Session D

Monday, May 4, 10:00 am– 1:00 pm,

D1 Evoked responses to auditory vs. visual attentional cues in auditory spatial discrimination

Norbert Kopco, Safarik University, Kosice, Slovakia and Boston University, Rene Sebena, Safarik University, Kosice, Slovakia

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 (Kopčo 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 Line: ATTENTION: Auditory

D2 Withdrawn

D3 Disentangling top-down and bottom-up influences on blinks in the visual and auditory domain

Mareike Brych, University of Wuerzburg, Supriya Murali, University of Wuerzburg, Liyu Cao, University of Wuerzburg, Barbara Haendel, 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 Line: ATTENTION: Multisensory

D4 Transcranial direct current stimulation improves sustained attention in breast cancer survivors

Alexandra M. Gaynor, Memorial Sloan Kettering Cancer Center, Denise Pergolizzi, Universitat Internacional de Catalunya, Yesne Alici, Memorial Sloan Kettering Cancer Center, Elizabeth Ryan, Memorial Sloan Kettering Cancer Center, Katrazyna McNeal, Memorial Sloan Kettering Cancer Center, Tim Ahles, Memorial Sloan Kettering Cancer Center, James Root, 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 Line: ATTENTION: Nonspatial

D5 Simultaneous EEG-fMRI-tES reveals a visual-cortex-DMN system of sustained vigilance via alpha oscillations

Kevin Clancy , Melissa Meynadasy, Florida State University, Jessica Simon, Florida State University, Wen Li, 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 Line: ATTENTION: Other

D6 Consumer-Based EEG Devices-Are They Mind-Wandering?

Shenyang Huang, Duke University, Claire Simmons, Duke University Duke University, William Krenzer, Duke University, Nita Farahany, 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 Line: ATTENTION: Other

D7 Delineating the impact of mind wandering on event-based prospective memories with varying error-related consequences

Kristina Krasich, Duke University, Eva Gjorgieva, Duke University, Samuel Murray, Duke University, Felipe De Brigard, Duke University, Marty G. Woldorff, 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 Line: ATTENTION: Other

D8 Individual Differences in Self-Reported Autistic Traits and the N2pc

Jane Couperus, Mt. Holyoke College, Juniper Hollis, Hampshire College, Jess Roy, Hampshire College, Amy Lowe, Hampshire College, Cathy Reed, Claremont McKenna College, Cindy Bukach, University of Richmod

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 Line: ATTENTION: Spatial

D9 Influence of reward on attention selectivity in Parkinson's disease

Matthew Pilgrim, McGill University, Department of Neurology and Neurosurgery, Zhen Ou, McGill University, Department of Neurology and Neurosurgery, Madeleine Sharp, McGill University, Department of Neurology and Neurosurgery.

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 Line: ATTENTION: Spatial

D10 Probing the properties of priority maps in visual working memory

Jiangang Shan, University of Wisconsin, Madison, Bradley Postle, 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 Line: 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, Massachusetts Institute of Technology, Wanze Xie, Boston Children's Hospital, Michelle Bosquet Enlow, Boston Children's Hospital, Harvard Medical School, Charles Nelson, Boston Children's Hospital, 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 (β=-.151, p=.017) and (b) N170 latency to angry faces in the right occipital region (β =-.127, p=.048). Additionally, Internalizing T-scores were moderately associated with the ECBQ scale scores of Fear (r=.452, p<.001), Sadness (r=.344, p=.007), and Shyness (r=.617, p<.001), and the factor scores of Negative Affectivity (r=.571, p<.001) and Surgency/Extraversion (r=-.273, p=.033). These findings suggest that higher internalizing scores are associated with faster neural responding to angry faces in preschoolers. Further, several temperamental dimensions were correlated with concurrent internalizing scores. Identifying early neural and behavioral markers of anxiety risk will inform the design of identification methods and interventions to prevent the development of anxiety in at-risk children.

Topic Line: EMOTION & SOCIAL: Development & aging

D12 Fear of Negative Evaluation is associated with Connectivity Strength within Dorsomedial Default Mode Network

Ji Soo Lee, Department of Psychology, Seoul National University, Hairin Kim, Department of Psychology, Seoul National University, Seyul Kwak, Department of Psychology, Seoul National University, Jeanyung Chey, Department of Psychology, 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 Line: EMOTION & SOCIAL: Development & aging

D13 The Link Between Sleep Quality and Stress Reactivity

Harlan Fichtenholtz, Keene State College, Emily Whitman, Keene State College, Harlan Fichtenholtz, 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 Line: EMOTION & SOCIAL: Emotional responding

