Session A

Saturday, May 2, 1:30–4:30 pm, Exhibit Hall

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

Lars Hausfeld, Maastricht University - Dept. Cognitive Neuroscience; Elia Formisano, Maastricht University - Dept. Cognitive Neuroscience

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

Topic Line: ATTENTION: Auditory

A2 Development of Implicit Location Probability Learning

Saebyul Lee, Korea Brain Research Institute; Injae Hong, Yonsei University; Su Keun Jeong, Korea Brain Research Institute

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

Topic Line: ATTENTION: Development & aging

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

Sarah Izen, University of Massachusetts Boston; Vivian Ciaramitaro, University of Massachusetts Boston

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

Topic Line: ATTENTION: Multisensory

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

Simona Temereanca, Brown University; Chloe Zimmerman, Brown University Warren Alpert Medical School; Dylan Daniels, Brown University; Brendan Cullen, University of Oregon; Howard Hughes, Fordham University; Tariq Cannonier, Brown University; Catherine Kerr, Brown University; Stephanie Jones, Brown University

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

potential EEG biomarkers of physiological effects of movement therapy on sensorimotor function and attention.

Topic Line: ATTENTION: Multisensory

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

Kathryn Devaney, Boston University; Emily Levin, Brown University; Sara Lazar, Harvard Medical School; David Somers, Boston University

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

Topic Line: ATTENTION: Other

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

Olga Leticevscaia, University of Reading; Talia Brandman, Wizmann Istitute of Science; Marius Vincent Peelen, Donders Institute for Brain, Cognition and Behaviour

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

Topic Line: ATTENTION: Other

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

Kierstin Riels, Andreas Keil, University of Florida

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

Topic Line: ATTENTION: Other

A8 Multiple Object Tracking: The Perception of Object Ensembles

Reem Alzahabi, Tufts University; Matthew Cain, Tufts University

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

Topic Line: ATTENTION: Other

A9 WITHDRAWN

A10 WITHDRAWN

A11 Anticipatory Biasing of Visuospatial Attention in Deaf Adults

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

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

Topic Line: ATTENTION: Spatial

A12 WITHDRAWN

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

Nicole van Rootselaar, University of Lethbridge; Jeffrey MacCormack, University of Lethbridge; Robbin Gibb, University of Lethbridge; Fangfang Li, University of Lethbridge; Claudia Gonzalez, University of Lethbridge

When toddlers attempt to perform complex grasping actions (i.e. using a pencil), it apparent that their skilled motor control is not fully developed. Research suggests that the trajectory of lateralized grasping predicts the development of other abilities including speech and cognition. Previous studies show that children with greater right-hand use also demonstrate better speech articulation and executive function (EF: ability to regulate behaviour, make decisions and control emotions). An additional developing skill during childhood is social competence (SC). A child's ability to positively interact with peers is linked to measures of EF but has never been examined in relation to lateralized hand use. We assessed right hand grasping for construction in preschool children and compared it to their speech development (vocabulary and articulation), EF (card sorting tasks, parent questionnaires) and SC (child play interactions in pairs, parent questionnaire). We found significant correlations, where higher levels of right-hand use predicted better performance for measures of speech development, EF, and for the first time, SC. These results reveal an intricate connection between lateralized motor development and abilities often referred to as 'higher-level' cognitive skills. This study is the first step towards elucidating the role of hemispheric lateralization in relation to the development of speech, EF, and SC. Potential applications include investigating right-hand training as an accessible tool to promote development of speech, EF, and SC.

Topic Line: EMOTION & SOCIAL: Development & aging

A14 WITHDRAWN

A15 Identifying Audiovisual Affective Congruence from Brain Activation Patterns

Chuanji Gao, University of South Carolina; Christine Weber, University of South Carolina; Douglas Wedell, University of South Carolina; Svetlana Shinkareva, University of South Carolina

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

Topic Line: EMOTION & SOCIAL: Emotional responding

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

Sarah Kark, University of California, Irvine; Joren Adams, University of California, Irvine; Liv McMillan, University of California, Irvine; Michael Yassa, University of California, Irvine

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

to rewards (BAS-Reward Responsiveness) is related to a more directional progression through mesolimbic network configurations (i.e., preferred brain state transitions vs. traversing configurations with equal probability). Correlations survived controlling for negative mood symptoms. These findings suggest that reward sensitivity is related to the coalescence and dissolution of mesolimbic network configurations over time and highlight the utility of dynamic RSFC approaches.

Topic Line: EMOTION & SOCIAL: Emotional responding

A17 WITHDRAWN

A18 Art as creative inspiration

Edward Vessel, Max Planck Institute for Empirical Aesthetics; Dominik Welke, Max Planck Institute for Empirical Aesthetics; Isaac Purton, New York University

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

Topic Line: EMOTION & SOCIAL: Emotional responding

A19 WTIHDRAWN

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

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

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

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

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

Travis Evans, VA Boston Healthcare System; Jennifer Britton, University of Miami

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

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

A22 Tendency to Ruminate Predicts Higher Alpha Power During Resting State

Nicole Forner, University of New Hampshire

When an individual is ruminating, they get stuck on a particular thought and replay the thought over and over again. A higher tendency to ruminate is associated with cognitive inflexibility and higher power in the alpha oscillatory band (8-12 Hz) during recognition memory. Observing the relationship between tendency to ruminate and alpha power at rest would demonstrate whether individuals with a higher tendency to ruminate have a stronger internal focus of attention. Participants (n=43) in our study completed the ruminative

responses scale revised (RRS-R), Beck depression inventory II (BDI-II), and Beck anxiety inventory (BAI) followed by six minutes of quiet wakefulness with eyes open while their brain activity was recorded using EEG. Standard linear regressions were used to assess the relationship between tendency to ruminate and alpha power controlling for depression and anxiety levels, particularly in left frontal and posterior parietal brain regions based on previous work. A greater tendency to ruminate predicts higher alpha power in left frontal regions (sr2=.097, b=.300, SEb=.15, standardized beta= .348; t(36)=2.007, p=.052). The same pattern approached significance in posterior parietal regions (sr2=.092, b=.341, SEb=.172, standardized beta= .339; t(36)=1.986, p=.055). Higher alpha power associated with a greater tendency to ruminate could suggest that these individuals may tend to focus their attention inwards and may have a harder time flexibly shifting their attention towards task-demands.

