

Paige Hickey[1], Annie Barnett Young[1], Aniruddh Patel[1], Elizabeth Race[1], [1]Tufts University

The brain spontaneously tracks rhythmic temporal regularities in the environment, such as music, through synchronization of neural oscillations to the beat. In a recent study, we found that individual variability in this neural tracking of rhythm correlated with the rhythmic modulation of memory across participants (Hickey et al, under review). Specifically, individuals with stronger neural tracking of a background beat during encoding demonstrated better subsequent memory for visual images presented in-synchrony versus out-of-synchrony with the beat. An outstanding question is whether differential neural processing also occurs at the time of stimulus presentation within subjects and enhances processing of images presented in-synchrony (on-beat) versus out-of-synchrony (off-beat) with the background beat. To address this question, we analyzed data from our prior EEG study in which participants incidentally encoded on-beat or off-beat images in the presence of a background musical rhythm. Results revealed differences in the amplitude and phase angle of electrophysiological responses at the time of stimulus presentation for on-beat versus off-beat images. Specifically, N2/P3 ERPs were enhanced for on-beat images compared to off-beat images over frontocentral electrodes. In addition, on-beat images occurred closer to the peak of the ongoing oscillations at the beat frequency (1.25 Hz). These results reveal differential neural processing on a trial-by-trial basis within subjects depending on the alignment of the stimulus with the background rhythm (on-beat versus off-beat). More broadly, these results support the hypothesis that neural responses to external rhythms influence higher-order cognitive functions, such as memory, by prioritizing processing at specific moments in time.

Topic Area: LONG-TERM MEMORY: Episodic

F70 ERP and Oscillatory Dynamics Differentiate Forget and Thought Substitution Cues in Intentional Forgetting

Ryan Hubbard[1], Lydia Jiang[1], Lili Sahakyan[1], [1]University of Illinois at Urbana-Champaign

Prior research has demonstrated that people are capable of intentionally forgetting information when instructed to do so. One popular method for studying forgetting is the directed forgetting paradigm, where 'forget' cues are presented either after each item (item-method) or after an entire block of items (list method). The specific mechanisms underlying directed forgetting remain a topic of debate, with accounts ranging from terminating rehearsal of forget items, direct suppression of forget items, or disengaging from contextual information through thought-substitution to reduce retrieval access for forget items. Here, we investigated these accounts by incorporating a thought-substitution condition ('Imagine' cue) along with Remember and Forget cues in an item-method directed forgetting paradigm. Imagine cues instructed participants to imagine themselves in a particular context following the presentation of each study word. This has previously been shown to shift context in list-method paradigms, but has never been examined in an item-method paradigm. Behaviorally, similar forgetting was found for Forget and Imagine cues, with both conditions producing lower recognition accuracy compared to Remember cues (n=28). Additionally, EEG was recorded during

instruction cues to examine neural activity related to remembering, forgetting, and imagining. Both event-related potentials (ERPs) and oscillatory activity dissociated remember and forget cues, as well as forget and imagine cues. These results suggest that different strategies can produce similar forgetting, but may rely on separable neural mechanisms. Our results may aid in adjudicating between theoretical accounts of the directed forgetting phenomenon.

Topic Area: LONG-TERM MEMORY: Episodic

F71 Whole brain ultrahigh resolution functional magnetic resonance imaging analysis of associative mnemonic processes

Stephanie Langella[1], Wei-Tang Chang[1], Weili Lin[1], Kelly Giovanello[1], [1]UNC-Chapel Hill

The hippocampus, which is integral for encoding and retrieving bound representations of events, can be anatomically segmented into subfields, which have differential roles in mnemonic processes (eg., mnemonic discrimination, match detection). Cortical regions across the brain are also critical for encoding associative memories; however, since standard functional magnetic resonance imaging (fMRI) spatial resolution precludes the ability to examine hippocampal subfield activity in conjunction with cortical regions, their roles are unstudied in the context of these subfield-level processes. The current project leveraged a novel imaging sequence that combines 1mm3 spatial resolution with a whole-brain field of view. Healthy young adults engaged in an associative memory task while undergoing fMRI. Participants were tasked to study and retrieve pairs of famous names and pictures of everyday objects. During the retrieval phase, pictures were either targets (the same picture as what was previously paired with the name), lures (very similar to but not the same as the original picture), mispaired (a previously studied picture but not with the given name), or novel (an unstudied picture). Evoked BOLD response was computed for each retrieval condition. Contrasts demonstrated marked differences in cortical activity during discrimination and match detection, as compared to retrieval of targets, in parietal and frontal regions, including dorsolateral prefrontal and orbitofrontal cortices. Additionally, lures elicited stronger activity in visual processing regions, whereas mispaired items elicited stronger temporal lobe activity. This study demonstrates the diffuse cortical activity that supports successful mnemonic discrimination and match detection, highlighting the importance of further examining hippocampal subfield-cortical activations.

Topic Area: LONG-TERM MEMORY: Episodic

F72 Test Query Affects Late Frontal Event-Related Potentials (ERP) During Recognition Memory

P. Andrew Leynes[1], Max D'Amato[1], Andrea DeRosa[1], Lauren Hollowniczky[1], Brandon Jackson[1], Nadeen Kamel[1], Patrick Manning[1], Maya Nandy[1], Jessica Robinson[1], Camara Seals[1], Abigail Shvorin[1], Tanushi Upadhyay[1], [1]The College of New Jersey

Recognition memory ERP studies have consistently reported an ERP component that reflects familiarity/conceptual fluency (i.e., FN400) and a component that reflects recollection (i.e., the Late Positive Component, LPC). The present study examined the effect of the test query focus during recognition. Thirty-five participants encoded words using a shallow task (i.e., counting number of vowels in the word) and then completed two recognition tasks that demanded yes/no responses. On one test, participants considered whether the probe was studied (i.e., 'Old?'), whereas they considered whether the probe was unstudied (i.e., 'New?') on the other test. The 'New?' query led to more correct rejections, fewer hits, and a more conservative decision criterion. The FN400 (400-600 ms) was observed during both tests, but the LPC (600-800 ms) was significant for only the 'New?' test. These results suggest that the test question alters decision criterion and affects the reliance on recollection to make a yes/no judgment. In addition, late ERPs (800-1000 ms) were more positive over right-frontal electrodes during the 'New?' test suggesting that detecting new items prompted more general monitoring processes like those that have been observed during tests of source memory (e.g., Wilding & Rugg, 1996).

Topic Area: LONG-TERM MEMORY: Episodic

F73 The reversion of information processing between episodic learning and retrieval across the adult lifespan

Seyedsoroush Mirjalili[1], Audrey Duarte[1], [1]Georgia Institute of Technology

Memory theories suggest that reconstruction of prior encoding experiences supports successful episodic memory and that the temporal dynamics of episodic reconstruction are reversed to those of encoding. However, it is unclear exactly how age and attention impact these dynamics. We designed a context memory task in which subjects encoded objects along with scene and color context features, one of which was to be ignored, to assess the hypothesis that low-level perceptual (color) features are encoded prior to high-level (scene) features, while high-level features are reconstructed prior to low-level ones during retrieval. To be more specific, we performed multivariate decoding analyses to investigate the time at which successfully remembered context features are most discriminable from forgotten contexts at both encoding and retrieval. We found that during encoding, low-level features were encoded earlier than high-level features while the opposite was found during retrieval, across age. However, the temporal dynamics were affected by attention, such that low-level context features were encoded earlier when they were attended and retrieved later when they were ignored (not attended). Importantly, age reduced the sensitivity of these temporal dynamics to top-down attention, consistent with an age-related difficulty using cognitive control to control episodic encoding and reconstruction. Collectively, these results suggest that while the reversion of information processing between encoding and retrieval is largely preserved with age, the ability to use top-down attentional control to impact these dynamics is not, which in turn contributes to worse memory performance.

Topic Area: LONG-TERM MEMORY: Episodic

F74 Did I see it? An event-related potential (ERP) study of material-specific prioritization of recollection

Arianna Moccia[1], Alexa Morcom[1], [1]University of Sussex

In order to prioritize recollection of sought-for information, people are thought to adopt retrieval orientations which bias their memory search. Previous studies have suggested that prioritization of recollection can occur when the targeted information is easy to recollect, or alternatively, when retrieval cues more strongly overlap with targeted memory traces. We investigated this using electroencephalographic event-related potentials (ERPs) in a recognition memory exclusion task. Participants studied object pictures and auditorily presented object names, then memory was probed with visually presented object names. When targets were auditory words, the left-parietal ERP old/new effect from 500-800 ms, associated with recollection, was reliable for targets but not for non-targets (items studied as pictures). However, when targets were pictures, a left-parietal effect was present for both targets and non-targets (items studied as auditory words), suggesting that recollection was prioritized only when participants used visual word cues to remember auditory words, as opposed to pictures. Since participants could identify targets from the picture source equally well and faster than targets from the auditory source, the ERP difference did not reflect easier recollection of auditory words. We also replicated Hornberger, Morcom & Rugg's (2004) finding that unstudied items elicited a widespread positive-going ERP effect between 300-

900 ms when auditory words versus pictures were targets, indicating that different retrieval orientations were adopted. The data favor a cue strength account, in which the degree of diagnostic overlap between retrieval cues and the targeted versus competing memory traces determines whether recollection can be prioritized.

Topic Area: LONG-TERM MEMORY: Episodic

F75 ERP evidence of suppression and intrusions of autobiographical memories of past immoral acts

Akul Satish[1], Robin Hellerstedt[1], Michael Anderson[2], Zara Bergström[1], [1]University of Kent, [2]MRC CBU, University of Cambridge

Memories of our past immoral acts can haunt us, leading to unpleasant emotions such as guilt and shame. People may therefore be motivated to suppress the memory by actively preventing thoughts of the event from coming to mind. Sometimes suppression fails however, leading to involuntary memory intrusions. Recent research has begun to delineate the cognitive and brain processes that underlie intrusions of relatively simple memories such as memories of words or pictures, but cognitive-neuroscience research on autobiographical memory intrusions is scarce. We used a modified Think/No-Think (TNT) task to investigate the intrusiveness of autobiographical memories of immoral acts and the underlying brain mechanisms as measured with EEG. Participants first generated 20 different memories of their own past morally wrong and morally right acts, and then completed the TNT task 24hrs later, where they were asked to either repeatedly think of these autobiographical memories or to try to prevent thinking of them, in response to cues. After each attempt, participants rated the extent to which the memory came to mind, in order to measure involuntary intrusions. Results suggest that unpleasant autobiographical memories of past immoral acts are more intrusive than memories of past moral acts. ERPs recorded during voluntary retrieval and suppression of autobiographical memories showed similar ERP effects as found in prior TNT research for simpler types of memories. Interestingly, these ERP components were different during initial attempts of retrieval vs. suppression compared to later attempts, and were also modulated by the morally right versus wrong nature of the memories.