D14 Enhanced Emotional Responses to Live Facial Expressions

Chun-Ting Hsu, Kokoro Research Center, Kyoto University, Wataru Sato, Kokoro Research Center, Kyoto University, Sakiko Yoshikawa, Kokoro Research Center, 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 Line: EMOTION & SOCIAL: Emotional responding

D15 Stress Alters Within-Network and Between-Network Connectivity for Default Mode Network - A Simultaneous EEG-fMRI Study

Jeremy Andrzejewski, Florida State University, Kevin Clancy, Florida State University, Wen Li, 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 Line: EMOTION & SOCIAL: Emotion-cognition interactions

D16 Reinforcement Learning and Rock, Paper, Scissors

Gregory Gagliardi, Centre for Biomedical Research, University of Victoria, Chad Williams, Centre for Biomedical Research, University of Victoria, Cam Hassall, Centre for Biomedical Research, University of Victoria, Olave E. Krigolson, Centre for Biomedical Research, 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 Line: EMOTION & SOCIAL: Emotion-cognition interactions

D17 Inferring meaning from variably intense emotion expressions

Natalie Holz, Max Planck Institute for Empirical Aesthetics, Pauline Larrouy-Maestri, Max Planck Institute for Empirical Aesthetics, David Poeppel, Max Planck Institute for Empirical Aesthetics / 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 Line: EMOTION & SOCIAL: Emotion-cognition interactions

D18 Withdrawn

D19 Representation of Valence Across Studies

Svetlana Shinkareva, University of South Carolina, Chuanji Gao, University of South Carolina, Douglas Wedell, 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 Line: EMOTION & SOCIAL: Emotion-cognition interactions

D20 Impact of Perceived Stress on Brain Network Activation During Memory Retrieval in Adolescents

Jennifer Sneider, McLean Hospital/Harvard Medical School, Julia Cohen-Gilbert, McLean Hospital/Harvard Medical School, Emily Oot, McLean Hospital/Boston University School of Medicine, Anna Seraikas, McLean Hospital, Eleanor Schuttenberg, McLean Hospital, Derek Hamilton, University of Mexico, Sion Harris, Boston Children's Hospital and Harvard Medical School, Lisa Nickerson, McLean Hospital/Harvard Medical School, Marisa Silveri, McLean Hospital/Harvard Medical School

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 ($p<.001$). These measures were negatively associated with activation of a medial temporal lobe sub-network of the DMN (MTL-DMN), comprising hippocampus, amygdala and prefrontal cortex, during memory retrieval ($p=.003$, $p=.007$, $p=.015$, respectively). These findings suggest that internalized stress interferes with spatial memory and engagement of the MTL-DMN, that is implicated in episodic memory, autobiographical recall, and constructing mental models. These findings could reflect an early marker for mental health problems, underscoring the importance of elucidating relationships between neurobiology, cognition and psychological well-being during adolescent development.

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

D21 Withdrawn

D22 Insula Connectivity during Narratives Predicts Willingness to Donate to a Cause

Anthony Vaccaro, University of Southern California, Brandon Scott, University of Southern California, Sarah Gimbel, University of Southern California, Antonio Damasio, University of Southern California, Jonas Kaplan, 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 Line: EMOTION & SOCIAL: Other

D23 Empathy influences behavioral perceptions and eye movements in non-literal language processing

Gitte Joergensen, , Lauren Benson, Indiana University, Pavitra Makarla, University of Connecticut, Hana Kim, East Carolina University, Kathrin Rothermich, 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 Line: EMOTION & SOCIAL: Person perception

D24 The time course of processing authentic and fake emotional vocalisations.

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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 Line: EMOTION & SOCIAL: Person perception

D25 Wuthdrawn

D26 Investigating the emergence of expression representations in a neural network trained to discriminate identities

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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 Line: EMOTION & SOCIAL: Person perception

D27 The Self-enhancement Effect at Implicit and Explicit Levels: Their Complementary Relationship and Cultural Difference

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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 Line: EMOTION & SOCIAL: Self perception

D28 A fNIRS investigation of event-related, Go-No-Go task in children

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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 Line: EXECUTIVE PROCESSES: Development &aging

D29 A validation framework for neuroimaging software: the case of population receptive fields