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

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

Alexandra Kelly, Drexel University; Maurice Flurie, Temple University; Bonnie Zuckerman, Temple University; Jamie Reilly, Temple University

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

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

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

Claire Simmons, Duke University; Shenyang Huang, Duke University; William Krenzer, Duke University; Nita Farahany, Duke University

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

Topic Line: EMOTION & SOCIAL: Other

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

Livia Tomova, Massachusetts Institute of Technology; Kim Wang, Massachusetts Institute of Technology; Kay Tye, Salk Institute; Rebecca Saxe, Massachusetts Institute of Technology

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

Topic Line: EMOTION & SOCIAL: Other

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

Shotaro Fujiwara, Tohoku University; Ryo Ishibashi, Tohoku University; Azumi Tanabe-Ishibashi, Tohoku University; Ryuta Kawashima, Tohoku University; Motoaki Sugiura, Tohoku University

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

praises, but not when receiving flattery. There was also a significant correlation between the activity level of PCC and the degree of reliability the subjects felt with the sincere feedbacks ($r=0.43$ $p<0.01$). There were no other significant activation or its correlation with reliability in the five ROIs. The current results indicate that these two parts of the reward system respond to verbal praise when the person puts trust in the contents of the feedback. These regions, especially the PCC, potentially reflect the value of sincere evaluation of oneself by others, not the superficial meaning of the praise words.

Topic Line: EMOTION & SOCIAL: Person perception

A27 The Difference in Behavioral and ERP Responses to Static and Dynamic Facial Expression Portraying Threat

Megan Marshall, Keene State College; Megan marshall, Keene State College; Harlan Fichtenholtz, Keene State College

Two experiments were conducted to determine the behavioral and event-related potential responses to static and dynamic facial expressions portraying threat. Experiment 1 was designed to assess the differences in the subjective perception of emotional intensity for static and dynamic facial expressions of threat. Twenty-eight participants rated the intensity of emotional expressions that varied in the absolute intensity of the expression (neutral, 50%, 100%) and amount of movement (static, dynamic). Experiment 2 was designed to assess the differences in event-related potentials elicited by static and dynamic facial expressions of threat (in context of target detection task). Faces with neutral, fearful and angry expressions were presented. The results of Experiment 1 showed that across all participants, 100% intensity expressions were rated as more intense than 50% intensity expressions and fearful expressions were rated as more intense than angry expressions. The results of Experiment 2 showed that at occipital electrodes sites dynamic facial expressions elicited increased P2 amplitude in comparison to static stimuli. At parietal electrode sites (P7, P8) there was an interaction between expression and movement condition where increased P2 amplitude was recorded in response to dynamic expressions of fear, but not anger. Overall, there is an enhanced response to dynamic then static representations of threat.

Topic Line: EMOTION & SOCIAL: Person perception

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

Emily Przysinda, University of Rochester School of Medicine and Dentistry; Emily Dudek, University of Rochester; Bridget Shovestul, University of Rochester; Abhishek Saxena, University of Rochester; J. Steven Lamberti, University of Rochester Medical Center; David Dodell-feder, University of Rochester

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

Topic Line: EMOTION & SOCIAL: Person perception

A29 WITHDRAWN

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

Yaen Chen, Northeastern University; Lauren Raine, Northeastern University; Arthur Kramer, Northeastern University; Charles Hillman, Northeastern University; Psyche Loui, Northeastern University

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

Topic Line: EXECUTIVE PROCESSES: Development &aging

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

Srishti Nayak, Princeton University; Amanda Tarullo, Boston University

Robust associations have been demonstrated between family socioeconomic status (SES) and executive function (EF) skills such as inhibitory control (IC). What specific mechanisms carry out these effects on the structure, function, and development of the EF system? Sleep is recently emerging as an important factor in understanding EF in both normal and clinical populations. In this study we ask: are daily sleep habits and behavior one such mechanism in children? We measured 109 children's (6-8 yrs) inhibitory control skills through a visual Stroop task which elicited a Stroop Effects score. Parents completed the Child Sleep Habits Questionnaire alongside. As predicted,

lower family SES was associated with higher Stroop effects in our sample ($p<.001$). Further, based on preliminary correlational analyses, parent-reports of combined daily sleep amount (nighttime and naps) was identified as a mediator/moderator of interest. The moderation model tested showed that 16.8% of the variance in Stroop interference was explained by SES, daily sleep, SES*daily sleep interaction, and Age as a covariate ($p<.001$). Further, daily sleep moderated the relationship between SES and Stroop interference ($p<.01$). Specifically, lower SES was most strongly associated with higher Stroop Effects in children with 9 hours of combined sleep per day ($p < .001$). This association dampened with 10 hours daily sleep ($p <.05$) and disappeared with 11 hours. Daily sleep and SES were relatively high in our sample, making the buffering effects of increased sleep on EF particularly salient. Results raise questions about sleep norms, lower SES families, and disrupted EF contexts (e.g. ADHD).

Topic Line: EXECUTIVE PROCESSES: Development &aging

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

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

Topic Line: EXECUTIVE PROCESSES: Development &aging

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

Christina Boardman, University of California Santa Barbara; Evan Layher, University of California Santa Barbara; Jean Vettel, Army Reserch Labratory; Michael Miller, University of California Santa Barbara

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

Topic Line: EXECUTIVE PROCESSES: Goal maintenance & switching

A34 WITHDRAWN

A35 WITHDRAWN

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

Michael Dubois, University of Toronto; Alexandra Decker, University of Toronto; Katherine Duncan, University of Toronto; Amy Finn, University of Toronto

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

Topic Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A37 Network Coupling & Task Performance

Derek M. Smith, Northwestern University; Thackery I. Brown, Georgia Institute of Technology; Eric H. Schumacher, Georgia Institute of Technology

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

Topic Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

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

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

Topic Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

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

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

Topic Line: EXECUTIVE PROCESSES: Other

A40 NSF Funding Opportunities for Cognitive Neuroscience

Kurt Thoroughman, NSF

A41 Brain plasticity following Organizational Skills Training in elementary school students: A pilot resting-state study

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Deficient organizational skills in neurodevelopmental conditions like attention-deficit/hyperactivity disorder contribute to school failure and conflicts at home. Unlike stimulant medication, evidence-based instruction-focused interventions can remediate children's organizational functioning. This open-label single-arm trial used resting-state fMRI to examine the neural correlates of behavioral improvements following modified Organizational Skills Training (OSTm). Elementary school students (n=29, mean age=9.1 years, 9 female) with elevated, impairing organization, time management and planning skills on the Children's Organizational Skills Scale (COSS) underwent fMRI scans before and after 12 weeks of OSTm and provided high-quality imaging data (mean framewise displacement<0.07 mm). Following OSTm, COSS standardized scores for 80% of the sample fell below the clinical impairment cut-off, showing robust improvement in organizational skills ($p<0.01$, Cohen's $d=2.2$). Our hypothesized neural target was the intrinsic functional connectivity (iFC) between dorsal anterior cingulate cortex (dACC; MNI=8, 7, 38) and a pre-registered mask (https://osf.io/5m5sx/) in anterior ventral striatum (aVS). Pre- vs post-treatment dACC-aVS iFC changed with effect size=0.40(n=29) or 0.49(n=28 without one outlier). Notably, the change in dACC-aVSFP iFC (the pre-registered aVS mask corresponding to the frontoparietal network) accounted for 13% of the variance of the improvement in parent-reported COSS T-scores. Collectively, these results demonstrate successful modification of an evidenced-based OST intervention and link behavioral remediation to changes in iFC. If replicated, the current findings suggest that practical, positive changes in organizational, time management and planning skills are associated with alterations in resting-state connectivity and enable

exploration of neural targets as mediators of organizational functioning and clinical change.