Topic Area: LONG-TERM MEMORY: Episodic

F76 Temporal dynamics supporting the multidimensional quality of episodic memory

Helen Schmidt[1], Rose A. Cooper[1], Maureen Ritchey[1], [1]Boston College

Episodic memories contain a wealth of multimodal details that can be reconstructed with varying degrees of precision. Despite such variability, research has only recently begun to identify the neural processes supporting recovery of different kinds of memory features that have been bound to an individual episode. In a recent fMRI study, we showed that continuous measures of episodic memory quality were correlated with cortico-hippocampal network integration during episodic retrieval (Cooper & Ritchey, 2019). Furthermore, distinct neural processes supported memory precision for different kinds of memory features. The temporal dynamics of episodic reconstruction, however, remain poorly understood. In this study, we used EEG to investigate the timing of retrieval processes related to a measure of multidimensional episodic memory quality. Participants (N=23) studied a series of objects presented in a specific location within a 360-degree panorama scene, in a color sampled from a continuous color spectrum, and accompanied by either an unpleasant or a neutral background sound. In a memory test, participants were asked to recall each object's encoding event and reconstruct its original color and scene location, providing fine-grained measures of memory quality. Time-frequency analyses revealed that overall episodic memory quality was associated with widespread alpha and beta desynchronization occurring approximately 1000 to 2500 ms after cue onset. These effects were differently related to memory for individual features. When considered alongside our previous fMRI results, these findings suggest that successful retrieval is associated with large-scale network integration as well as temporal desynchronization as episodic memory features are reconstructed.

Topic Area: LONG-TERM MEMORY: Episodic

F77 The diminishing precision of temporal information in episodic memory retrieval

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

The temporal information signifying when a memory was encoded can play important roles in episodic retrieval, from distinguishing among multiple traces to effectively guiding search strategy. Numerous studies employing cognitive and neural measures have investigated changes in retrieval success for recent versus remote memory, but less is known about the precision of judging temporal information associated with individual memories, how precision might change over time, and how other decision factors influence such judgments. Here, we apply a computational approach commonly used to test retrieval precision in working and episodic memory to understand how the time when a memory was encoded is estimated. Subjects (N=32) first studied continuous lists of pictures and then undertook a test in which they placed each picture, as precisely as possible, along a continuous timeline of the study list. The primary results, based on mixture-modeling, were that precision was enhanced for items studied recently compared to more remotely, and there was virtually no contribution of guessing to such judgments. Finally, we observed a clear effect of response bias, whereby items tended to be judged as more recent then their actual study time. The results are discussed in the broader context of how recollection precision changes over time, and how memory for time might be distinct from that for other continuous features (e.g., spatial location, a color spectrum).

Topic Area: LONG-TERM MEMORY: Episodic

F78 Multi-Step Prediction and Integration in Naturalistic Environments

Hannah Tarder-Stoll[1], Christopher Baldassano[1], Mariam Aly[1], [1]Columbia University

Memories of past experiences allow us to flexibly anticipate future events at multiple timescales, including seconds, minutes, or hours in the future. Yet, most studies of prediction investigate only short timescales (Schapiro et al., 2012, Brown et al., 2016). How do we represent, and use, multiple timescales of prediction? We had participants learn sequences of rooms in immersive virtual reality. The same rooms were experienced in different orders along two routes, enabling the identification of context-specific learning. After learning, participants generated predictions about upcoming rooms up to five steps ahead in a given (cued) route. Participants successfully anticipated upcoming rooms in the cued route, identifying which of two rooms occurs sooner along the route with 88.4% accuracy. Performance decreased with distance into the future: accuracy was 90.2% for target rooms one step away and 83.9% for four steps away. Thus, individuals generate multiple timescales of predictions about upcoming events in well learned environments, and predictions flexibly change based on the context. To find further evidence of flexible predictions, we asked whether participants could learn a link between two of the sequences, and then predict upcoming rooms along this single, integrated route. Participants successfully updated their predictions to reflect the integrated sequence, and performance improved over time (final prediction accuracy of 86.8%). These results indicate that memory can be used to

generate predictions about future events along a range of timescales and, critically, such multi-step predictions can be flexibly updated in dynamic environments.

Topic Area: LONG-TERM MEMORY: Episodic

F79 Neural measures of subsequent memory reflect endogenous variability in cognitive function

Christoph Weidemann[1], Michael Kahana[2], [1]Swansea University, [2]University of Pennsylvania

Human cognition exhibits a striking degree of variability: Sometimes we rapidly forge new associations whereas at other times new information simply does not stick. Although strong correlations between neural activity during encoding and subsequent retrieval performance have implicated such 'subsequent memory effects' (SMEs) as important for understanding the neural basis of memory formation, uncontrolled variability in external factors that also predict memory performance confounds the interpretation of these effects. By controlling for a comprehensive set of external variables, we investigated the extent to which neural correlates of successful memory encoding reflect variability in endogenous brain states. We show that external variables that reliably predict memory performance have only minimal effects on electroencephalographic (EEG) correlates of successful memory encoding. Instead, the brain activity that is diagnostic of successful encoding primarily reflects fluctuations in endogenous neural activity. These findings link neural activity during learning to endogenous states that drive variability in human cognition.

Topic Area: LONG-TERM MEMORY: Episodic

F80 Event boundaries shape memory formation: evidence from single unit recordings in humans

Jie Zheng, Andrea Gómez Palacio Schjetnan[1], Taufik Valiante[1], Adam Mamelak[2], Jeffrey Chung[2], Gabriel Kreiman[3], Ueli Rutishuaser[2], [1]Krembil Research Institute, University Health Network, [2]Cedars-Sinai Medical Center, [3]Boston Children's Hospital

Our brain constantly segments continuous experience into discrete events ('episodes'), which enables the recombination of these events for adaptive future use. However, what indicates the onset and offset of an event and how such segmentation behavior influences later memory recall remain elusive. To investigate this, we tested subjects' memory of clips with boundaries (NB, continuous movie shot; SB, cuts to a new scene within the same movie; HB, cuts to a new scene from a different movie) while recording single neuron activity from 13 drug-resistant epilepsy patients. Their memory of clip content was evaluated in the scene recognition task, where they need to identify frames from watched clips as 'old' and novel frames as 'new'. Their memory of a clip's temporal structure was evaluated in the temporal discrimination task, where they need to identify which of two frames happened first in the original clip. We found higher recognition accuracy of frames presented shortly after boundaries while lower accuracy when recalling the temporal order of two frames separated by HB in the original clip. Such behavior outcomes confirmed the influence of boundaries on memory formation, highlighting variant representations of a continuous event and loose temporal associations across events. At the neuronal level, we found 39/266 putative boundary signaling neurons in the medial temporal lobe and their response strength (12/39) predicts subjects' memory performance. These findings provide initial steps towards elucidating the neural circuit mechanisms for event segmentation and suggest a putative role of these boundary responsive neurons in subsequent memory retrieval.

Topic Area: LONG-TERM MEMORY: Episodic

F81 Classifying EEG spectral features that predict subsequent memory performance across multiple sessions

David DiStefano[1], Elizabeth Race[1], [1]Tufts University

Prediction of subsequent memory using pre-stimulus electroencephalography (EEG) data has practical implications in cognitive science and brain-computer-interface (BCI) research. Prior research has demonstrated that it is possible to use machine learning to classify pre-stimulus EEG signals that predict whether a stimulus will be later remembered or forgotten. An open question is whether classification of brain states that predict later memory within a session can generalize to a novel dataset and predict memory performance in a different session. To investigate this question, the current study collected EEG data from seven participants while they performed a long-term memory task (Session 1). Participants were then brought back the next day for a second long-term memory task (Session 2). We then used a guided feature selection process to identify EEG frequency bands from the encoding portion of Session 1 that optimally trained support vector machines (SVM) for each participant to classify subsequent memory performance on held-out trials from Session 1. The subject-specific models optimized for Session 1 were then tested on Session 2 datasets, yielding greater-than-chance classification accuracy for 5-out-7 participants with a mean classification accuracy of 58% across all participants. These results suggest that individualized, frequency-based feature selection can provide useful input for EEG classification model design that generalizes to novel datasets and predicts memory performance across time. Additionally, these SVM results serve as a baseline for comparison of more promising models such as Bayesian neural networks.

Topic Area: LONG-TERM MEMORY: Other

F82 Differential Influence of Lesions to Ventromedial Prefrontal Cortex on Schema and Category Knowledge

Ariana Giuliano[1], Asaf Gilboa[1], Morris Moscovitch[1], Vanessa Ghosh[1], Kyra Bonasia[1], [1]University of Toronto & Rotman Research Institute

Prior knowledge (PK) has long been implicated in a variety of memory-related operations, such as acquisition and retrieval. Mnemonic effects of PK may result from its influence on how we interpret incoming information. To do so, PK must first be reinstated and instantiated as it interacts with incoming information. We focused on two types of PK, semantic categories presumed to be mediated by the anterolateral temporal lobes (ATL) and schemas, presumed to be mediated by the ventromedial prefrontal cortex (vmPFC). However, because semantic categories are also implicated in schematic knowledge, vmPFC damage may also impair category processing. Patients with vmPFC damage (n=11) and matched controls (n=13) brought to mind a schema or a category (reinstatement) and then classified stimuli belongingness to it (instantiation) while electroencephalography was recorded. Rejecting schema lures was slower than category lures, and patients had particular difficulty inhibiting competing information of both types. Reinstating PK was associated with pre-stimulus low-frequency vmPFC-posterior parietal desynchronization for schemas and lateral-temporal with inferotemporal for categories. Patients showed abnormal synchrony patterns in both conditions. Instantiating PK was indexed by post-stimulus low and high-frequency power decreases in the anterior neocortex. While some differences emerged between schemas and categories, the activity in the vmPFC and lateral temporal cortex overlapped considerably. Notably, however, only patients with damage to the subcallosal vmPFC showed deficits specific to schematic processing. We conclude that damage to vmPFC influences processing of both schemas and categories, but the underlying network-level mechanisms of this disruption differ.

Topic Area: LONG-TERM MEMORY: Other

F83 Cognitive biases linger after reading a transporting narrative

Buddhika Bellana[1], Christopher Honey[1], [1]Johns Hopkins University

Narratives have the ability to transport us into alternate worlds. The subjective experience of transportation is well-characterized, but we know little of its cognitive consequences. In this study, we asked how the experience of narrative transportation affects our patterns of subsequent thought. To this end, we measured 'spontaneous thinking', via a 5-minute free association task, before and after participants read a narrative text. In the 'Intact' condition, participants read a 271-sentence narrative, one sentence at a time, at their own pace. In the 'Scrambled' condition, participants read the same content, but with the sentences in a randomized order. We then used word-embeddings to examine how spontaneous free associations differed before and after participants read the story. Participants who reported stronger feeling of transportation during the story subsequently produced free associates whose semantic meanings were closer to the story themes. This was true irrespective of whether participants were in the Intact or Scrambled conditions. Surprisingly, we could not detect a post-stimulus semantic influence of the narrative amongst participants who were not transported; this was true even when they successfully understood the narrative (e.g., in the Intact condition, with high comprehension scores). Finally, we replicated these results in a second group of participants with a different published story. Overall, we observed lingering semantic biases after reading a transporting narrative; these lingering effects appeared to covary with the subjective experience of transportation, more than story comprehension.