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Neuroimaging software methods are complex, making it a near certainty that some implementations will contain errors. Modern techniques (i.e. public code and data repositories, continuous integration, containerization) enable the reproducibility of the analyses and reduce coding errors, but cannot guarantee the scientific validity of the results. It is difficult for researchers to check the scientific accuracy of software by reading the source code; ground truth test datasets are needed. We describe a computational framework for validating and sharing software implementations and apply it to an application: population receptive field (pRF) methods for functional MRI data. The framework is composed of three main components implemented with containerization methods to guarantee computational reproducibility: (1) synthesis of fMRI time series from ground-truth pRF parameters, (2) implementation of four public pRF analysis tools and standardization of inputs and outputs, and (3) generic report creation to compare the results with the ground truth parameters. The framework and methods can be extended to many other critical neuroimaging algorithms. In assessing generalization across four implementations, our results showed imperfect parameter recovery; we propose mitigation strategies, as this effect was present in all implementations. Computational generalization evaluation methods support scientific creativity, as opposed to the oft-repeated suggestion that investigators rely upon a few agreed upon packages. Having system testing protocols can help (a) developers, (b) researchers to verify the software's accuracy, and (c) reviewers to evaluate the methods used in publications and grants.

Topic Line: METHODS: Neuroimaging

D30 Real World Multitasking Experience Interferes with Lab-Based Volitional Multitasking

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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 Line: EXECUTIVE PROCESSES: Goal maintenance & switching

D31 The Hidden Cost of a Cell Phone: Behavioral and Neural Correlates of Attention and Cognitive Control Related to Smartpho

Joshua Upshaw, University of Arkansas, Carl Stevens, University of Arkansas, Giorgio Ganis, University of Plymouth, Darya Zabelina, University of Arkansas

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 Line: EXECUTIVE PROCESSES: Goal maintenance & switching

D32 Effects of Transcranial Direct Current Stimulation (tDCS) on Operator Vigilance: A Double-blind, Sham-controlled Study

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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 Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

D33 Incidental encoding reveals the time-varying nature of post-error adjustments in cognitive processing

Eva Gjorgieva, Duke University, Tobias Egner, 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 Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

D34 The Relation between Inhibitory Control and Neural Patterns of Reactivity to Craved Items

Melissa Moss, University of Oregon, Krista Destasio, University of Oregon, Brendan Cullen, University of Oregon, Elliot Berkman, 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 Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

D35 Frontoparietal Connectivity During Cognitive Control in Autism Spectrum Disorder

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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 ($p < .01$, $BF_{\neg 10} = 7.120$), 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 Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

D36 Examining Prefrontal Cortex Contributions to Cognitive Flexibility With Noninvasive Electric Brain Stimulation

Kent Hubert, Drexel University

D37 Cerebello-Striatal Resting-State Network Efficiency and Cortical Network Coherence

T. Bryan Jackson, TEXAS A&M UNIVERSITY, Jessica Bernard, 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 Line: EXECUTIVE PROCESSES: Other

D38 Neurofunctional Indices of Executive Functioning in Autism Spectrum Disorder

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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 Line: EXECUTIVE PROCESSES: Other

D39 Dissociated neural representations of content and structure in auditory sequence memory

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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 Line: EXECUTIVE PROCESSES: Working memory

D40 Frequent longitudinal sampling reveals learning-related changes in working memory substrates

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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 Line: EXECUTIVE PROCESSES: Working memory

D41 An EEG study of the role of executive control in individual differences in working memory

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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 Line: EXECUTIVE PROCESSES: Working memory

D42 Events structure information accessibility less in children than adults

Jie Ren, , Katherine Duncan, University of Toronto, Amy Finn, 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 Line: EXECUTIVE PROCESSES: Working memory

D43 Effects of attentional prioritization on the representation of content and of context in visual working memory

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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 Line: EXECUTIVE PROCESSES: Working memory

D44 Rotational remapping between 'decision-potent' and 'decision-null' representations in visual working memory

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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 Line: EXECUTIVE PROCESSES: Working memory

D45 Relationship of atrophy to task-related activity in the language network for different PPA clinical phenotypes

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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 Line: LANGUAGE: Development & aging

D46 Examining Relationships between Home Literacy Environment, Language and White Matter Tracts from Infancy to Toddlerhood

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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 Line: LANGUAGE: Development & aging

D47 Semantic substitution errors in Chinese reading aloud

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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 說 'say' instead of 問 '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 Line: LANGUAGE: Lexicon

D48 NSF Funding Opportunities for Cognitive Neuroscience

Kurt Thoroughman, NSF, Kurt Thoroughman, NSF

D49 Spatiotemporal dynamics of left Inferior Frontal Gyrus recruitment during spontaneous and cued speech production

Nikita Agrawal, NYU School of Medicine, Werner Doyle, NYU School of Medicine, Orrin Devinsky, NYU School of Medicine, Adeen Flinker, NYU School of Medicine