Topic Line: EXECUTIVE PROCESSES: Other

A42 WITHDRAWN

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

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

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

Topic Line: EXECUTIVE PROCESSES: Working memory

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

Malayka Mottarella, University of Washington; Chantel Prat, University of Washington

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

Topic Line: EXECUTIVE PROCESSES: Working memory

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

Rachel Ratz-Lubashevsky, postdoc research associate; Michael Frank, Brown University

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

Topic Line: EXECUTIVE PROCESSES: Working memory

A46 Frontoparietal contributions to visual working memory precision

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

Topic Line: EXECUTIVE PROCESSES: Working memory

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

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

Topic Line: LANGUAGE: Development & aging

A48 Orbitofrontal Cortex Cell-types Differentially Encode Goal-Directed Decision-making Actions and Outcomes

Christian Cazares, University of California San Diego; Christina Gremel, University of California San Diego

Daily life involves making self-initiated decisions to select and execute the most appropriate course of action. While neurobiological investigations have identified a key role for orbitofrontal cortex (OFC) computations in decision-making, the specific cell populations within OFC underlying these computations are unknown. To examine OFC computations performed during ongoing decision-making actions, we used in vivo electrophysiology and virally mediated, genetically encoded fluorescent calcium indicators as proxies for OFC neuronal activity during an instrumental task where a freely moving mouse must hold a lever press down for an inferred minimum duration in order to get a reward. We used outcome devaluation procedures and found that performance in this task was under goal-directed behavioral control. OFC neurons differentially encoded lever press performance, demonstrating significant firing rate up- and down-modulation around lever press onset and offset. The magnitude of modulation at lever press offset was largely indicative of decision-making action outcomes, such that a support vector machine (SVM) decoder trained with peri-event OFC activity accurately classified whether a lever press succeeded in exceeding the hold down criteria. Furthermore, the spatiotemporal patterns of decision-making action encoding differed between genetically identified OFC cell-types, such that excitatory projections decreased and inhibitory interneurons increased their activity as animals were holding down the lever. Overall, our results suggest that the OFC dynamically encodes inferred goal-directed actions, and that this dynamic encoding is modulated by local circuitry excitation-inhibition balance.

Topic Line: THINKING: Decision making

A49 Planning nouns and verbs across semantic categories

Miriam Hauptman, New York University; Esti Blanco-Elorrieta, New York University, NYUAD Research Institute; Miriam Hauptman, New York University, NYUAD Research Institute; Liina Pylkkänen, New York University, NYUAD Research Institute

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

Topic Line: LANGUAGE: Lexicon

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

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

Topic Line: LANGUAGE: Lexicon

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

Kinsey Bice, University of Washington; Chantel Prat, University of Washington

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

Topic Line: LANGUAGE: Other

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

Allison Hancock, Utah State University; Carla I Orellana, Utah State University; Sushma Alphonsa, University of Nevada Reno; Tyson Barrett, Utah State University; Ron Gillam, Utah State University

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

Topic Line: LANGUAGE: Other

A53 Macro-Linguistic Gestural Facilitation for Narrative Discourse in Aphasia

Ted Jenkins, Rhode Island College

Hand gestures frequently communicate non-redundant information in tandem with spoken language. Embodied cognition theory often links such manual movements to reducing the cognitive load associated with certain language tasks. Previous studies have provided evidence of gestural facilitation in both typical and atypical populations in micro-linguistic measures (e.g., lexical retrieval), but often do not consider macro-linguistic ones (e.g., narrative organization). Persons With Aphasia (PWA), a population associated with issues of linguistic processing following neurological damage, are often observed to have increased gesture frequency during language production compared with controls. However, it is not known whether this increased gesture rate still plays a similar facilitative role in macro-linguistic production. The current study examined whether active gesture can predict increased narrative discourse production (micro- and macro-) between three different PWA groups (i.e., Anomic, n=15; Broca's, n=15; Wernicke's, n=15) and a typical control group (age and gender matched). Using a linear regression analysis of narrative retellings of the story of Cinderella, it was predicted that representational gestures (e.g., iconics), vs. non-representational ones (i.e., simple beats), would be linked to increased micro- and macro-discourse production. The results revealed for all groups that there was not the typical significant relationship between micro-linguistic production, but with macro-linguistic measures ($p<.05$). These findings suggest that when a language sample switches from a micro- to a macro-level task, the same facilitation is provided at a larger level. Encouraging more dynamic hand movements may facilitate discourse production on a macro-linguistic level in PWA.

Topic Line: LANGUAGE: Other

A54 WITHDRAWN

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

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Diagnosing speech impairment in traumatic brain injury (TBI) is difficult, as speech outcomes may be confounded by comorbid cognitive impairment. However, accurate diagnosis is necessary for selecting interventions and predicting outcomes. This study examines the contribution of cognitive impairment to speech outcomes in TBI. Twenty patients with moderate to severe TBI and nine controls participated. TBI patients were divided by cognitive scores: severe (MoCA 26). Speech outcomes of interest included: percent of pause (% pause) in reading sentences (short, 4-5 words; long, 10-14 words), spontaneous speech (cookie figure description), and recitation (prayer); articulation rate; diadochokinetic (DDK) rate; maximum phonation time (MPT); and maximum metronomic counting time (MCT). DDK rates were lower in TBI than in controls. Patients with severe cognitive sequelae showed higher % pause than controls in all the speech tasks. Patients with moderate cognitive sequelae showed higher % pause than controls in spontaneous speech and recitation, but not in sentence reading tasks. Across all groups, % pause was highest in spontaneous speech and lowest in short sentence

reading. No between-group differences were observed in articulation rate, MCT, and MPT. Results show a distinctive pattern of % pause that varies with cognitive impairment and task demand. The absence of differences in articulation rate, MCT, and MPT is indicative of preserved neuromotor control, in which cognition seems to play no role. Poor speech-motor outcomes in TBI, particularly delayed speaking rate, may be primarily driven by cognitive impairment.