Topic Area: LONG-TERM MEMORY: Priming

F84 Cerebellum and semantic memory: a TMS study with the DRM task

Daniele Gatti[1], Giuliana Mazzoni[2], Floris Van Vugt[1], Tomaso Vecchi[1], [1]University of Pavia, [2]Sapienza University Rome

It has been proposed that memory is not actually a memory system, but rather a predictive system. This view accounts for the 'errors' that memory makes under normal conditions and for the adaptive value of processes such as transformation, reconsolidation and updating. In the last decades, it has also been shown that the cerebellum is involved in a wide range of motor and non-motor functions linked to predictive processes. Neuromodulation studies reported cerebellar involvement in semantic domains, such as semantic prediction and semantic priming, but no brain stimulation study has directly investigated whether the cerebellum is also involved in semantic memory processes. Here, we administered online transcranial magnetic stimulation (TMS) during a classical semantic memory task, the DRM, to investigate the role of the right cerebellar hemisphere in semantic memory. The TMS was administered during the recognition phase over the right cerebellum and over the vertex as control condition. In Experiment 1, cerebellar TMS impaired participants' sensitivity for studied words compared to strongly related lures without affecting control conditions suggesting that cerebellar TMS had an enhancement effect on the gist trace that, according to the fuzzy-trace theory, is responsible for the production of false memories. In Experiment 2 we used a more complex version of the task, and cerebellar TMS impaired participants' sensitivity for studied words in general. Moreover, during cerebellar TMS participants' correct response latencies were faster compared to control stimulation. Overall, results support the hypothesis of cerebellar involvement in semantic memory.

Topic Area: LONG-TERM MEMORY: Semantic

F85 Desirable difficulty in Learning from Errors

Eugenia Marin-Garcia[1], Yeray Mera[1], [1]University of the Basque Country

Experimental evidence has shown that making errors, if it is followed by corrective feedback, can benefit learning. This effect has been usually found with semantically related learning material as word-pairs. The goal of this study is to investigate if learning from errors is modulated by semantic relationship of the stimuli. In Experiment 1, we manipulated semantic relationship by presenting a mixture of strongly and weakly semantically related word-pairs based on forward associative strength. Experimental procedure included learning phase, initial cued recall test followed by corrective feedback and final test. Results showed an interaction between semantic relationship (strong vs. weak) and learning experience on the initial test (error vs. correct). Only material with weak semantic relationship exhibited a significant error-generation benefit on the final test: there was a higher correct-answers percentage after experiencing an error on the initial test compared with experiencing a correct answer. In Experiment 2, the same procedure was followed with two groups of participants: one group studied semantically related word-pairs and the other group unrelated word-pairs. Results showed that there was an error-generation benefit on the final test for both, semantically related and unrelated material. However, the error-related benefit was greater for semantically unrelated word-pairs. Thus, in both experiments, less semantically related conditions and therefore, harder to learn conditions, benefited more from experiencing errors. Previous evidence has shown that certain difficulties increase long-term retention because greater elaborative processing and attention are engaged responding to difficulties. Error learning benefit may be relying on these processes as well.

Topic Area: LONG-TERM MEMORY: Semantic

F86 High and low-frequency cerebellar stimulations modulated the performance of procedural learning task

Yun Lien[1], Shang-Hua Lin[1], Ching-Po Lin[1], Li-Hung Chang[1], [1]National Yang-Ming University

Could cerebellar modulations influence the process of learning? In recent years, more and more studies demonstrated that the cerebellum involves not only motor processing but also several cognitive skill acquisitions. However, how the cerebellum contributes to those cognitive functions is not explicit. To address this question, we used repetitive transcranial magnetic stimulation (rTMS) to induce the frequency-dependent effect on the cerebral cortex. Here, forty-three participants were recruited and randomly assigned to high-frequency (HF, 10 Hz), low-frequency (LF, 1 Hz), and sham groups with different cerebellar rTMS interventions on cerebellar vermis. The standard pursuit rotor task was used to observe the performance of procedural learning and its associated visuomotor coordination functions. Our results demonstrated that the improvement of procedural learning ability in the HF group was significantly larger than the LF group (HF v.s LF: p

Topic Area: LONG-TERM MEMORY: Skill Learning

F87 Noninvasive stimulation frequency doubly dissociates cerebellar involvement in episodic memory ver linguistic prediction

Shruti Dave[1], Joel Voss[1], [1]Northwestern University

Cerebellar cortex is associated with a number of distributed brain networks serving cognitive functions, including episodic memory and language processing. How the cerebellum selectively interacts with distributed brain regions for distinct functional outcomes is currently unknown. One possible explanation is that functional coordination across the brain depends on synchronized interregional activity at different frequency bands. Episodic memory for instance, is associated with hippocampal-cortical synchrony in the

theta frequency band. In contrast, frontal, temporal, and parietal cortex exhibit beta-frequency synchrony during linguistic prediction. We sought to test if cerebellar participation in these functions could be biased by application of noninvasive brain stimulation (TMS) at frequencies matching each network's endogenous rhythm. Across 3 sessions, 24 adults received right lateral cerebellar stimulation at a theta-frequency (i.e., theta-burst) pattern, right lateral cerebellar stimulation at a beta-frequency pattern, and stimulation at an out-of-network control site. Relative to control stimulation, theta-burst stimulation improved episodic memory encoding, whereas beta-frequency stimulation had no effect on memory. In contrast, beta-frequency stimulation enhanced ERP correlates of linguistic prediction (i.e., the N400), whereas theta-burst stimulation did not. Significant cross-over interaction (p = .01) indicated that theta-burst versus beta-frequency stimulation frequencies doubly dissociated cerebellar involvement in memory versus linguistic prediction. These findings indicate that discrete cognitive abilities can be enhanced via appropriately patterned stimulation of cerebellum and supports the role of synchronized oscillatory activity in cerebellar interactions with distinct functional networks.

Topic Area: METHODS: Electrophysiology

F88 Cortical Activity Tracks Fractal Complexity in Both Artistic and Mathematical Images, but with Different Mechanisms

Stephanie Kane[1], Rebecca White[2], Eric Rawls[3], Carl E. Stevens, Jr.[1], Darya Zabelina[1], [1]University of Arkansas, [2]University of New Hampshire, [3]University of Minnesota Medical School

Previous electrophysiological studies have shown that viewing fractal patterns of differing dimensions in natural scenery and in computer-generated fractals leads to differences in brain activity. However, few studies have investigated electrophysiological brain activity in human-generated artistic fractals of varying dimensions. This study aimed to investigate differences in brain electrical activity while participants viewed and rated artistic- versus computer-generated mathematical fractals. Fractal dimensions describe how fractal patterns at different magnifications combine to form their final shape and fall between Euclidean dimensions (e.g., a line, D=1, and a filled plane, D=2). We recorded EEG while participants (n = 19) viewed a range of normally distributed fractal images with dimensions between 1.12 and 1.98 and rated how much they liked each image. Half of the fractal images were artistic (Jackson Pollock white layers), and each artistic fractal had a mathematical twin (random Cantor set) with the same dimension. EEG were decomposed to a time-frequency representation, and single-trial Spearman correlations were computed between fractal dimension and time-frequency EEG. Significance of correlations were tested using cluster-based permutation analysis. Results revealed that for the mathematical fractals, low-frequency power over central scalp locations accurately tracks fractal dimension. However, for the artistic fractals, low-frequency phase over parietal regions accurately tracks fractal dimension. This demonstrates that different brain regions (central versus parietal) and mechanisms (power versus phase) track complexity of artistic and mathematical fractal patterns, at approximately the same time scale. Future work will examine whether brain responses while viewing fractal patterns differ in high versus low creative individuals.

Topic: METHODS: Electrophysiology

F89 Developmental changes of brain rhythms to naturalistic social and non-social stimuli in infants: an MEG study

Taylor Chiang[1], J. Christopher Edgar[1], Samantha Lam[1], Heather L. Green[1], Luke Bloy[1], Emily S. Kuschner[1], Mina Kim[1], Jillian Lebus[1], Minhui Ouyang[1], Hao Huang[1], Timothy Roberts[1], Yuhan Chen[1], [1]Children's Hospital of Philadelphia

To better understand the contribution of neural network activity to social behaviors early in life, the present study evaluated associations between social brain measures and social behaviors in infants and toddlers aged 2-42 months. Using infant magnetoencephalography (MEG), neural activity was measured in 49 typically developing infants (411±295 days, 33 males) while participants viewed videos with social (women singing nursery thymes) and non-social (dynamic toys) content. For each infant, MEG was co-registered to an age-appropriate MRI template. Whole-brain source images were computed using dSPM, and the average power at pediatric delta (1-3Hz), theta (3-6Hz), and alpha (6-9Hz) frequencies estimated for social and non-social conditions. Social behaviors were measured using Vineland Adaptive Behaviors Scale-III. Significant differences in occipital theta and alpha activity were observed between social and non-social conditions (ps

Topic Area: METHODS: Neuroimaging

F90 Parcellating the social, cognitive, and motor topography of the cerebellum

Athanasia Metoki[1], Yin Wang[2], Haroon Popal[1], Nico Dosenbach[3], Ingrid R. Olson[1], [1]Temple University, [2]Beijing Normal University, [3]Washington University School of Medicine

The standard narrative about cerebellar function is that it plays a role in fine-grained motor functions. However, it is becoming increasingly clear that the cerebellum plays a functional role in many aspects of cognition. Whether its contribution happens in a domain general or domain specific way is heavily debated. To address this question, we used the Human Connectome Project (HCP) dataset, which is a large-scale multimodal neuroimaging dataset. We used fMRI task activation maps for emotion, language, motor, social, and working memory. We extracted clusters of activation for each task and local maxima within each cluster. Then we used the Sørensen?Dice coefficient to calculate the cluster overlap between each task and calculated the Euclidean distance between all peak activations (local maxima) within each cluster. Of the ten possible cluster pairs, only four displayed >10% overlap: language and social (46%), motor and working memory (21%), emotion and social (19%), social and working memory (11%). Within these overlapping clusters, language and social had two pairs of local maxima (out of 64) with a Euclidean distance

Topic Area: METHODS: Neuroimaging

F91 Using fMRI to model nonlinear interactions between brain regions

Craig Poskanzer[1], Mengting Fang[1], Aidas Aglinskas[1], Stefano Anzellotti[1], [1]Boston College