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 Line: LANGUAGE: Other

D50 The Relationship between White Matter Structural Integrity and Language Performance in Individuals with Aphasia

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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 ($p<.05$) was significantly associated with aphasia severity after Bonferroni correction. In brief, tractography through use of AFQ provided information regarding white matter structural integrity of the left hemisphere that related to aphasia severity. Discussion includes examination of pointwise statistics of specific parts of the tract and its relation to language

Topic Line: LANGUAGE: Other

D51 Alpha suppression increases during situation model construction: Neural evidence for the structure building framework

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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 Line: LANGUAGE: Other

D52 Musical Training is Associated with Better Reading and Differences in Resting State Functional Connectivity in Adults

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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 Line: LANGUAGE: Other

D53 Learning Swedish Predictive Tones Correlates with Grey and White Matter Reorganization

Mikael Novén, Lund University, Merle Horne, Lund University, Markus Nilsson, Lund University, Mikael Roll, 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 Line: LANGUAGE: Other

D54 Neuronal Activity Reveal Region-Specific Functionality for Language Perception and Production

Leyao Yu, NYU School of Medicine, Doyle Werner, NYU School of Medicine, Orrin Devinsky, NYU School of Medicine, Adeen Flinker, NYU School of Medicine

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 Line: LANGUAGE: Other

D55 Event-related brain potent effects of actions and role relations during second language picture-sentence verification

Pia Knoeferle, Humboldt-Universität zu Berlin, Katja Maquate, Humboldt-Universität zu Berlin, Jennifer Lewendon, Bangor University, Carsten Schliewe, Humboldt-University zu Berlin

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 Line: LANGUAGE: Semantic

D56 A comparison of three vector space models of word meaning for mapping the semantic system

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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 Line: LANGUAGE: Semantic

D57 Hemispheric asymmetries in processing semantic relationships during reading

Melissa Troyer, University of Western Ontario, Marta Kutas, 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 Line: LANGUAGE: Semantic

D58 Voice- and species-sensitivity in the event-related potential of miniature pigs

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Neuroimaging studies identified brain areas in humans, in non-human primates and recently, in non-primate mammals that preferentially process conspecific vocalizations compared to other vocalizations and environmental noises. The relative contribution of voice- and conspecific preference to these reported processing biases remained unclear. We examined for the first time the event-related potentials for voice perception in awake miniature pigs kept as companion animals (n=6) with non-invasive EEG. We played 80 pig-, 80 dog-, 80 human-vocalizations, and 80 environmental sounds in random order to pigs. We applied 4 electrodes, a frontal (Fz), a central (Cz) and a right temporo-frontal electrode and an electrode next to the left eye. EEG data was segmented from 200 ms before to 1 s after stimulus onset, and baselined. We removed movement artifacts 1) by automatic artifact-rejection based on extreme amplitude values, then 2) by observation of eye- and muscle-movements in the video-recordings and 3) by visual inspection of the EEG of the remaining trials. Using permutation statistics in 50 ms long time-windows, we found significant differences between the event-related potentials (ERPs) of conspecific and human voices (300-350 ms) and between the ERPs of conspecific and dog voices (400-450 ms) at Cz. ERPs of conspecific voices were different from ERPs of environmental sounds at 450-500 ms at the right temporo-frontal electrode. The ERP results suggest separate mechanisms for voice- and species-sensitivity in different time-windows and recording locations in family-raised miniature pigs. A central ERP component for species-sensitivity is followed by a later right-hemisphere ERP for voice-sensitivity.

Topic Line: PERCEPTION & ACTION: Audition

D58 Humor modulates prediction error updating in first and second language reading comprehension

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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 Line: LANGUAGE: Semantic

D59 Lists with and without syntax: Neural correlates of syntactic structure

Ryan Law, New York University Abu Dhabi, Liina Pylkkänen, 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 Line: LANGUAGE: Syntax

D60 Attention! Behavioral evidence of distinct contributions of attention and working memory to speech comprehension

Corianne Rogalsky, Midwestern University, Arianna LaCroix, Midwestern University, Cassandra Rehwalt, Arizona State University, Estefania Ordaz, Arizona State 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 Line: LANGUAGE: Syntax

D61 ERPs show preserved recollection but loss of familiarity in young adults who experience alcohol related memory blackouts