Topic Line: LANGUAGE: Other

A56 WITHDRAWN

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

Yushuang Liu, The Pennsylvania State University; Janet van Hell, The Pennsylvania State University

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

Topic Line: LANGUAGE: Semantic

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

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

Topic Line: LANGUAGE: Semantic

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

Courtney Stevens, Willamette University; Seth Eggleston, Willamette University

Previous event-related brain potential (ERP) research suggests overlap in the neural systems subserving semantic processing in music and language. For example, prior research indicates that 1- to 10-second clips of classical music can establish a semantic context, with larger N400 responses to 'unrelated' versus 'related' visual word targets (Daltrozzo & Schön, 2008; Koelsch et al., 2004). Here, we examined whether a smaller unit of music, the two-note musical interval, could similarly establish a semantic context that affects the processing of subsequently presented single word targets. A total of 144 pairs of interval-word stimuli (e.g., octave [perfect 8th] - 'sunshine') were developed through two pilot studies. In the ERP study, adult participants (n=21) listened to a single musical interval lasting 1700 msec followed by visual presentation of a single word for 1500 msec. Participants made binary judgments to indicate whether they considered the word 'related' or 'unrelated' to the auditory prime. All target words appeared in both the 'related' and 'unrelated' position in three different interval conditions (harmonic, ascending, or descending). Similar to previous research that used musical excerpts as primes, results indicated that the two-note interval primes resulted in an enhanced negativity for predetermined unrelated versus related target words ($p < .05$, Cohen's $d = +0.47$). This effect was evident from 600-800 msec over central and parietal-occipital electrodes. These results suggest that discrete units of music as small as two-note musical intervals can carry semantic weight and influence the processing of words with established meanings.

Topic Line: LANGUAGE: Semantic

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

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Many aspects of a new language can be acquired and processed within minutes. Learners can rapidly acquire the skill to segment words, understand phonological regularities and identify meaning and grammar. Rapid learning is reflected neurophysiologically in quickly emerging event-related potential (ERP) patterns, affecting early, pre-attentive and later, more conscious processing. However, only words with native-language (L1)-like phonology influence the pre-attentive ERPs. We set out to investigate whether native language phonology also influences how novice learners respond to incorrect grammar in the newly acquired language. In a word-picture association-learning paradigm, learners (tonal and non-tonal speakers) were taught

artificial words that contained grammatical features (number and gender) embedded in vowels and tones. Occasional pictures that were inconsistent with one of the preceding word's phonological cues always elicited an N400 in learners with a tonal L1. Learners from a non-tonal background, however, only produced an N400 when the mismatch was based on the word's vowel, not the tone. Furthermore, we did not find any classical grammar-related ERP components (E/LAN, P600). The observed N400 could be thought to signal that an anticipated grammatical feature did not appear in the picture. This is supported by a correlation of N400 amplitude and response times. Learners with, e.g., a larger N400 for vowel-based mismatches, were faster at classifying the picture as incorrect when the vowel-related feature was mismatched. Importantly, only L1-like phonological cues could evoke predictions about associated features in upcoming pictures, emphasising the importance of transfer in initial second language acquisition.

Topic Line: LANGUAGE: Syntax

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

Jordan Chamberlain, The Pennsylvania State University; Nancy Dennis, The Pennsylvania State University

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

Topic Line: LONG-TERM MEMORY: Development & aging

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

Brenda Hanna-Pladdy, University of Maryland School of Medicine; Li Jiang, University of Maryland School of Medicine; Rao Gullapalli, University of Maryland School of Medicine

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

Topic Line: LONG-TERM MEMORY: Development & aging

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

Jordana Wynn, Rotman Research Institute, University of Toronto; Bradley Buchsbaum, Rotman Research Institute, University of Toronto; Jennifer Ryan, Rotman Research Institute, University of Toronto

Older adults often mistake new information as 'old', especially when that information feels familiar. This response bias has been thought to reflect pattern completion, the reactivation of a previously encoded stimulus in response to partial input. Yet, the degree to which this behaviour and the proposed underlying cognitive operation are related, and change with age, remains unclear. We used eye movement monitoring in conjunction with behavioural responses to quantify older adults' pattern completion bias as a function of eye movements during encoding and partially-cued retrieval. Analysis of eye movements revealed decreased encoding efficiency and increased retrieval-related reinstatement by older adults relative to younger adults. However, whereas younger adults utilized the reinstated encoding experience (i.e., gaze patterns) to support behavioural pattern completion (i.e., lure false alarms), older adults instead relied on reinstated encoded content (i.e., salient image regions). These findings provide critical evidence that age-related declines in pattern completion, and recollection more broadly, can be attributed to changes in both the content of encoded and retrieved representations, and the processes by which they support explicit memory judgements.

Topic Line: LONG-TERM MEMORY: Development & aging

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

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

Autism spectrum disorder (ASD) is a neurodevelopmental disorder traditionally characterized by impaired social interaction and communication, and restricted and repetitive behaviors and interests, but more recently has been associated with altered brain functional connectivity. A growing number of studies have further demonstrated that individuals with ASD exhibit a variety of impairments on long-term memory tasks. Given that a broad network of posterior medial, anterior temporal (collectively, the PM/AT network), and ventral frontal and parietal (VFP) regions have been shown to support the content and quality of episodic and semantic memory, understanding the altered connectivity within this network may help elucidate the nature of memory deficits in ASD. Here, we analyzed resting-state fMRI data in this network in over 200 individuals with ASD and age-matched controls, drawn from the Autism Brain Imaging Data Exchange (ABIDE I and II) and our own studies. Using multivariate pattern analysis (MVPA), we were able to decode

ASD diagnosis with over 80% accuracy based on connectivity across the PM/AT and VFP networks, with classification being highest when based on across- relative to within-network connectivity. Additionally, we observed distinct patterns of results for adolescents (13-17 years) compared to young adults (18-30 years), consistent with prior evidence that these age groups should be considered separately. These findings of intrinsic organizational differences involving memory subnetworks are discussed in terms of guiding our understanding of behavioral memory deficits in ASD.