Whenever we perform a cognitive task, multiple brain regions are engaged, and information is transformed from brain region to brain region. A new method (MVPD, Anzellotti et al. 2017, Li et al. 2019, Fang et al. in preparation) goes beyond standard functional connectivity, capturing the interactions between multivariate patterns of response in different brain regions. In addition to being multivariate, interactions between brain regions are likely nonlinear. However, it remains unknown whether nonlinear models of the interactions between brain regions can be effectively estimated from fMRI data. We used artificial neural networks to model the interactions between brain regions during the viewing of complex visual stimuli (the film Forrest Gump), comparing out-of-sample predictions of linear and nonlinear versions of three different neural network architectures (1 hidden layer, 5 hidden layers, and a 5 layer dense net). We found that the relative effectiveness of linear and nonlinear models depended on the network's architecture and on the brain regions analyzed. Across all networks, linear models better predicted variance explained in a higher proportion of voxels (1 layer model: 55.31%; 5 layer model: 68.18%; 5

layer dense model: 68.07%), however, the voxels that were better explained by the linear models were significantly grouped in the posterior regions of the brain ($p = .002$). In contrast, voxels that were better explained by nonlinear models were consistently clustered in the anterior regions of the brain, though these clusters failed to reach statistical significance. This pattern of linear/nonlinear model performance was consistent across all network

Topic Area: METHODS: Neuroimaging

F92 Predicting Cardiovascular Disease Risk Using Functional Connectivity and Structural Morphology Metrics

Amy Isabella Sentis[1], Javier Daparte[1], Peter J. Gianaros[2], Timothy Verstynen[1], [1]Carnegie Mellon University, [2]University of Pittsburgh

Cardiovascular disease (CVD) may be influenced by the brain's regulation of autonomic and hemodynamic processes that maintain homeostasis. We previously demonstrated a unimodal pattern of brain activity that reliably associates with individual differences in stressor-evoked blood pressure reactivity, a predictor of poor long-term cardiovascular health outcomes. Recent work in the emerging field of neurocardiology has demonstrated the ability of brain-based markers to better predict CVD risk over conventional clinical markers. We hypothesized that a multimodal approach will generate a brain-based biomarker that reliably predicts a vascular marker of CVD risk, specifically mean intima media thickness (IMT). Neuroimaging and demographic data from 324 participants from the Pittsburgh Imaging Project were included in our analyses. We implemented a prediction stacking algorithm that combined multimodal neuroimaging data to predict mean IMT. Specifically, we included intrinsic networks of functional connectivity and subcortical and cortical structural brain metrics. Predicted and observed IMT were moderately related ($r = 0.23$, $p < 0.001$). Our model accounted for 5.3% of the variance, which is in the typical range for predication modeling given that a majority of the variance in mean IMT is accounted for by demographic factors, such as age and sex. This work builds on growing neuroimaging evidence by showing that functional and structural features of neural circuits, particularly those involving processing of stressful environmental events, may complement conventional risk factors for predicting CVD.

Topic Area: METHODS: Neuroimaging

F93 Relationship of mood, cognition and physical activity in Depression: Remote symptom monitoring using wearable technology

Nathan Cashdollar[1], Francesca Cormack[1], Maggie McCue[2], Caroline Skirrow[1], Jennifer Schuster[2], Nick Taptiklis[1], Emilie Glazer[3], Elli Panagopoulos[3], Tempest Van Shaik[3], Ben Fehnert[3], James King[3], Jenny H Barnett[1], [1]Cambridge Cognition, [2]Takeda Pharmaceuticals, [3]CTRL Group

The ubiquity of digital technology in our day-to-day life, such a mobile phones and wearable technology, has allowed researchers to capture the daily fluctuations in mood and cognition that many individuals with psychiatric disorders experience. Here we demonstrate the feasibility of remotely collecting cognitive data in individuals suffering from Depressive Disorder, as well as the relationship of these high-frequency cognitive assessments with the remote monitoring of symptoms and physical activity. This was a study of six weeks duration in 30 adults with mild-moderate depression, stabilized on antidepressant monotherapy. Daily remote data collection (via an Apple Watch) consisted of a working memory assessment (N-back) up to 3 times a day, self-reported mood assessments, step count and average heart rate. Participants showed an initial improvement in N-back performance, but reached a learning plateau on average of 10 days after study onset. N-back performance also showed a significant diurnal effect for the time of day, and step counts were lower at the beginning and end of each week. Higher step counts overall were associated with better N-back learning and increased daily step count was associated with better mood on the same and following day. Daily N-back performance covaried with self-reported mood after participants reached their learning plateau. The current results support the feasibility of deploying remote symptom monitoring techniques via wearable technology in psychiatric populations and establish methods for synthesizing high-frequency cognitive data, brief mood and biometric data in order to create sensitive digital profiles of clinical symptoms.

Topic Area: METHODS: Other

F94 Pattern-based genome-wide relatedness analysis of human brain structure

Bingjiang Lyu[1], Kamen Tsvetanov[1], Lorraine Tyler[1], Alex Clarke[1], Else Eising[2], Simon Fisher[2], William Amos[1], [1]University of Cambridge, [2]Max Planck Institute for Psycholinguistics

The human brain underpins various cognitive functions, however, the genetic association of its structure is still not fully understood. We adopted a pattern-based genome-wide relatedness analysis which correlates local genetic relatedness with brain structure relatedness between individuals in a population-based cohort. The local genetic relatedness was calculated using the genotyping pattern of neighbouring SNPs within a genetic block with fixed length, providing a more informative measure by combining multiple adjacent single nucleotide polymorphisms. This method greatly reduces the number of independent tests. Moreover, it provides a flexible way to incorporate co-factors, for example, genome-wide genetic relatedness which accounts for shared ancestry. We applied this method to genome-wide data and brain imaging data of a population-based sample of 708 healthy participants from the Cambridge Centre for Ageing and Neuroscience project. Specifically, we extracted the first principle components of regional grey matter (GM) volume and fractional anisotropy of white matter (WM) fiber tracts, which were used to calculate the brain structure relatedness of GM and WM. Brain structure relatedness of GM and WM was separately tested against local genetic relatedness of non-overlapping genetic blocks across the whole genome. Significance was determined by permutation test with up to 2 million randomizations. One hit block on chromosome 17 was identified for the GM, another hit on chromosome 10 was found for WM. importantly, these results were consistently found with different block lengths (i.e., 50KB, 100KB). Our approach provides a more robust and flexible way to investigate the genetic association of brain structure.

Topic Area: METHODS: Other

F95 Volumetric MRI Analysis of Brain Areas in Patients with ANKS1B Neurodevelopmental Syndrome

Ilana Deyneko[1], Abigail Carbonell[1], Chang Hoon Cho[1], Ana Francisco[1], Douwe Horsthius[1], Bryen Jordan[1], Sophie Molholm[1], [1]Albert Einstein College of Medicine

Haploinsufficiency in the gene ANKS1B underlies a rare genetic disorder that presents as a neurodevelopmental syndrome. This gene encodes the protein AIDA-1, which was shown to be present throughout the brain by mouse proteomic analysis. This potentially indicates a wide-spread influence of AIDA-1 on many neuronal functions, but it is unclear which areas of the brain are most affected by this disorder. Several families with deletions in this gene were found and diagnosed; a few of these families were brought in for more in-depth neuropsychological testing and neuroimaging at our institute. The symptoms of the affected patients include Autism, Attention Deficit/Hyperactivity Disorder, speech and motor deficits, and global developmental delays. Structural MRI scans were collected during clinical testing - based on the clinical read, the majority of the patients had abnormal findings such as dysgenesis or thin body of the corpus callosum and hyperintensities in white

matter. Additionally, we have obtained MRI scans of an ANKS1B deletion mouse model to complement our smaller patient population. Based on these findings, we are now studying the effects of this syndrome on specific areas of the brain within the patient population with a focus on the corpus callosum and the cerebellum. Preliminary quantitative analysis of the human and mouse sMRI scans using voxel-based morphometry indicates a smaller corpus callosum and a smaller cerebellum, which may explain the motor deficits. In conclusion, quantitative results support the original clinical read, and suggest possible functional properties of this gene for future analysis.

Topic Area: NEUROANATOMY

F96 Differences in Resting-State Midbrain Connectivity in Parkinson's Disease

Ian O'Shea[1], David Smith[2], Vishnu Murty[2], [1]Northeastern University, [2]Temple University

Functional MRI has shown dissociations between networks centered on Substantia Nigra (SN) and Ventral Tegmental Area (VTA; Murty et al., 2014). Connectivity of the dopaminergic midbrain is known to mediate the neurobehavioral deficits associated with Parkinson's disease (PD). During early phases of the disorder, PD is defined by degradation of the SN while sparing the VTA. Prior fMRI studies have characterized SN connectivity in PD using resting-state fMRI; however, these studies often utilized relatively small sample sizes. Further, prior research rarely characterized interactions across SN and VTA, which could be altered by sub-region specific changes in dopaminergic tone. Here, we characterized connectivity differences in midbrain sub-regions in PD patients and healthy controls. Using 3 publicly-available resting-state fMRI datasets (N=111; Badea et al., 2017; Tessa et al., 2019), we compared functional coupling of seeds placed in the VTA and SN with a-priori target ROIs. Results showed a group*seed interaction in the sub-genual cingulate (p

Topic Area: NEUROANATOMY

F97 Beyond Pavlov: Distinct Electrophysiological Responses to Aversive First-Order and Second-Order Conditioned Stimuli

Prateek Dhamija[1, 2], Lai Wong[1, 2], Asaf Gilboa[1, 2], [1]University of Toronto, [2]Rotman Research Institute at Baycrest

Stimuli in daily life only rarely directly co-appear with primary rewards or punishments, and so motivated behaviour is thought to be driven by complex higher order associations with stimuli that had acquired value through first-order conditioning. Rodent research has revealed distinct neural structures, including the hippocampus, are required for the formation and maintenance of higher-order but not first-order conditioning. In this study, we aimed to determine if this held true for humans with two predictions: (1) The electrophysiological responses of first order and higher order conditioning are distinct and (2) The hippocampus is involved in higher order associations. Participants underwent first order conditioning pairing tones (CS±) with either aversive bursts of white noise (unconditioned stimulus) or neutral tones. Subsequent second order conditioning paired CS+ and CS- with new tones (SO+ and SO-). Behavioural and neural responses were indexed by pupil dilation and electroencephalogram responses respectively in middle-aged participants (40 â?' 65 years, n = 18). CS+ tones led to a greater P200 component which was source estimated to left insula, whereas SO+ tones led to greater N150 component which was source estimated to posterior hippocampus. Both differences correlated with pupil dilation in the absence of a US. This experiment demonstrates that first order and second order conditioning have distinct temporal neural signatures and possible different sources of electrophysiological responses. Consistent with previous rodent studies, second-order conditioning may engage the hippocampus, suggesting a role for this structure in higher-order aspect of value learning.