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Alcohol related Memory-Blackouts (MBO) are transient amnesic events caused by excessive alcohol consumption and are commonly experienced in young adulthood. It is well known that prolonged exposure to alcohol leads to increased apoptosis in the brain; therefore, we predict that repeated MBO events may also lead to structural/functional changes, particularly related to memory. The present study, the first of its kind, employed behavioural and EEG methods to examine differences in memory when sober between young adults who blackout frequently, and those who have never blacked-out. Forty participants (mean age = 21.56) were split into two groups, control (n= 18, 5 male) and MBO (n= 22, 10 males). Participants studied word-lists and then completed a recognition memory experiment under EEG, consisting of an old/new decision and a source task. We found no significant difference in behavioural accuracy between groups, consistent with existing literature. Control participants showed the classic left parietal ERP memory effect appearing as a graded increase in amplitude from correctly-rejected new words to successfully remembered old words. The experimental group responded similarly when successfully recollecting item and source (termed hit-hit trials), however, they surprisingly showed no significant difference between hit-miss (indexing familiarity) or correctly rejected trials. This suggests that even while sober, those who have experienced frequent MBO's may rely on abnormal compensatory strategies to discriminate between known and familiar episodic events. Future work needs to replicate this finding in older populations, who may be more heavily affected by the recurrence of MBO events across the lifespan.Topic Line: LANGUAGE: Semantic

D62 CSF tau levels correlate with age but not sex or MOCA in a memory clinic population.

Syra Mehdi, Alzheimer Disease Center, Shreya Nair, Alzheimer Disease Center, Anil Nair, 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 ($p<0.05$). Sex ($p = 0.664$), race ($p = 0.928$), MOCA ($p = 0.31$) were not associate with CSF tau levels.Conclusions: Variation in CSF tau protein levels is associated with age but not sex, race, or MOCA in the memory clinic sample.

Topic Line: LONG-TERM MEMORY: Development & aging

D63 Mindfulness training improves cognition and resting-state connectivity between the hippocampus and posteromedial cortex

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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 Line: LONG-TERM MEMORY: Development & aging

D64 Withdrawn

D65 Neural correlates of emotional episodic memory encoding and retrieval: Neuroimaging meta-analyses using seed-based d map

Kristina Dahlgren, Emory University, Charles Ferris, Emory University, Stephan Hamann, 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 Line: LONG-TERM MEMORY: Episodic

D66 Withdrawn

D67 Multi-unit activity in human MTL reflects retrieval of spatial and temporal context

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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 Line: LONG-TERM MEMORY: Episodic

D68 Warning eyewitnesses about misinformation influences sensory reactivation during memory retrieval

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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 Line: LONG-TERM MEMORY: Episodic

D69 Fitness and Stress as Modulators of Hippocampal Subfield Structure and Function in Aging

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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 Line: LONG-TERM MEMORY: Episodic

D70 Reinstated episodic context guides visual exploration during scene recognition

James Kragel, Joel Voss, 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 Line: LONG-TERM MEMORY: Episodic

D71 Cortisol-Testosterone Interactions on Approach/Avoid Behaviors and Emotional Memory Consolidation

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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 Line: LONG-TERM MEMORY: Episodic

D72 Holistic recollection and incidental reinstatement of scene context

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According to computational theories of memory, hippocampal (HC) pattern completion triggers recollection via reinstatement of distributed cortical representations of events. A strong version of this view predicts recollection will be holistic, with simultaneous reinstatement of multiple dimensions of unique events. In a preregistered functional magnetic resonance imaging (fMRI) study (https://osf.io/hndbq), participants (N=28) studied items as auditory words or pictures on scene backgrounds. At test, participants judged whether they had previously seen or heard items presented as visual words. Scene names were given as cues prior to test words, but source memory for study modality did not require any recall of the scene context. Representational similarity between multivoxel regional activity patterns at encoding and retrieval was computed after adjusting for cue-locked responses. Like Staresina, Henson, Kriegeskorte and Alink (2012), we found that when recollection was successful parahippocampal cortex (PHC) activity patterns were more similar to patterns observed during the original events ? even though scene context reinstatement was incidental to the source judgement. We also replicated Staresina et al.'s finding that over trials, HC activation predicted PHC reinstatement, with evidence also of scene reinstatement in HC. However, although PHC scene context reinstatement was again greater when remembering a particular item-scene pairing than when remembering the same scene, this event-unique reinstatement did not track successful recollection of the item's study modality. The data support the notion of HC-triggered cortical reinstatement of multiple information dimensions of experienced events, although recovery of the different dimensions may only be partially coupled.