Topic Line: LONG-TERM MEMORY: Episodic

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

Rose Cooper, Boston College; Maureen Ritchey, Boston College

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Nicholas Diamond, University of Pennsylvania; Brian Levine, Rotman Research Institute, Baycrest Health Sciences

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Lauren DiNicola, Harvard University; Rodrigo Braga, Stanford University; Randy Buckner, Harvard University

Recent within-individual analyses revealed that two parallel networks exist within the bounds of the canonically-defined default network (DN). These networks (A and B) are juxtaposed but distinct across distributed cortical zones (e.g., Braga & Buckner 2017 Neuron). Preliminary work examining these networks' functions revealed that Network A, linked to parahippocampal cortex, is preferentially recruited for Episodic Projection tasks (e.g., remembering), while Network B, linked to the temporoparietal junction, preferentially subserves Theory of Mind (ToM) tasks (DiNicola et al. 2019 bioRxiv). The present work sought to quantify whether such distinctions were limited to specific regions, aligning with prior, group-averaged work, or were present across distributed network zones. In an initial dataset, we scanned 6 individuals 4 times each and replicated a functional dissociation between Networks A and B, which preferentially subserved Episodic Projection and ToM tasks, respectively. Using a trial-level approach, we estimated 60 Episodic Projection and 40 ToM contrasts per network, for 5 distributed cortical regions within each individual. Across individuals, 18 of 30 region-specific tests found significant network by domain interactions (60.0%). 5 individuals showed interactions in 3 or more regions, including those along the midline previously considered DN hubs. Equivalent analyses of null data yielded only one false positive result (3.3%). After establishing analysis procedures, we replicated the approach and findings in an independent sample of 6 additional individuals (70.0% of regions show interaction effects; 0 false positives). These results refine understanding of how parallel, distributed networks in association cortex are organized to support task processing demands.

Topic Line: LONG-TERM MEMORY: Episodic

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

Carina Fan, Brian Levine, Rotman Research Institute; Michael Mack, University of Toronto

People differ in how they remember the past: some richly re-experience details from memories, while others recall only the gist of past episodes. Episodic memory contributes to a variety of functions such as future imagination and problem solving, but strong episodic memory abilities and a focus on specific details may hinder performance on tasks that require generalization or inference. As such, individual differences in episodic memory could relate to differences in more domain-general cognitive mechanisms of decision making. We measured self-reported episodic memory abilities in over two thousand participants and tested their performance on a grammatical reasoning task. There was a slight negative correlation between overall task performance and episodic memory ability, and we applied hierarchical drift diffusion models (DDM) to better understand the cognitive mechanisms that may underlie this effect. We compared the fit of three models, each regressing one DDM parameter on episodic memory abilities: drift rate (v), boundary separation (?), and non-decision time (t). The best model fit drift rate to memory abilities, indicating that individuals with lower episodic memory abilities were quicker to accumulate task-relevant evidence in making a correct decision. This suggests that individual differences in memory abilities can manifest in post-

encoding stages and in putatively non-mnemonic tasks. These results not only have theoretical implications for understanding individual differences in memory and how they relate to other areas of cognition, but they also extend the application of DDM to large datasets composed of many participants but few trials per participant.

Topic Line: LONG-TERM MEMORY: Episodic

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

Charles Ferris, Emory University; Sarah Taha, Emory University; Erin Morrow, Emory University; Cory Inman, UCLA; Stephan Hamann, Emory University

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Haley Fritch, Boston College; Preston Thakral, Harvard University; Scott Slotnick, Boston College; Robert Ross, University of New Hampshire

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Nghi (Nick) Hoang, University of Toronto and Rotman Research Institute; Fahad N. Ahmad, Rotman Research Institute, Baycrest; ZhongXu Liu, University of Michigan - Dearborn; Marilyne Ziegler, University of Toronto; Morris Moscovitch, University of Toronto and Rotman Research Institute

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

Topic Line: LONG-TERM MEMORY: Episodic

A72 Replay of novel spatial routes improves navigation in older adults

Bryan Hong, University of Toronto; Miranda Chang, University of Toronto; Shayna Rosenbaum, York University, Rotman Research Institute; Morgan Barense, University of Toronto, Rotman Research Institute

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

found that participants in the replayed condition had better temporal order memory and allocentric memory for locations encountered along the guided tour compared to participants in the non-replayed condition. A subsequent experiment using a within-subject design replicated this pattern of results. These findings suggest that reviewing rich video cues can improve learning of novel spatial routes in older adults.

Topic Line: LONG-TERM MEMORY: Episodic

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

Sara Y. Kim, University of Notre Dame; Jessica D. Payne, University of Notre Dame

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

Topic Line: LONG-TERM MEMORY: Episodic

A74 Distributed representations of remembered vs. imagined events

Robert Molitor, University of Oregon; Alexandra Tremblay-McGaw, University of Oregon; Sarah DuBrow, University of Oregon; Brice Kuhl, University of Oregon

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

Topic Line: LONG-TERM MEMORY: Episodic

A75 WITHDRAWN

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

Chloe Newbury, Royal Holloway University of London; Rebecca Crowley, Royal Holloway University of London; Kathleen Rastle, Royal Holloway University of London; Jakke Tamminen, Royal Holloway University of London

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

Topic Line: LONG-TERM MEMORY: Episodic

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

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Distinguishing between highly similar items in memory relies on the dentate gyrus (DG)/CA3 regions in the hippocampus. The Mnemonic Similarity Task (MST) Lure discrimination index (LDI) has been shown to be a sensitive behavioural measure of mnemonic discrimination. In this study, we aimed to test the sensitivity and specificity of the MST LDI score in community-dwelling older adults screened with the Montreal Cognitive Assessment (MoCA). The MoCA is a widely used screening measure for cognitive impairment, sensitive to several etiologies of cognitive dysfunction. Using regression analyses, we tested a sample of 88 participants (mean age = 70, n = 53 scoring 26 and above) to determine whether MoCA overall score, MoCA score without delayed recall subscale score, delayed recall subscale score, and overall cognitive status (overall score below or above a cut-off of 26) predicted MST

lure discrimination performance above demographic factors (age, sex, education). Regression models showed all measures were significant predictors of MST LDI performance, over and above demographic variables. In contrast, the visuospatial/executive functioning subscale score was not significant in a regression model ($p = .07$). Our results suggest the MST LDI score is sensitive to both delayed memory scores and overall cognitive status. Compared to computational models of LDI score relying solely on hippocampal DG/CA3 region integrity, these results question the idea that the MST LDI is sensitive only to memory. Instead, our results suggest that LDI scores relate to more general cognitive status in healthy older adult community dwelling populations.