Topic Area: OTHER

F98 Altered Resting-state Functional Connectivity Patterns Associated with Metabolic Syndrome

Barnaly Rashid[1], Victoria Poole[1], Francesca Fortenbaugh[2], Michael Esterman[2], William Milberg[2], Regina McGlinchey[2], David Salat[2], Elizabeth Leritz[2], [1]Harvard Medical School, [2]VA Boston Healthcare System

Objective: To examine whether metabolic syndrome (MetS), the clustering of three or more cardiovascular risk factors, such as hypertension, obesity and diabetes, disrupts the resting-state functional connectivity (FC) of the large-scale cortical brain networks, including the default mode (DMN), executive control (ECN) and dorsal attention networks (DAN). Methods: Resting-state functional magnetic resonance imaging (fMRI) data were collected from seventy-eight middle-aged and older adult (27 MetS; 51 non-MetS; 45-75 years). Surface-based functional parcellation was used to extract time series of intrinsic activity in the large-scale brain networks. The spatially averaged time series of the brain networks were then correlated with all brain voxels using a whole-brain seed-based FC approach. Group level analyses were conducted using multiple linear regressions. Results were corrected for multiple comparisons (p

Topic Area: OTHER

F99 The Emergence of Early Sound Categorical Responses in the Human Brain

Benjamin Lahner[1], Santani Teng[1,2], Matthew X. Lowe[1], Ian Charest[3], Aude Oliva[1], Yalda Mohsenzadeh[4], [1]MIT, [2]SKERI, [3]University of Birmingham, [4]University of Western Ontario

Environmental sounds are quickly transformed through a cascade of representations from the auditory mid-brain to higher level cortical areas, giving a complete understanding of the auditory environment in a few hundred milliseconds. Knowing whether a sound originated from an animal or an object, for instance, allows humans to effectively interact with their surroundings. Even though distinct brain regions have been found for different sound categories (Jung et al., 2018; Kim et al., 2011), the spatio-temporal dynamics involved in category-specific auditory analysis make it a difficult phenomena to investigate. Here, we specifically studied how different categories of sounds (human voices, animal noises, sounds generated by objects, and sounds from large scenes) are represented over time in the whole human brain. We extended the fMRI-MEG fusion approach of Cichy and collaborators (Cichy et al., 2016) to track down the regions and dynamics of particular types of sounds. Results show that sound representation emerge by 80-90 msec in the early auditory cortex, with responses diverging in different brain regions after 150 msec as a function of the sound category. These results suggest that some brain regions function as classifiers while other regions specialize in processing specific categories of sound. Understanding the auditory system's precise dynamics and organization responsible for this reliable and quick categorization presents an opportunity to develop robust and efficient artificial learning.

Topic Area: PERCEPTION & ACTION: Audition

F100 Interpretable model based phonetic selectivity using high density µECoG

Suseendrakumar Duraivel[1], Ken Chiang[1], Michael Trumpis[1], Charles Wang[1], Katrina Barth[1], Michael Haglund[1], Derek Southwell[1], Saurabh Sinha[1], Jonathan Viventi[1], Gregory Cogan[2], [1]Duke University

Previous work has demonstrated that the human auditory cortex encodes phonetic information during speech perception. The cortical mapping of these phonetic features can be used to develop effective speech prosthesis using ECoG; however, the micro-scale spatial specificity of these features is unknown. Decision tree analysis is an interpretable modeling technique that can characterize the spatial importance of electrodes for phonetic feature selectivity. We, therefore, combined high-density neural recordings with decision-tree models to produce interpretable phonetic maps in the human cortex. To validate this technique, we use an ensemble decision-tree model to predict neural-responses to auditory tones in the rat auditory cortex, since the tonotopy is well established. We played 13 different tones (90 trials each) and recorded cortical signals from an anesthetized rat's auditory cortex using a 60 channel (406 um pitch) μECoG array. Our results reveal an above-chance decoding accuracy in tone prediction (ROC-AUC: 0.93 ± 0.015), and we observed spatial clustering of decision weights for each tone in accordance with existing tonotopy. We then recorded human-cortical signals using a 256 channel (1.72 mm pitch) μECoG array implanted on the superior temporal gyrus of an awake epileptic patient who listened to 58 different sentences during resective surgery. Results (ROC-AUC: 0.74 ± 0.02) demonstrated spatial clustering of decision weights for certain classes of phonetic features. These findings indicate that phonetic information is spatially selective at the micro-scale in human STG, and the decision tree modeling can be a reliable tool for cortical phonetic feature mapping.

Topic Area: PERCEPTION & ACTION: Audition

F101 Implicit perceptual-motor learning of repeating auditory sequences

Y. Catherine Han[1], Paul Reber[1], [1]Northwestern University

The implicit extraction of regularities through experience is hypothesized to be important for language. Perceptual-motor sequence learning tasks with visual cues have established implicit learning without awareness, while statistical learning paradigms have demonstrated automatic extraction of regularities from auditory input. However, implicit auditorily-cued sequence learning is not well-established. Here, we report results from an auditorily-cued variant of the Serial Interception Sequence Learning task. Auditory cues signaled precisely-timed motor responses based on cue pitch, with keys D, F, J, and K mapped to distinct starting frequencies. Participants were not informed that a covertly embedded 12-item repeating sequence was present on 80% (training) and 33% (test) of trials. In Experiment 1, the offset of a glissando cue shape (20% rise in pitch frequency) signaled the timing of each motor response. In Experiment 2, motor responses were timed to the third onset of a three-cue sequence (100ms tones separated by 325ms on average). Participants exhibited sequence-specific learning via reliably greater motor response accuracy to cues within the repeating sequence than repeating foils, Experiment 1, $t(11)=2.3$, p

Topic Area: PERCEPTION & ACTION: Audition

F102 WITHDRAWN

F103 The Stochastic Resonance model of auditory perception: a unified explanation of tinnitus and Zwicker tone

Patrick Krauss[1], Achim Schilling[1], Holger Schulze[1], [1]University of Erlangen

Recently, Stochastic Resonance (SR) has been proposed to play a major role in auditory perception. SR is ubiquitous in nature and refers to a phenomenon where weak signals that are below a given threshold may be detected anyway if noise, i.e. a random signal of optimum intensity, is added to the signal of interest. At brainstem level, we propose SR to maintain optimal information transmission from the cochlea to the auditory system. Here, non-auditory projections from the somatosensory system to the dorsal cochlear nucleus would serve as an adjustable source of noise. By this, the auditory system could adapt to changes of the auditory input at second or even sub-second timescales. In case of chronically reduced auditory input, e.g. due to cochlear damage or synaptopathy, non-auditory projections would be disinhibited in order to improve hearing thresholds by means of SR. According to the SR model, this increased internal noise would correspond to the observed neuronal hyperactivity that is associated with subjective tinnitus. By this, hearing thresholds would be slightly improved. As a side effect, the increased noise would then be perceived as tinnitus. Along the same lines, transient phantom tone perceptions after ear plugging, or the Zwicker tone perception after stimulation with notched noise, may be explained. In addition, SR may also play a role at the cortical level, where it might explain a variety of phenomena of cross-modal enhancement.

Topic Area: PERCEPTION & ACTION: Audition

F104 Neural Resonance to Syncopated Rhythms: Model Predictions and Experimental Tests

Edward Large[1], Yi Wei[1], [1]University of Connecticut

We examined perception-action synchronization and neural responses to rhythms with no spectral energy at the frequency human listeners perceive a basic underlying beat or pulse (e.g., 'missing-pulse' rhythms). A dynamical systems model, based on Neural Resonance Theory (NRT), predicts that strong neural oscillations will emerge in a motor planning network at the missing-pulse frequency in response to 'missing-pulse' rhythms. First, in a behavioral session, we measured participants' ability to synchronize to missing-pulse, isochronous, and random-control rhythms. Next, in an EEG session, we measured participants' steady-state evoked potentials (SS-EPs) using a 256-channel, high-density EEG, and localized the neural responses using their individual MRI images. For the isochronous rhythm, we observed strong pulse-frequency SS-EPs in left and right primary auditory areas, left and right premotor cortex (PMC), right supplementary motor area (SMA), and left and right putamen. No pulse-frequency SS-EPs were observed in these areas for the random-control rhythm. For the missing-pulse rhythms, we observed strong pulse-frequency SS-EPs in right PMC and right SMA. Our results are consistent with a model of pulse perception that emerges from populations of oscillations arising in multiple, interacting brain regions.

Topic Area: PERCEPTION & ACTION: Audition

F105 Caesarean-section birth is associated with atypical intrinsic functional connectivity of visual regions in adulthood

Lily Solomon-Harris[1], Scott Adler[1], W. Dale Stevens[1], [1]York University

The rate of caesarean-section (C-section) births has been steadily increasing worldwide since the 1990s. While several studies have demonstrated that a range of early birth factors affect cognitive development, relatively few have examined the effects of delivery method. Adler and Wong-Kee-You (2015) demonstrated that human infants born via C-section have impaired stimulus-driven reflexive visual attention at 3-months of age. Moreover, they recently found that this effect persists into adulthood. We aimed to determine whether these deficits are associated with altered intrinsic functional network architecture in the brain. Multi-echo resting-state functional MRI scans were acquired from healthy young adults (n=81) who were born via vaginal delivery (n=61) or C-section (n=20). Seed regions of interest in bilateral primary visual cortex, the superior colliculi, and frontal eye fields were used to examine resting-state functional connectivity (RSFC) of these regions across the brain. Participants born via C-section showed stronger RSFC of left primary visual cortex and the superior colliculi with multiple regions, almost exclusively within the default network. Conversely, they showed weaker RSFC of the right frontal

eye field with visual and motor network regions. These results are striking in light of previous work demonstrating that stronger RSFC between primary visual cortex and the default network in healthy adults predicted worse performance on visual search tasks. Cognitive/perceptual deficits resulting from C-section birth have profound implications, given the rising prevalence of this procedure.

Topic Area: PERCEPTION & ACTION: Development & aging

F106 Visually guided movement with increasing Time-on-Task: Effects on movement preparation and movement execution

ÁRPÁD CSATHÓ[1], András Matuz[1], [1]University of Pécs

Prefrontally mediated and capacity limited cognitive functions seem to be particularly sensitive to the detrimental effects of fatigue induced by increasing Time-on-Task (ToT). Previous studies have also suggested that movement behavior, especially the preparatory phase, is costly in term of cognitive capacity. Yet effects of ToT specific to the different phases of movements have received little attention. Therefore, in two experiments, we assessed the effect of ToT on a visually guided pointing task. In both experiments, participants (n = 21 and 22) were instructed to point to targets by moving the cursor from the center to the peripheral target. In experiment 1, target stimuli appeared at one of the four positions. In experiment 2, there were 16 possible target positions enhancing the uncertainty about movement direction. The first three blocks of the task lasted 15 minutes without rest. Participants then had a 2-min break followed by an additional block of trials. Variables of movement preparation time, movement execution, and subjective fatigue were recorded. Movement execution was measured as movement time, movement error, peak velocity, path length-task axis length ratio etc. Gaze position recording was used to control fixation. In both experiments, the most robust finding was that movement preparation became slower with increasing ToT. In contrast, movement execution was associated with decreasing speed-accuracy trade-off: fatigued participants made faster but more erroneous movements. To conclude, the results suggest that enhanced level of mental fatigue is manifested in a slow preparatory phase followed by a faster but often more erroneous movement execution.