Topic Line: LONG-TERM MEMORY: Episodic

D73 Neural mechanisms underlying face memories modulated by context-dependent impressions of trustworthiness for others

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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 Line: LONG-TERM MEMORY: Episodic

D74 Withdrawn

D75 Differential effects of reappraisal- and suppression-based regulation during retrieval of episodic memories

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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 Line: LONG-TERM MEMORY: Episodic

D76 Frontoparietal contributions to strategic criterion shifts during recognition memory

Tyler Santander, University of California, Santa Barbara, Elissa Aminoff, Fordham University, Michael Miller, University of California, Santa Barbara

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 Line: LONG-TERM MEMORY: Episodic

D77 Neural Correlates of Autobiographical Memory Retrieval: A Meta-Analysis Using Seed-based d Mapping

Susie Shepardson, Emory University, Kristina Dahlgren, Emory University, Stephan Hamann, 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 Line: LONG-TERM MEMORY: Episodic

D78 Neural representations of structured semantic knowledge mediate variability in episodic memory

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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 Line: LONG-TERM MEMORY: Episodic

D79 Targeted Memory Reactivation of Face-Name Associations Depends on Undisturbed Slow-Wave Sleep

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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 Line: LONG-TERM MEMORY: Episodic

D80 Differential Mnemonic Discrimination of Faces: A Contributing Mechanism to the Other-Race Effect

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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 Line: LONG-TERM MEMORY: Episodic

D81 Consumption of a fermented dairy beverage over four-weeks improves relational memory in healthy young adults

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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 Line: LONG-TERM MEMORY: Other

D82 Dissociating fMRI activity related to familiarity strength vs. decision criteria during recognition memory

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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 Line: LONG-TERM MEMORY: Other

D83 Using event related potentials to understand the effect of feedback timing on learning systems

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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 Line: LONG-TERM MEMORY: Other

D84 Disitinct disruption of functional connectivity in semantic dementia

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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 Line: LONG-TERM MEMORY: Semantic

D85 Waves of Binding: EEG oscillations during integration of visual, auditory, and lexical stimuli

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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 Line: LONG-TERM MEMORY: Semantic

D86 Behavior and neurophysiological correlates of sensitivity to positional regularity in a novel statistical learning test

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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 Line: LONG-TERM MEMORY: Semantic

D87 Distinct patterns of intrinsic spectral-power associations on the sub-second and seconds timescales

Marcia Grabowecky, Melisa Menceloglu, Northwestern University, Satoru Suzuki, 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 Line: LONG-TERM MEMORY: Semantic

D88 Uncovering dynamical states through concurrent electroencephalography (EEG) and electrocorticography (ECoG)

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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 Line: METHODS: Electrophysiology

D89 Withdrawn

D90 Using fNIRS to Determine Dual Task Walking Brain Activation Changes in Older Adults: Systematic Review and Meta-Analysis

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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, $p<0.01$), WWT (0.759,$p<0.01$) and OW tasks (0.195, $p<0.01$) are significant enough in showing PFC activation differences among different subgroups. Subgroup meta-analysis showed that SS (Stroke: 4.319, $p<0.01$) and WWT (Multiple Sclerosis: 1.344, $p<0.01$) can discriminate dual task HbO_2 mean differences better than OW in adults with neuromuscular disease. We also looked at the dual task cost prefrontal cortex activation differences between adults with and without neuromuscular disease during SS and WWT tasks. Conclusion: Our results revealed increases in brain activation among dual-task walking conditions such as SS and WWT. Older adults with neuromuscular disease generally showed increase in brain activation suggesting that they had to use more attentional resources during dual task walking, which could lead to increased fall risk and mobility impairments.

Topic Line: METHODS: Neuroimaging

D91 Predictive models of IQ from functional connectivity data may not be sex specific

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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<0.05; females-to-males: r=0.33, p<0.05). These performances were on par with sex-specific models (average sex-specific: r=0.38) and sex-combined models (r=0.40). However, when using only a single connectome for within sex predictions, sex differences in model performances were observed similar to previous literature. For example, the Social and Working Memory task performed significantly better in males (r=0.336, r=0.413) than females (r=0.103, r=0.099) respectively. Together, these results suggest that predictive models of IQ base on functional connectivity may not be sex-specific.

Topic Line: METHODS: Neuroimaging

D92 Withdrawn

D93 From Lab to Livingroom: The Validation of low-cost fNIRS

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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 Line: METHODS: Neuroimaging

D94 Modeling Degenerate Neural Architecture Using Neural Topographic Factor Analysis

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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 Line: METHODS: Neuroimaging

D95 A Regularization Method for Linking Brain and Behavior

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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 Line: METHODS: Other

D96 Early exposure to reading relates to leftward structural asymmetries critical for literacy development in pre-readers.

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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 Line: NEUROANATOMY

D97 Does functional connectivity within the DMN predict individual differences in social pleasure in schizophrenia?