Topic Line: LONG-TERM MEMORY: Episodic

A78 WITHDRAWN

A79 Targeted memory reactivation during sleep and memory suppression

Eitan Schechtman, Northwestern University; Anna Lampe, Northwestern University; Brianna J Wilson, Northwestern University; Eunbi Kwon, Northwestern University; Michael Anderson, University of Cambridge; Ken A Paller, Northwestern University

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

Topic Line: LONG-TERM MEMORY: Episodic

A80 Distinct neural substrates for scene perception and imagery

Adam Steel, Dartmouth College; Madeleine Billings, Dartmouth College; Caroline Robertson, Dartmouth College

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Preston Thakral, Harvard University; Donna Rose Addis, Rotman Research Institute; Daniel Schacter, Harvard University

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

Topic Line: LONG-TERM MEMORY: Episodic

A82 Effects of Enhancement and Suppression Cueing on Long Term Memory

Janis Gaudreau, Keene State College; Harlan Fichtenholtz, Keene State College

Previous research has found that more often participants are able to up-regulate their memory, or remember stimuli because of cueing, rather than down-regulate their memory, or forget the stimuli because of cueing. EEG results from past research show that frontal positivity is greater for items that were recognized with high confidence compared to those that were missed. The goal of the current study is to investigate whether cueing to remember or forget stimuli will affect visual long-term memory. Participants completed an encoding task in which the participant was cued to remember, forget, or view 300 pictures on an image by image basis. After a 2-minute rest period, participants were presented with a recognition memory test with 300 old and

300 new pictures responding if each was: (1) definitely an old picture, (2) maybe an old picture, (3) maybe a new picture, or (4) definitely a new picture. Behavioral results show that there is a significant impact of instructional cue on memory performance. Images receded by a 'remember' cue were recognized better than those preceded by either 'view' or 'forget' cues. Additionally, pictures preceded by a 'view' cue were recognized better than those following a 'forget' cue. During encoding, definite hits and definite misses show unique patterns of frontal positivity across suppression, enhancement, and passive viewing stimuli. Overall the outcome of this study is an addition to past research supporting the conclusion that people can enhance their own memory at will, but can also choose to suppress or forget information.

Topic Line: LONG-TERM MEMORY: Other

A83 Strategy Implementation and Feedback Processing in Healthy Young Adults

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

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

Topic Line: LONG-TERM MEMORY: Other

A84 An Afternoon Nap Enhances Repetition Priming and Antipriming

Anna B Madden-Rusnak, Texas State University; Rebecca G Deason, Texas State University; Chad J Marsolek, University of Minnesota; Carmen Westerberg, Texas State University

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

Topic Line: LONG-TERM MEMORY: Priming

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

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

Topic Line: LONG-TERM MEMORY: Semantic

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

Casey Imperio, CUNY: The graduate center; Elizabeth Chua, Brooklyn College, CUNY the Graduate Center

Improving memory via strategic control is a crucial skill that is thought to rely on outputs from metamemory monitoring. Previous research showed that metamemory monitoring accuracy improved with high definition transcranial direct current stimulation (HD-tDCS) over the left dorsolateral prefrontal cortex

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

Topic Line: LONG-TERM MEMORY: Semantic

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

Berry Van den Berg, University of Groningen; Timothy Sondej, University of Groningen; Marty Woldorff, Duke University; Monicque Lorist, University of Groningen

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

Topic Line: LONG-TERM MEMORY: Skill Learning

A88 Investigating theta oscillations in intermodal selective attention

Audrey Murray, Universite du Quebec a Montreal; Dave Saint-Amour, Universite du Quebec a Montreal; Isabelle Soulieres, Universite du Quebec a Montreal

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

Topic Line: METHODS: Electrophysiology

A89 DeepMedic for automated lesion segmentation in chronic stroke

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

Topic Line: METHODS: Neuroimaging

A90 Oral Contraceptive Pills Reduce Cortical Thickness in Inferior Frontal Gyrus

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Gonadal hormones influence neuronal organization and plasticity, yet the consequences of altering them with hormonal contraception are not known, and observational studies have indicated that oral contraceptive pill (OCP) use may be linked to changes in brain structure. To clarify this relationship and

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

Topic Line: METHODS: Neuroimaging

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

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

Topic Line: METHODS: Neuroimaging

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

Farshad Rafiei, Georgia Tech.; Dobromir Rahnev, Georgia Tech.

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

Topic Line: METHODS: Neuroimaging

A93 Characterizing Social Interaction Via Dyadic Hyperscanning Techniques

Ruohan Xia, University of Virginia; Runzhi Chen, University of Virginia; Kayden Stockwell, University of Virginia; Tanya Evans, University of Virginia

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

Topic Line: METHODS: Neuroimaging

A94 WITHDRAWN

A95 WITHDRAWN

A96 Multivoxel pattern analyses of brain structure to classify dyslexia

Ja Young Choi, Harvard University; Gabrielle Torre, Boston University; Yaminah Carter, Boston University; Terri Scott, Boston University; Satrajit Ghosh, MIT; Tyler Perrachione, Boston University

Developmental dyslexia is a common learning disability that specifically affects the development of fluent and accurate reading skills. Although dyslexia is thought to have a neurological origin, a reliable neuroanatomical signature of

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

Topic Line: NEUROANATOMY

A97 WITHDRAWN

A98 Brief cognitive screening in youth at risk for psychosis

David Roalf, University of Pennsylvania; Kosha Ruparel, University of Pennsylvania; Tyler Moore, University of Pennsylvania; Monica Calkins, University of Pennsylvania; Ruben Gur, University of Pennsylvania

Cognitive dysfunction is associated with psychosis. Individuals with, or developing, psychosis are not typically evaluated for cognitive dysfunction. Unfortunately, most current cognitive testing procedures are lengthy or have not been validated in youth with psychosis symptoms. Here, we measured cognitive performance using a cognitive screening inventory, the MMSE, and a comprehensive computerized neurocognitive battery, the Penn CNB. Cognitive performance was measured in 334 typically developing (TD; mean age = 17.23 +/- 3.58) youth and 208 youth at risk for developing psychosis (PS; mean age = 17.57 +/- 3.16). MMSE [$F(1,534)=34.98$, $p< 5.9x10-9$] and CNB [$F(1,502)=28.78$, $p< 1.2x10-7$] performance were lower in PS as compared to TD. Scores on the MMSE were positively correlated with CNB accuracy [$r(505)=0.46$, $p<2.2x10-16$] and with Executive [$r(505)=0.46$, $p<2.2x10-16$], Social [$r(505)=0.27$, $p<1.9x10-9$] and Memory [$r(505)=0.34$, $p<2.6x10-15$] CNB factor scores. MMSE [$r(535)=-0.30$, $p<1.57x10-12$] and CNB [$r(502)=-0.22$, $p<4.72x10-7$] performance performance was negatively correlated with clinical symptom severity. In addition, MMSE [$r(485)=0.32$, $p<6.08x10-13$] and CNB [$r(455)=0.29$, $p<1.5x10-10$] performance were positively correlated with measures of global functioning. In sum, the MMSE is a clinically relevant cognitive screen in PS youth, and MMSE performance is associated with computerized neurocognitive testing. Given that cognitive dysfunction is linked to global function, the failure to identify cognitive dysfunction likely has significant influence on quality of life and the course of treatment. As such, the use of available and well-validated cognitive screening should be considered part of routine mental health clinical visits.