Topic Area: PERCEPTION & ACTION: Motor control

F107 Distinct causal contributions of DLPFC and M1 in long-term motor skill learning and performance

Taraz Lee[1], Quynh Nguyen[1], James Brissenden[1], Tyler Adkins[1], Katy Michon[1], [1]University of Michigan

Prior neuroimaging work has shown that local activity and the network connections of cognitive control regions such as the dorsolateral prefrontal cortex (DLPFC) show marked reductions as motor expertise develops. In contrast, motor cortex (M1) activity seems to steadily increase over the course of training. However, neuroimaging data can only provide correlational evidence. Here, we sought evidence for the causal role of both the DLPFC and M1 at different stages of motor skill learning by using a combination of fMRI and continuous theta-burst stimulation (cTBS) using transcranial magnetic stimulation (TMS). Participants trained on six motor sequences in a sequence learning task over 8 weeks. Two sequences were practiced extensively (1200 trials), two moderately (300), and two minimally (25). Following training, participants returned for three separate sessions and received cTBS over right DLPFC, right M1, or vertex (control condition) just prior to performance of all sequences during fMRI scanning. Sequence information could be decoded from a large swath of frontal and motor regions. The effects of stimulation on behavior was highly dependent on depth of training. M1 stimulation led to more marked deficits in the more extensively trained skills. In contrast, DLPFC stimulation led to impairments in performance across all skill levels with larger deficits for novice skills. These results provide evidence that cognitive control regions play a causal role in skilled performance at all stages of learning, but that their contribution diminishes as expertise develops.

Topic Area: PERCEPTION & ACTION: Motor control

F108 Neural correlates of the relation between body ownership and agency: a tDCS study

Angela Marotta[1], Massimiliano Zampini[2], Anna Re[3], Mirta Fiorio[1], [1]University of Verona, [2]University of Trento, [3]University of Messina

Willed actions are accompanied by the experience of controlling the own movements (sense of agency) and the feeling that the moving body part is belonging to the self (sense of body ownership). Agency and ownership have been mainly investigated separately, leaving unexplored the neural underpinnings of the relation between the two. This study explored the causal role of the premotor cortex (PM) and the cerebellum, in modulating the relation between ownership and agency. We used the moving Rubber Hand Illusion (mRHI). Participants looked at a rubber hand while moving their hidden hand. The type of movements (active or passive) and the posture of the rubber hand (plausible or implausible) differed among three conditions (active plausible, passive plausible, active implausible). Subjective reports and proprioceptive drift were used to measure ownership and agency. Anodal and sham tDCS were applied on the PM (Experiment 1) or the cerebellum (Experiment 2) prior the mRHI. We recruited 45 participants. Independently by the type or site of tDCS, subjective reports revealed that active plausible condition evoked both agency and ownership; passive plausible condition evoked ownership but not agency; active implausible condition evoked agency but not ownership. Moreover, in the active plausible condition, anodal tDCS over the PM reduced the drift, whereas anodal tDCS over the cerebellum increased the drift. Our findings suggest that facilitating the activity of PM or the cerebellum had different effects on proprioceptive component of voluntary movements, with the former (PM) preventing and the latter (cerebellum) increasing the proprioceptive drift.

Topic Area: PERCEPTION & ACTION: Multisensory

F109 Cross-modal or not cross-modal, that is the question: The study of aftereffect in variance perception

Sachiyo Ueda[1], Reiko Yakushijin[2], Akira Ishiguchi[3], [1]Toyohashi University of Technology, [2]Aoyama gakuin University, [3]Ochanomizu University

We could grasp various features of the outside world by summary statistics efficiently. Variance among them is an index of information reliability, and may affect perceivers' subsequent behavior because large variance may reflect latent anomalies or risks. Previous research showed that prolonged perceiving of ununiform stimuli in a visual property affected subsequent variance perception in different visual properties. In this study, we explored if adaptation to ununiform stimuli affected variance perception in different modality. Four experimental conditions (auditory_to_visual, visual_to_auditory, auditory_to_auditory, and visual_to_visual) were conducted. As an example, in the auditory_to_visual condition, participants first saw a sequence of visual stimuli in which the elements' size was perturbed with one of the six magnitudes of variance, and were required to classify the variance in each stimulus as relatively small or large. Then, they observed a sequence of auditory stimuli perturbed in pitch with certain variance (adaptation session). After that, they did the same visual variance classification task as before. We found that perceived variance got significantly larger after prolonged exposure to small variance adaptors when the adaptor and test stimuli were presented in the same modality. In contrast, when they were presented in different modalities, not the adaptation aftereffect but some priming effect occurred.

Our results indicated that the mechanisms of human variance perception are segregated between sensory modalities. We confirmed our results with cognitive modeling based on the Bayesian statistics.

Topic Area: PERCEPTION & ACTION: Multisensory

F110 Modulation of somatosensory interneural inhibition according to behavioral goal: going for overall gist or subtle detail

Irena Arslanova[1], Keying Wang[1], Hiroaki Gomi[2], Patrick Haggard[1], [1]Univesrity College London, [2]NTT Communication Science Laboratories

We are surrounded by abundance of stimuli that needs to be processed in a meaningful way to guide behavior. Perceptual studies have almost exclusively focused on brain's ability to select a subset of presented stimuli for preferential processing. Such selectivity is supported by interneural inhibition; whereby adjacent cortical areas tend to inhibit one another when simultaneously activated, leading to enhanced perception of subtle details. However, little is known about the capacity to bring together separate stimuli to build up a single unified percept. Here, we produced tactile motion trajectories in different directions along participants' right index and middle fingerpads. In half of the blocks, participants had to report the difference between the two motion directions (discrimination blocks), while in the remaining blocks they had to report the average direction between the two trajectories (aggregation blocks). During the inter-trial-interval, we delivered mild electrical shocks either to right index, middle, or both fingers simultaneously. In line with previous studies, we found that elicited somatosensory evoked activity to simultaneous shocks was smaller than the linear sum of activity for separate shocks ? a marker of intercortical inhibition. Importantly, the inhibition was significantly reduced when participants aggregated the two motion directions relative to when they discriminated the exact same stimuli. This suggests that interneural inhibition can be preparatorily adjusted depending on the behavioral goal. Overall, our results provide novel evidence for brain mechanism that can select whether our perception is dominated by overall gist or discriminative detail.

Topic Area: PERCEPTION & ACTION: Other

F111 The representation of micro-valences in high-level visual processing for everyday images

Lauren Chan[1], Elissa M. Aminoff[1], [1]Fordham University

Are complex properties, such as micro-valences, integrated in the neural representations of high-level visual stimuli? If so, does this predict behavioral preferences? Micro-valences are the subtle affective valences towards seemingly neutral stimuli. In order to investigate the effect of micro-valences on visual processing of complex images, we examined the affective ratings ('like', 'neutral', or 'dislike') and fMRI data of participants from the BOLD5000 dataset, in which they viewed 5000 'everyday' visual scenes taken from well-established computer vision image datasets such as COCO, ImageNet, and SUN (Chang et al., 2019). Initial analyses showed that affective judgement significantly modulated the BOLD response of at least two category-selective regions: the lateral occipital complex (LOC), a region selective for objects ($F(2, 1788) = 13.43$, $p < .01$), and the parahippocampal place area (PPA), a region selective for scene-processing ($F(2, 1788) = 48.35$, $p < .01$). The BOLD response from the PPA was higher in 'disliked' compared to 'liked' images; the BOLD response from the LOC was higher in 'liked' compared to 'neutral' images. From these results, we hypothesized that in 'everyday' images, object-focused stimuli would elicit positive micro-valences, while scene-focused stimuli would elicit more negative micro-valences. Follow-up ANOVAs revealed that object-categorized COCO images had a more positive affective rating compared to scene-categorized COCO images, $F(1, 4186) = 41.66$, $p < .01$. From this analysis, we suggest affect is an important component of high-level visual processing and should be incorporated into understanding the organization and representation of the ventral visual stream.

Topic Area: PERCEPTION & ACTION: Vision

F112 Koniocellular Pathway Contributions to Saccadic and Manual Responses to Threat Faces

Kestas Kveraga[1], [2], Hee Yeon Im[3], Noreen Ward[2], Reginald Adams Jr.[4], [1]Harvard Medical School, [2]Massachusetts General Hospital, [3]Boston Children's Hospital, [4]Penn State University

The human visual system employs parallel pathways that differ in their tuning to luminance, color, and spatial frequency. Recently, neuroimaging studies employing threat cues presented to the magnocellular (M) and parvocellular (P) pathways revealed differential responses to threat, with greater sensitivity to clear and ambiguous threat cues, respectively. While recent neurophysiology studies have found that simple K stimuli activated the superior colliculus, critical for directing attention and eye gaze, the role of the koniocellular (K) pathway in threat processing has been largely unstudied. To examine K pathway contributions to threat processing, we briefly presented peripheral face stimuli that were psychophysically biased towards M, P, or K pathways, by employing low luminance-contrast, isoluminant red-green and blue-yellow stimuli, respectively. Observers were presented with angry or neutral male and female faces and were instructed to report whether the face was angry or neutral while their eye movements and manual responses were recorded. We found that faces presented to the K pathway evoked saccades with the lowest latency, but the saccade latency did not vary with facial expressive and identity cues. Further, manual responses were also fastest to K-biased stimuli; however, manual response speed and accuracy varied as a function of facial expression and identity cues, depending on the pathway to which the stimuli were presented. Our findings provide initial evidence in humans that threat stimuli presented to the K pathway are able to evoke fast saccadic and manual responses, with the latter responses sensitive to compound facial threat cues.

Topic Area: PERCEPTION & ACTION: Vision

F113 Culture and Spatial Frequency Impact Perceptual and Attentional ERP Components

Tong Lin[1], Xin Zhang[2], Eric C Fields[1, 3], Robert Sekuler[1], Angela Gutchess[1], [1]Brandeis University, [2]Massachusetts Eye and Ear Infirmary, [3]Boston College

Although cross-cultural differences in 'higher-level' processes have been repeatedly demonstrated, recent work suggests that culture also may influence 'lower-level' perceptual processes, such as sensitivity for spatial frequency. In this study, we used EEG and Gabor patches of different spatial frequencies to investigate how individuals with distinct cultural backgrounds differ in the processing of lower versus higher spatial frequency information. 17 Americans and 19 East Asians were recruited from Brandeis University. Stimuli were Gabor patches of 4-degree angular size, with spatial frequencies ranging from 0.5 cycle per degree to 4 cpd. Participants fixated centrally, and Gabor patches were presented on either the left or right side of the screen for 100ms. To ensure participants were on task, participants were instructed to use peripheral vision to monitor onset of an intermittent red dot slightly below the fixation cross, and to press a button as soon as it appeared. We tested the effects of spatial frequency (LSF, HSF) and cultural background (Easterners, Westerners) in a 2 x 2 ANOVA. Although we were particularly interested in perceptual and attentional effects emerging between 100-300 msec at occipital and frontal channels, we used a mass univariate analysis that conducts statistical tests at each electrode and timepoint, applying multiple comparison corrections. Significant main effects of spatial frequency and culture emerged, with LSF evoking widespread effects between 200-300 msec

compared to HSF, and East Asians exhibiting a larger P3a component over frontal channels compared to Americans, indexing allocation of attention and expectations.