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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 Line: NEUROANATOMY

D98 Age differences in cortical gyrification: Evidence from accelerated longitudinal datasets

Christopher Madan, University of Nottingham

Cortical gyrification decreases as we age, as has been shown in several studies using cross-sectional data. Interestingly, the topology of these changes bears little resemblance to the pattern of age-related differences in cortical thickness, indicating differences in the underlying biological mechanism. Here we examine gyrification in longitudinal data for the first time. Gyrification is examined in multiple samples of open-access MRI data, including several hundred individuals. We similarly observe age-related decreases in gyrification, but also observe limitations related to the interval between timepoints and reliablity of cortical reconstruction methods. Critically, by using longitudinal data, the specific folding patterns of individuals can be visualised across timepoints, providing further insights into these changes in cortical structure. Complementary measures of brain structure, such as sulcal morphology and angular power spectra of cortical folding are also examined.

Topic Line: NEUROANATOMY

D99 Withdrawn

D100 Withdrawn

D101 Low Socioeconomic Status as a Proxy for Stress in the Brain

Ashley Mensing, Columbia University, Kristin Maurer, Columbia University, Nikita Das, Columbia University, Eleanna Burns, Columbia University, Eleanna Burns, Columbia University, Yaakov Stern, 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=<.001; F=3.270, p=.01) with significant differences noted in mean volume between each SES group. Lower volume for both structures was observed in the middle range of SES values rather than the lowest as predicted. Differences in PFC thickness was also observed (F=5.02, p=.001), however this effect was driven largely by mean differences between the lowest ranked and the highest ranked participants.

Topic Line: OTHER

D102 Contextual constraint and key membership influence neural correlates of melodic prediction violations

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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 Line: PERCEPTION & ACTION: Audition

D103 Withdrawn

D104 Accuracy in chunk retrieval is correlated with the presence of acoustically driven delta brain waves

Johanna Rimmele, Max Planck Institute for Empirical Aesthetics Boston University, David Poeppel, New York University, Oded Ghitza, 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 Line: PERCEPTION & ACTION: Audition

D105 Learning and Reward through a New Musical System

Matthew Sachs, Northeastern , Euan Zhang, Northeastern Dana Walker, Northeastern, Psyche Loui, 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 ($p<.05$ FWE-corrected first-level analysis). Furthermore, a main effect of liking was observed in the VMPFC, STS/MTG, and SMA. The results provide evidence for a neural distinction between liking in a new music context and liking in a more familiar system.

Topic Line: PERCEPTION & ACTION: Audition

D106 Structural connectivity fingerprints of category-selective visual regions mature early in infancy.

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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 Line: PERCEPTION & ACTION: Development & aging

D107 Inhibitory Gating in Older Adults and Persons with Parkinson's Disease after a Socially Evaluated Cold Pressor

Andrew Zaman, Iowa State University, Elizabeth Stegemoller, 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 ($p<0.01$), cortisol ($p = 0.04$), systolic blood pressure ($p = 0.01$), and diastolic blood pressure ($p = 0.04$). No group differences or interactions were found for any of the measures. The decrease in gating following an acute stressor reflects a decrease of inhibition on sensory pathways and may be a mechanism associated with increased PD motor symptoms following

Topic Line: PERCEPTION & ACTION: Development & aging

D109 Neural reuse in the anterior insula? Disgusting smells selectively increase precision of visual looming perception

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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 Line: PERCEPTION & ACTION: Multisensory

D110 Withdrawn

D111 Neurofunctional correlates of body-ownership and sense of agency: a meta-analytical account of self-consciousness

Silvia Seghezzi, University of Milano-Bicocca, Gianluigi Giannini, University of Milano-Bicocca, Laura Zapparoli, 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 Line: PERCEPTION & ACTION: Other

D112 Sensitivity to information about face shape in the fusiform gyrus of congenitally blind individuals

Lukasz Bola, Huichao Yang, Beijing Normal University, Alfonso Caramazza, Harvard University, Yanchao Bi, 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 Line: PERCEPTION & ACTION: Vision

D113 Neural entrainment to synchronous and asynchronous observed human movement

Emiel Cracco, Ghent University, Haeeun Lee, Goldsmiths, University of London, Guido Orgs, 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 Line: PERCEPTION & ACTION: Vision

D114 Discriminability of Neural Patterns within the Magnocellular and Parvocellular Visual Pathways

Daniel Elbich, The Pennsylvania State University, Reginald Adams, The Pennsylvania State University, Kestutis Kveraga, Harvard Medical School, Nancy Dennis, The Pennsylvania State University

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 Line: PERCEPTION & ACTION: Vision