Topic Line: OTHER

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

Annabelle Tao, Harvard University; Jiarui Wang, Harvard Medical School; Gabriel Kreiman, Harvard Medical School

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

Topic Line: OTHER

A100 Auditory Sensory Gating: Effects of Noise

Fan-Yin Cheng, University of Texas at Austin; Julia Campbell, University of Texas at Austin; Chang Liu, University of Texas at Austin

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

Topic Line: PERCEPTION & ACTION: Audition

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

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It is congruent with our everyday experience that most of our actions produce sounds. So far, it is unclear whether these action sounds are used as auditory feedback to evaluate the quality of action execution and are therefore important for motion control. For this study, we trained our participants in two sound-producing actions, one with intentional (tap dancing), one with incidental (hurdling) action sounds, and showed them point-light videos of their own actions in a functional Magnetic Resonance Imaging (fMRI) experiment. We examined the diverging influence of action sound omission on action evaluation (via action performance rating scores) and neuronal processing of these two action sound types, especially regarding the question whether auditory predictions are provided whenever the sound is removed.

Findings suggest that the brain enhanced auditory predictions during tap dancing, and visually in hurdling. Auditory predictions manifested in the supplementary motor area (SMA), whose activity correlated both positively with rating scores and negatively with primary auditory cortex activity when sound was removed from tap dancing videos. In these videos, we suggest that a generative model of the expected sound was delivered by SMA, leading to attenuation in primary auditory areas. Our results contribute to a deeper insight into the importance of action sounds for understanding, evaluating and improving our action execution and action perception in sports and in everyday life.

Topic Line: PERCEPTION & ACTION: Audition

A102 WITHDRAWN

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

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

Topic Line: PERCEPTION & ACTION: Audition

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

Parker Tichko, Northeastern University; Edward Large, University Of Connecticut

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

Topic Line: PERCEPTION & ACTION: Development & aging

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

Dennis Lambert, Christina Wong, San Francisco State University; Ezequiel Morsella, San Francisco State University

Involuntary mental imagery can be elicited in the Reflexive Imagery Task (RIT). In this task, subjects are presented with line drawings of everyday objects (e.g., CLOCK) and instructed to not think of the name of the objects. Involuntary subvocalizations occur on a substantive proportion of the trials. It has been hypothesized that this involuntary imagery is activated in a reflex-like manner. Accordingly, it has been observed that this imagery habituates (i.e., is less likely to arise) after repeated stimulation, as when each stimulus object is presented (4 s) for ten consecutive trials (Bhangal et al., 2016). With a sample of 65 subjects, we replicated Bhangal et al. (2016) and found the same habituation effect, $F(9, 576) = 66.48$, $p < .0001$. We also extended Bhangal et al. (2016) by investigating whether the nature of the habituation

varies as a function of word frequency (High Frequency Words [e.g., 'DOOR'] versus Low Frequency Words [e.g., 'KITE']) of the stimulus and the degree to which the stimulus is associated with danger and threat (e.g., SPIDER [Threatening] versus CANDY [Non-Threatening]). For each of the four conditions, there were forty stimuli. Our project is amenable to neuroimaging technologies and provides further evidence that the involuntary cognitions arising in the RIT can be construed as being automatic and reflex-like. This extension of the RIT, with the involvement of threatening stimuli, also has implications for our understanding of cognitive control and psychopathological conditions involving intrusive, undesired cognitions.

Topic Line: PERCEPTION & ACTION: Motor control

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

Yi Wei, University of Connecticut; Yi Wei, University of Connecticut; Edward Large, University of Connecticut

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

Topic Line: PERCEPTION & ACTION: Motor control

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

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

Topic Line: PERCEPTION & ACTION: Multisensory

A108 WITHDRAWN

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

Cybelle Smith, University of Pennsylvania; Sharon Thompson-Schill, University of Pennsylvania; Anna Schapiro, University of Pennsylvania

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

Topic Line: PERCEPTION & ACTION: Other

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

Essang Akpan, Marc N. Coutanche, Principal Investigator

The magnitude of similarity between patterns of activity reflects underlying neural information. Representational similarity analysis (RSA) can be used to examine the representational dissimilarity matrix (RDM) of a single region, or to compare RDMs of different regions through a second-order correlation. This regional comparison typically collapses each region's timeseries in order to compare (global) representational dissimilarity spaces, removing any information that might be contained in similarity fluctuations over time. We present a method for identifying regions with common across-trial fluctuations in their representational similarity. We analyze an open functional magnetic resonance imaging (fMRI) dataset collected as participants viewed clips of animals from different animal taxonomies performing different behaviors. We use a jackknife resampling procedure to quantify the influence of removing

each trial on the global RDM in the activity patterns of ventral temporal cortex. A searchlight was used to identify regions that show similar changes to their jackknifed timeseries over time, which was then compared to the set of regions that can be associated through a second-order (global) RSA, and through functional connectivity. Jackknife resampling reveals that a subset of regions within the ventral stream showing a correlated global RDM or significant functional connectivity have common RDM fluctuations across time. These regions also overlapped with the second-order RSA and functional connectivity analysis.

Topic Line: PERCEPTION & ACTION: Vision

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

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

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

Topic Line: PERCEPTION & ACTION: Vision

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

Frederik Kamps, MIT; Daniel Dilks, Emory University

By adulthood, face processing depends on a network of cortical regions that respond selectively to faces. A fundamental division of labor in this network has been drawn between regions representing dynamic or changeable aspects of faces, including the posterior superior temporal sulcus (pSTS), and regions representing static or invariant aspects of faces, including the fusiform face area (FFA). How does this division of labor develop? Do dissociable dynamic and static systems emerge slowly, only after many years of experience? Or are they established relatively early, within the first few years of life? Addressing this question, here we measured responses across the cortical face network in 5 (N=16) and 8 year old (N=16) children. Child participants were scanned using fMRI while viewing dynamic movies and static images of faces, objects, and scenes. Consistent with previous work, both FFA and pSTS responded selectively to faces (relative to objects and scenes) by 5 years old, with similar face selectivity found in 8 year olds. Critically, by age 5 (and continuing at age 8), FFA and pSTS already represented face information differently, with pSTS-but not FFA-responding significantly more to dynamic than static faces. Importantly, pSTS only responded to motion information on faces, not on objects or scenes, indicating pSTS responses are not driven by domain-general motion processing, even in childhood. Taken together, these findings suggest that the division of labor between dynamic and static face processing systems is established early, sometime within the first few years of life.