Topic Area: PERCEPTION & ACTION: Vision

F114 Reorganization of functional connectivity does not obviously explain outcome post-lobectomy

Anne Margarette Maallo[1], Erez Freud[2], Michael Granovetter[1], Marlene Behrmann[1], [1]Carnegie Mellon University, [2]York University

Resection of the epileptogenic zone largely results in seizure reduction in pharmacoresistant epilepsy. Many studies have noted cognitive improvements post-resection, especially when surgery is undertaken earlier in life. Despite the key role of vision in human behavior, rather few studies have explored outcomes following cortical resection of the occipito-temporal cortex in children, who have the most potential for recovery. We have shown that, while hemianopia persists and retinotopy does not reorganize post-surgery, intermediate and high-level visual abilities are within normal limits except in patients with significant comorbidities. The central question addressed here is what mechanism underlies the competence in those individuals with normal perceptual profiles. One hypothesis is the network reorganization in the contralesional hemisphere and perhaps even in the residual tissue in the ipsilesional hemisphere. This hypothesis was tested using pre- and post-resection data from six children who had undergone lobectomy. Using the BOLD response to visual category localizers, we explored the functional connectivity between different brain regions defined from anatomical parcellation. We then examined connectivity between visual category-selective regions present, as well as between networks for given category (e.g. face versus house networks). We also included the LGN and the pulvinar in the analysis, given claims that subcortical regions may regulate communication between cortical areas. The results show almost entirely typical functional cortico-cortical and subcortico-cortical connectivity within the contralesional hemisphere . These findings indicate that the positive cognitive outcome is not obviously a consequence of dramatically rearranged functional networks and that alternative explanations ought to be sought.

Topic Area: PERCEPTION & ACTION: Vision

F115 Pre-stimulation phase modulates high-beta TMS entrainment effects on conscious visual perception

Adrien Martel[1], Chloe Stengel[1], Monica Toba[1], Antoni Valero-Cabre[1], [1]Institut du Cerveau et de la Moelle Épinière (ICM)

Prior studies from our laboratory have shown a causal association between the entrainment of high-beta (30Hz) oscillatory activity with Transcranial Magnetic Stimulation (TMS) delivered to the right Frontal Eye Field (FEF) and improvements of conscious visual perception for near-threshold stimuli. However, the response to neurostimulation is known to depend in part on the cortical activity state at the moment of stimulation, raising the question whether the effects on conscious perception we observed previously are modulated by pre-stimulation brain activity. To this end, we re-analyzed electroencephalographic (EEG) data recorded on healthy human participants (N=14) while they performed a conscious visual detection task and were subjected to brief rhythmic (30Hz) or random bursts of Transcranial Magnet Stimulation (TMS), with an equivalent number and duration of pulses delivered to the right FEF prior to the appearance of lateralized near-threshold target. We pooled trials together according to correct (hits) and failed (misses) detection of the target and compared the EEG preceding the stimulation and subsequent target onset. Our results show significantly higher inter-trial phase theta synchronization over parietal areas prior to stimulation for hits when compared to misses, suggesting that there is a preferential phase for the TMS onset to maximize visual detection. These data are in accord with recently proposed models of attentional orienting that posit an interaction between attentional sampling in theta frequency and higher amplitude of beta and gamma rhythms in fronto-parietal networks during peak phase of theta oscillations.

Topic Area: PERCEPTION & ACTION: Vision

F116 Separating complex spatial perception from scene construction: fMRI and patient investigations of the hippocampus

Cornelia McCormick[1], Flavia De Luca[2], Ian A. Clark[3], Peter Zeidman[3], Marshall A. Dalton[4], Goffredina Spano[3], Thomas D. Miller[5], Meher Lad[6], Sinead L. Mullally[6], Timothy D. Griffiths[6], Clive R. Rosenthal[7], Eleanor A. Maguire[3], [1]University Medical School Bonn, [2]University of Sussex, [3]University College London, [4]University of Sydney, [5]Royal Free Hospital, UK, [6]Newcastle University, [7]University of Oxford

The hippocampus has been implicated in scene processing but it remains unclear how specific features of scenes such as their visual complexity, whether or not their content is naturalistic, and the nature of the cognitive process operating upon the scenes (e.g. perception or spatial construction) modulate hippocampal involvement. Here, we devised a novel paradigm where participants searched pairs of images for either colour (perceptual) or layout (constructive) differences. Importantly, images depicted either naturalistic scenes or matched, non-scene phase-scrambled images, as well as containing either a few (simple) or multiple (complex) elements. First, 20 healthy participants performed the task while undergoing functional magnetic resonance imaging (fMRI). We found that the hippocampus was engaged when participants processed naturalistic scenes but not scrambled images. In addition, the posterior hippocampus was recruited during perceptual scene trials while the anterior hippocampus was selectively engaged during constructive scene trials. Second, we tested 12 patients with bilateral hippocampal damage on a behavioural version of the task. The patients performed comparably to healthy controls when identifying differences between the scrambled image pairs, but were significantly worse at detecting differences between the pairs of naturalistic scenes. Of particular note, the effects documented in the fMRI experiment and the patient behavioural study were evident irrespective of the visual complexity of the images. We conclude that the processing and representation of naturalistic scenes, be they simple or complex, may be at least one key function of the hippocampus.

Topic Area: PERCEPTION & ACTION: Vision

F117 Novel objects in a rapid serial visual presentation (RSVP) stream elicit an attentional blink

Ryan Mruczek[1], [1]College of the Holy Cross

Long-term familiarity with objects alters the neural processing of those objects. Novel images are associated with higher levels of spiking activity in inferior temporal cortex and stronger low-frequency local field potentials (Anderson et al., 2008, CerebCortex). Familiarity is also associated with changes in object recognition efficiency. Visual search is faster when the distractors are highly familiar (Mruczek & Sheinberg, 2005, P&P). Here, it is shown that novel objects also disrupt serial visual processing in a manner akin to the attentional blink. Participants were trained to classify target objects (left or right, participant-specific arbitrary mapping) embedded in an RSVP stream. During a multi-day training phase, participants performed this task with a set of distractor objects. Thus, participant gained familiarity with this set of distractors, without mapping an explicit motor response to those images. Subsequently, participants performed the same target-classification task with a small number of novel distractors embedded in the RSVP stream. During this test phase, targets followed a 'key distractor' (either familiar or novel) with

varying lags (0-2 intervening distractors). Reaction times for correct target classification following novel, compared to a familiar, key distractors were significantly slower. This effect was most pronounced for targets immediately following the key distractor (0-lag, 200ms SOA), and was not apparent for longer lags (600ms). These results indicate that novel objects elicit an attentional blink, possibly due to associated prediction errors following unexpected stimuli (e.g., visual mismatch negativity) and the subsequent draw on attentional resources to resolve such prediction errors.

Topic Area: PERCEPTION & ACTION: Vision

F118 Effect of stimulus properties and task on electrophysiological dynamics in the human visual word form area

Clara Sava-Segal[1], Andreas Rauschecker[1], Clara Sava-Segal[1], Su Liu[1], Ren Na[2], Omri Raccah[1], Josef Parvizi[1], [1]Stanford University, [2]Peking University

The human visual word form area (VWFA) has been extensively studied with neuroimaging methods which lack precise temporal resolution and focuses largely on measures of response amplitude. We posit that our understanding of the VWFA functions has been limited due to lack of information about the precise timing and duration of neural responses during various stimulus and task conditions. Towards this aim, we recorded directly from the VWFA in seven participants using intracranial electrodes, while subjects viewed word form stimuli with different orthographic information, noise levels in different visual field positions. Our recordings revealed a delayed and reduced power of activity in the high frequency broadband (HFB) range within the VWFA when word stimuli were presented with noise or in the ipsilateral visual field, whereas real words, pseudowords, and consonant strings elicited similar magnitude and timing of HFB responses. Importantly, switching from incidental reading to lexical decision task had no effect on the timing, but increased the amplitude and duration of VWFA responses. In subjects with simultaneous recordings in lateral inferior temporal gyrus (LITG) language area and Broca's area (BA), we found the onset of activity in the BA and LITG to be simultaneous and consistently later than the VWFA activity. Finally, electrical perturbation of VWFA (3 left and 1 right hemisphere) disrupted subjects' reading ability. Spatiotemporal and causal findings extend our understanding of the privileged functional connectivity between the VWFA and language areas and support a clearly different routing of visual information during passive compared to active reading.

Topic Area: PERCEPTION & ACTION: Vision

F119 The 1-second boundary in time perception is a function of temporal processing windows

Franklenin Sierra[1], David Poeppel[2], Alessandro Tavano[1], [1]Max Planck Institute for Empirical Aesthetics, [2]New York University

"There is a consensus in the literature that there exists a cut-off between sub-second and supra-second time perception processes (e.g. Lewis & Miall, 2003; Buhusi & Meck, 2005; Karmarkar & Buonomano, 2007; Rammsayer & Troche, 2014). In three psychophysical studies in which participants judged the perceived duration of a test segment relative to a standard segment in the visual domain, we tested whether such a cut-off changes (i) as a function of inter-stimulus interval (ISI), a proxy for memory decay, or (ii) as a function of standard segment duration. In each study, we used a two-alternative forced choice design in which we adopted four different ISI durations, mapping the sub-second/supra-second range: 400, 800, 1600, and 2000 ms. Participants decided whether the standard duration (120, 160 or 200 ms, for Experiment 1, 2 and 3, respectively) or the test duration (standard duration + delta t) was longer. We conjectured that the shorter the ISI, the shorter the constant error (CE), as sensory memory decay would decrease performance. In fact, for 120-ms standard duration, longer ISIs translated into higher temporal sensitivity and discrimination, ruling out memory decay as an explanatory factor. Importantly, the benefit of longer ISIs disappeared once the standard duration was increased to 200 ms, at which point performance at all ISIs was statistically indistinguishable. Our results suggest that that sub-second/supra-second cut-off in time perception is a function of standard segment duration, possibly signaling a constraint in the precision of sensory encoding."

Topic Area: PERCEPTION & ACTION: Vision

F120 The Effects of Sleep on Neural Learning Signals

Mathew Hammerstrom[1], Wande Abimbola[1], Chad Williams[1], Olav Krigolson[1], [1]University of Victoria

The importance of sleep has become increasingly apparent; for example, the impact of non-REM sleep on memory consolidation. Indeed, Walker (2008) demonstrated that without adequate sleep, hippocampal function is disrupted and our ability to encode new memories is markedly decreased. But what about non-hippocampal learning systems? For instance, it has recently been posited that humans rely on a reinforcement learning system within the medial-frontal cortex for behavioural optimization. Further, there is currently a lack of research investigating sleep-related effects on other learning systems such as the aforementioned one within the medial-frontal cortex. Here, we sought to address this issue. Specifically, we had participants play a simple two-choice 'bandit' gambling game while electroencephalographic (EEG) data was recorded after obtaining data about their previous night's sleep behaviour. Post experiment, we examined the relationship between hours slept the night before and the amplitude and latency of the reward positivity â?' a component of the human event-related brain potential associated with feedback evaluation. Our results demonstrate a positive relationship between hours slept the night before and reward positivity amplitude. Further, we also saw sleep-related effects on the latency of the reward positivity. In other words, participants with more sleep had larger and faster EEG reinforcement learning signals. Given the increasing trend in society towards diminished sleep cycles, our results speak to a growing need for better sleep hygiene.