D115 Drawing as a window into visual learning and plasticity following treatment for congenital bilateral blindness

Sharon Gilad-Gutnick, Massachusetts Institute of Technology, Katharine Wu, Wellesley College, Juliette Sander, Wellesley College, Sunny Tang, Dartmouth College, Pragya Shah, Project Prakash, Priti Gupta, Project Prakash, Pawan Sinha, Massachusetts Institute of Technology

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 Line: PERCEPTION & ACTION: Vision

D116 Saccadic and Pupillary Response as Biobehavioral Markers in a Perceptual Organization Task

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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 ($p < .001$) and accuracy ($p < .001$). Saccades were identified by change in x,y coordinates above the 80th percentile, which segregated saccades from normal eye jitter. We found that total horizontal saccades were correlated with % organization ($p < .001$), whereas vertical saccades were not. These data represent the first evidence of biobehavioral markers for perceptual organization.

Topic Line: PERCEPTION & ACTION: Vision

D117 Rapid reorganization in adult human primary visual cortex and consequent perceptual elongations are mediated by GABA

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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 Line: PERCEPTION & ACTION: Vision

D118 Superior discrimination of complex biological motions in native ASL signers

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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 <.05, corrected). Hearing Non-signers showed differentiation between conditions in the theta range only starting 1000 ms after stimulus onset. Inter-trial coherence analysis showed Deaf Signers exhibit a significantly stronger early theta burst when seeing a coherent PLD compared to a scrambled PLD ($p < .05$, corrected), which is not seen in Hearing Non-signers. We suggest that native signers experience less effort and their brains more quickly discriminate between complex biological motion PLDs.

Topic Line: PERCEPTION & ACTION: Vision

D119 Information can be extracted from ventral stream multi-voxel patterns across spatial scales using the wavelet transform

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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 Line: PERCEPTION & ACTION: Vision

D120 How Frank Lloyd Wright Used Fundamental Mechanisms of Perception To Generate His Uniquely Powerful Aesthetics.

John Shoaff, 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 Line: PERCEPTION & ACTION: Vision

D121 Food choice reflected in brain activation: age matters.

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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 Line: THINKING: Decision making

D122 System Updating? Rational and Irrational Decision-Making in a Changing Task.

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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 Line: THINKING: Decision making

D123 Boundary Conditions for the Positive-Skew Preference in Risky Decision Making

Kendra Seaman, The University of Texas at Dallas, Sade Abiodun, 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 Line: THINKING: Decision making

D124 Opinion Changes on Debatable Arguments Involve Executive Process, but Opinion Amplification does not

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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 Line: THINKING: Decision making

D125 Prolonged Cannabis Use Decreases Cognitive Effort

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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 Line: THINKING: Decision making

D126 Effects of posterior-anterior shift in the aging brain on creativity: A combined ICA and resting-state fMRI study

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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 Line: THINKING: Development & aging

D127 The Role of Intuitions on the Emergence of Conscious Knowledge: Evidence from a Serial Reaction Time Task

Adam Weinberger, Georgetown University, Adam Green, 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 Line: THINKING: Other

D128 Simultaneous measurement of speech and autonomic nervous activity during a conversational creative problem-solving task

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Creative problem solving has been important for the advent of new technologies such as artificial intelligence. Since creative problem has no correct answer, it is difficult to evaluate quality of answer of the problem objectively. In this study, we assumed that subjective confidence in answer of the problem should be useful to evaluate the quality of answer. To extract an objective indicator of the confidence for real-time evaluation, we evaluated the confidence, speech, and autonomic nervous activity during a conversational creative problem-solving task. The task was pair work consisting of an answerer and a supporter. Since ten subjects participated and each subject participated as an answerer once and a supporter once, ten pairs participated totally. Each pair performed ten trials. We divided trials into two groups; high and low confidence trials based on answerer's confidence. Then we compared speech and autonomic nervous activity between two groups. Speech activity was evaluated using speech duration and number of short time utterances. As autonomic nervous activity, sympathetic nervous activity was evaluated using skin conductance. In high confidence trials, answerer's speech duration was significantly longer than that of supporter's, and answerer's number of short time utterances was significantly smaller than that of supporter's. In addition, answerer's skin conductance was significantly high and contrastively that of supporter was significantly low in high confidence trials, compared with those in low confidence trials. Results suggest that contrast differences of speech and sympathetic nervous activity between an answerer and a supporter are indicators of the confidence.

Topic Line: THINKING: Problem solving

D129 Higher intelligence is associated with a more effective adaptation of brain activity to cognitive demands

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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.

Topic Line: THINKING: Reasoning