Topic Line: PERCEPTION & ACTION: Vision

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

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Developmental prosopagnosia (DP) is characterized by an impairment in face recognition, which involves an extended network of brain regions. It is unclear whether DPs' impairment is related to local or more global white matter (WM) structural differences. Previous studies with small samples of DPs have reported that impaired face recognition in DPs is associated with low WM integrity in either the fibers local to right fusiform region, or the long-range ventral occipital-temporal tracts. In this study, we collected imaging data in 23 DPs and 23 age-matched controls, along with a comprehensive battery of face perception and face memory tests. Based on DSM-5 criteria, DPs were categorized as having mild/major perceptual deficits, <1SD on any two perceptual tests (9 DPs), or perceptually unimpaired DPs (14 DPs). Diffusion data were analyzed in FSL. Anatomical ROI-based voxel-wise analysis showed that only DPs with perceptual deficits had reduced integrity in the right hemisphere fusiform region compared to controls, while no difference was observed between non-impaired DPs and controls. Further, we did not find significant differences in the whole-brain voxel-wise analysis. Our results suggest that the discrepancies in WM connectivity are associated with heterogeneity in the severity of perceptual deficits. Our future directions are to map this difference on the functionally defined face-specific areas and look at the differences in structural connectivity between DPs and controls.

Topic Line: PERCEPTION & ACTION: Vision

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

Javid Sadr, University of Lethbridge

How do perception, memory, and affective response co-operate to produce our apprehension and evaluation of incoming stimuli? One might reasonably expect fundamental aspects of recognition to rest on some internally generated measure of goodness-of-fit, relating incoming stimulation to prior experiences or even innate templates; critically, however, this should not be confused with solely externalized metrics of objective stimulus quality or clarity. Elabourating and specifying a processing-fluency perspective, we not only examine the interaction (or duality) between this perceptual-mnemonic goodness-of-fit and the hedonic experience of subjective preference but also demonstrate an exciting and counter-intuitive effect: greatly diminishing stimulus information profoundly and systematically enhances subjective attraction. Here, in a series of experiments featuring entirely different image-level stimulus manipulations, each progressively diminishing visual input/information, subjects performed the simple, natural task of rank-ordering novel faces by attractiveness. Across all experiments -- parametric contrast reduction, gaussian blur, and partial occlusion -- we find a powerful and very consistent effect of reduced visual input increasing perceived attractiveness. There are no male/female differences in this 'partial information effect' of

enhanced subjective attraction to diminished objective stimulation, nor any differences in response in repeated blocks of trials when the stimuli are re-encountered and thus no longer novel. In this crucial clarification of processing fluency and its affective and behavioural correlates, we see that as objective image quality and stimulus information is reduced, a positive hedonic experience seems to arise as a subjective phenomenological index of enhanced perceptual goodness-of-fit for underspecified stimuli.

Topic Line: PERCEPTION & ACTION: Vision

A115 Typical facial expression recognition without motor simulation

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

Topic Line: PERCEPTION & ACTION: Vision

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

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

Topic Line: PERCEPTION & ACTION: Vision

A117 WITHDRAWN

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

Zhiheng Zhou, University of California Davis; University of Nevada Reno; Lars Strother, University of Nevada Reno

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

Topic Line: PERCEPTION & ACTION: Vision

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

Cristina Banuelos, Carnegie Mellon University; Kasey Creswell, Carnegie Mellon University; Stephen Manuck, University of Pittsburgh; Peter Gianaros, University of Pittsburgh; Timothy Verstynen, Carnegie Mellon University

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

Topic Line: THINKING: Decision making

A120 Neural correlates underlying spatial and social navigational distance processing.

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

Topic Line: THINKING: Decision making

A121 WITHDRAWN

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

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

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

Topic Line: THINKING: Decision making

A123 WITHDRAWN

A124 WTIHDRAWN

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

Yuhua Yu, Northwestern University; Carola Salvi, University of Texas at Austin; Mark Beeman, Northwestern University

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

Topic Line: THINKING: Problem solving

A126 WITHDRAWN

A127 An fMRI investigation of functional network connectivity during abstract reasoning

Thomas Morin, Boston University; Kylie Moore, Boston University; Chantal Stern, Boston University

The goal of this study was to investigate the functional connectivity of cortical brain networks that support abstract reasoning behavior. We developed a simplified, one-dimensional version of the Raven's Progressive Matrices task which required participants to complete sequences composed of either discrete symbols or a continuous visual pattern (N = 27). Earlier work from our lab has demonstrated that this task elicits activity in the dorsal attention and frontoparietal control networks. Following fMRI preprocessing (FMRIPREP; Esteban et al., 2018), beta series correlation analysis methods (Rissman et al., 2004) were implemented using NiBetaSeries (Kent & Herholz, 2019) and

were used to compare task-evoked functional connectivity between cortical networks during discrete and continuous sequence completion. Seed-regions were defined from the Schaefer-400 parcellation, which divides cortex into 400 regions and assigns each region to one of the Yeo-7 resting state cortical networks (Schaefer, 2018). Our results identified changes in functional connectivity associated with reasoning about discrete and continuous sequences. Changes in connectivity were most prevalent in cortical parcels assigned to the Yeo-7 visual, dorsal attention, cognitive control, and default networks. Preliminary analyses suggest that connectivity in these networks was highest for the discrete sequence condition, consistent with the idea that abstract reasoning is dependent on integration of information across multiple cortical networks.

Topic Line: THINKING: Reasoning

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

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

Topic Line:

A129 Learning Preferences as an Index of Individual Differences in Cognitive Flexibility

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Recent findings suggest that when solving problems involving cognitive flexibility (CF), individuals who approach a learning task using exploration, outperform those who approach the task using exploitation. Based on these data, we hypothesized that CF is a function of individual differences in learning preference and task demands. In an initial behavioral study, healthy native English speakers were administered three CF tasks that incorporated (i) shifting, (ii) divergent thinking, or (iii) both shifting and divergent thinking elements. Participants' response selection history on a reward-based learning task, which could be approached either through exploitation or exploration, was used to determine each participant's learning style and predict CF performance. As CF has been linked to prefrontal cortex (PFC) activation, in a second study we used a similar paradigm to examine whether modulation of PFC with noninvasive brain stimulation would produce measurable effects on CF that would be mitigated by individual learning preferences. While completing a CF task and a control task, participants underwent high-definition transcranial direct current stimulation (tDCS), a noninvasive brain stimulation approach involving small electric currents (1.5mA) through a 4x1 electrode montage over the left-lateral PFC. Participants received either excitatory, or inhibitory, or sham stimulation. We show that different CF task components (i.e., whether the task involved divergent thinking) interact with participants learning preferences as measured by the independent learning task and that such effects are altered by modulation of PFC activity. We discuss how learning preferences might capture individual differences in CF.

Topic Line: EXECUTIVE PROCESSES: Other

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