Topic Area: THINKING: Decision making

F121 A spatio-temporal analysis on neural correlates of intertemporal choice

Qingfang Liu[1], Woojong Yi[1], Brandon Turner[1], [1]The Ohio State University

Intertemporal choice requires choosing between an immediate smaller reward and a delayed larger reward. Previous studies suggest a delay discounting mechanism where the subjective value of monetary reward decreases with time delay and this subjective value is tracked by ventral medial prefrontal cortex and ventral striatum. Then an accumulation process subserved by dorsal medial frontal cortex (DMFC) and self-control mechanism subserved by dorsal lateral prefrontal cortex (dlPFC) together select a choice based on subjective valuation result. However, the mechanisms of how value accumulation and self-control interact to make a choice, and how self-control applies on the subjective valuation process remain elusive. To examine these questions in the time course of decision, we developed and performed an EEG experiment and manipulated the probability of choosing delayed option as an independent variable by a staircase procedure before the EEG session. A computational model equipped with mechanisms including power transformation of time and reward information, attention selection and stochastic value accumulation was developed and fit to choice and response time data in a hierarchical Bayesian approach. Phase-based functional connectivity between putative dmFC and posterior parietal cortex resembles the reconstructed accumulation dynamics from the best-fitting computational model on every experimental condition, and this functional connectivity tracks both value encoding and accumulator competition mechanisms. By combining

computational model and phase-based functional connectivity, our result suggests an interaction between choice valuation and accumulation competition in the time course of intertemporal choice.

Topic Area: THINKING: Decision making

F122 Variability in delay discounting is related to anhedonia in individuals exposed to multiple adverse childhood experience

Elizabeth Olson[1,2], Kevin Frederiks[1], Tate Overbey[1], Isabelle Rosso[1,2], [1]Mclean Hospital, [2]Harvard Medical School

"Background: Adverse childhood experiences (ACEs) contribute to negative physical and psychological outcomes, though there may be significant heterogeneity in response to ACE exposures. Delay discounting (DD) is a potential transdiagnostic marker of disinhibitory and reward-related psychopathology. Although accelerated DD in association with ACE exposure has been shown, clinical correlates of individual differences in DD in the context of high ACEs are unknown. Methods: DD norms were created using a sample of non-trauma exposed healthy controls (n = 18) who reported no exposure to ACEs and who had consistent DD data on a computerized paradigm. We defined normal-range DD as being no more than 0.5 SD accelerated versus this normative control group, and examined symptom profiles in ACE-exposed adults with and without accelerated DD. Results: Among individuals exposed to 4+ ACEs (n = 28), 16 participants showed normal-range DD (within 0.5 SD of the HC mean), and 12 had accelerated DD. There were no significant differences between high-ACE/normal DD and high-ACE/accelerated DD groups in overall PTSD or depressive symptom severity. Despite equivalent overall symptom severity levels, the groups significantly differed in anhedonia (Snaith-Hamilton Pleasure Scale), $F(1,23) = 4.33$, $p = .049$, partial eta squared = .159. Conclusion: While prior research demonstrates that increasing ACE exposure is associated with accelerated DD, our data suggest the presence of significant heterogeneity in DD, even in individuals exposed to four or more ACEs. These results suggest that DD could be used as a behavioral marker specifically sensitive to reward processing deficits within highly ACE-exposed samples."

Topic Area: THINKING: Decision making

F123 Uncovering the use of decision heuristics in a complex, uncertain environment: an eye-tracking study

Ramiro Eduardo Rea Reyes[1], Youngbin Kwak[1], [1]University of Massachusetts, Amherst

Prior research supports the use of decision heuristics, especially under a complex decision environment. Not much work describes what information search strategies are implemented. We focused on analyzing fixation patterns under a complex decision-making scenario, using eye tracking. Fifty subjects performed a 3-phase, 2-option forced-choice probabilistic paradigm, while we monitored their eye-movements. We presented two 2x2 grids, where each cell reflected binary cue domains with probabilistic weights reflecting the probability of winning. Training and first testing-phase (T1) had identical contingencies (D1=0.95/0.05; D2=0.8/0.2; D3=0.65/0.35; D4=0.5/0.5); the second testing-phase (T2) presented all domains with equal contingencies (0.8/0.2). The equal cue contingencies in T2 favors use of a compensatory strategy that equally consider all cue domains over heuristics. Participants chose the cue they considered had higher winning chances, which they learned through trial and error. We provided feedback (win/loss) after each trial. We found decrease in accuracy between T1-T2 ($F(1.97,96.77)=5.92$, $p=0.004$), suggesting use of a decision heuristic during T1 that prioritized certain cue domains and disregarded others. To characterize the search patterns, we tested if they followed the predictions of Take-The-Best (TTB), a heuristic that performs well in non-compensatory scenarios like T1. We found a linear trend on the proportion of fixations allocated across domains in descending order of importance ($t(138)=-4.88$, p

Topic Area: THINKING: Decision making

F124 The influence of positive and negative incentives on physical effort persistence

Yue Zhang[1], Xiamin Leng[1], Amitai Shenhav[1], [1]Brown University

A growing research body seeks to understand how humans weigh the incentives for exerting physical effort. To study trial-by-trial variability in effort-based choice, common tasks vary incentives and measure either which level of difficulty (physical demand) participants choose or how hard they work when they've been assigned a certain difficulty level. These tasks are unable to capture how incentives shape the amount of hard work participant choose to do. To fill this gap, we developed a novel paradigm in which participants are given fixed time intervals to complete as many trials as they want of a physical effort task. Each trial requires a short but rapid series of key presses, after which participants are immediately able to initiate the next trial. The incentives for completing these trials varied across intervals. Study 1 (N=22) varied the amount of money participants would receive for each trial completed in an interval. Study 2 (N=30) additionally varied whether the incentives were framed as positive reinforcement (as in Study 1) or negative reinforcement (avoiding potential loss). We found that participants completed more trials when incentives were larger ($ps < 0.01$) and when they were negatively rather than positively reinforcing ($p < 0.05$). These incentives effects were independently reflected both in how hard the participant worked within a given trial and how quickly they initiated the next trial. By providing a novel measure of voluntary effort persistence, this work carries promise for studying divergent incentive influences on effort allocation in healthy and clinical populations.

Topic Area: THINKING: Decision making

F125 Neuropsychological Outcomes of Children Under Three Treated with Proton Radiation Therapy

Safia Elyounssi[1], Sarah Burstein[2], Brendan Pulsifer[3], Matthew Jerram[1], Casey Evans[2,4], [1]Suffolk University, [2]Massachusetts General Hospital, [3]Bowdoin College, [4]Harvard Medical School

Introduction: Approximately 4,600 children are diagnosed with brain tumor (BT) annually in the US (20%

Topic Area: THINKING: Other

F126 The relationship between macroscale cortical motifs and distinct patterns of ongoing thoughts

Brontë Mckeown[1], Hao-Ting Wang[2], Will Strawson[2], Jonathan Smallwood[1], [1]University of York, [2]University of Sussex

Contemporary accounts of ongoing thought recognise it as a heterogeneous and multidimensional construct, varying in both form and content. An emerging body of evidence demonstrates that distinct types of experience are associated with unique neurocognitive profiles, that can be described at the whole-brain level as different interactions between multiple large-scale networks. The current study sought to explore the possibility that macro-scale whole-brain functional connectivity patterns at rest may be meaningfully related to patterns of ongoing thought that occurred over this period. Participants underwent resting-state functional magnetic resonance imaging (rs-fMRI) followed by a questionnaire retrospectively assessing the content and form of their ongoing thoughts during the scan. Advanced machine learning was applied to both the rs-fMRI data to identify components explaining the greatest variance in whole-brain connectivity patterns, and to

the questionnaire data, to identify components explaining dimensions that explained the variance in ongoing thought patterns. Multivariate analyses revealed that individual differences in whole-brain connectivity components, predicted distinct patterns of ongoing thought - highlighting the utility of macroscale patterns of brain organization as indices of different patterns of thoughts. These results add to an emerging literature that suggests that unique patterns of experience are associated with unique neurocognitive profiles.

Topic Area: THINKING: Other

F127 Facilitating problem solving with targeted memory reactivation during in-lab overnight sleep

Kristin Sanders[1], Kara Dastrup[1], Lane Patterson[1], Anjan Ghosh[1], Ken Paller[1], Mark Beeman[1], [1]Northwestern University

Numerous anecdotes and several experiments suggest that sleep facilitates problem solving, especially when the solution requires thinking about the problem in a new way. In a recent study (Sanders et al., 2019) participants attempted to solve puzzles, each paired with a distinct sound cue, during an initial evening session; then, while participants slept at home in their own beds, we presented some of the sounds associated with participants' unsolved puzzles. In the morning, participants solved more of their previously unsolved puzzles that were Cued during sleep than those that were not cued. The current study used the same general paradigm, except 40 participants slept in the lab while full EEG was recorded throughout the night, allowing the collection of better and additional sleep measures. Across participants, following the first night of sleep, participants solved more Cued than Uncued puzzles. Moreover, this cueing effect positively correlated with the number of cues presented and negatively correlated with measures of sleep disruption. However, following the second night, participants solved reliably fewer Cued than Uncued puzzles. Thus, across the two nights overall, we did not observe a cueing effect on morning solving. Differences between the two sessions suggest sound cues may not have been as effective on the second night of sleep.

Topic Area: PERCEPTION & ACTION: Vision

F128 Religiosity is associated with less prediction of the typical: an event-related brain potential study

Michael Kiang[1], Justice Cupid[2], Sarah Ahmed[1], Jennifer Lepock[1], Todd Girard[2], [1]University of Toronto, [2]Ryerson University

Why are some people more religious than others? Researchers have proposed that differences in how individuals process information may contribute to their degree of religiosity. According to one hypothesis, people with stronger tendencies to seek definitive explanations for situations with incomplete information are more likely to be religious. According to a different hypothesis, individuals who exhibit less brain signaling of 'prediction error' in response to unexpected stimuli may be more likely to discount evidence contradicting religious beliefs, making them more likely to maintain such beliefs. We sought neurophysiological evidence for these hypotheses using the N400 event-related brain potential (ERP) response, which is smaller to more contextually probable stimuli, reflecting prediction of probable completions for meaningful situations. We recorded ERPs from participants who viewed category phrases, each followed by a high-typicality category exemplar, low-typicality exemplar, or non-exemplar word. As expected, N400s were largest (most negative) for non-exemplars, intermediate for low-typicality exemplars, and smallest for high-typicality exemplars. Religiosity correlated with smaller N400 amplitude differences between high-typicality exemplars and both low-typicality exemplars and non-exemplars. The results suggest that people with less of a tendency to predict contextually probable relative to improbable stimuli, resulting in smaller prediction error signals, may be predisposed to develop or maintain religiosity.

Topic Area: THINKING: Reasoning