Session B

Sunday, May 3, 10:00 am– 1:00 pm, Exhibit Hall C

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

Christian Brodbeck, University of Maryland, College Park; Alex Jiao, University of Maryland, College Park; L. Elliot Hong, University of Maryland School of Medicine; Jonathan Z. Simon, University of Maryland, College Park

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

Topic Line: ATTENTION: Auditory

B2 Decoding attention control and selection in young and older adults

Xiangfei Hong, Shanghai Mental Health Center; Jiaqi Wang, Shanghai Jiao Tong University; Jianan Wang, Shanghai Jiao Tong University; Junfeng Sun, Shanghai Jiao Tong University; Jijun Wang, Shanghai Mental Health Center; Chunbo Li, Shanghai Mental Health Center; Mingzhou Ding, University of Florida; Shanbao Tong, Shanghai Jiao Tong University

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

Topic Line: ATTENTION: Development & aging

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

Kaisu Lankinen, Massachusetts General Hospital / Harvard Medical School; Seppo P. Ahlfors, Massachusetts General Hospital / Harvard Medical School; Fahimeh Mamashli, Massachusetts General Hospital / Harvard Medical School; Anna Blazejewska, Massachusetts General Hospital / Harvard Medical School; Tommi Raij, Shirley Ryan AbilityLab / Northwestern University; Jyrki Ahveninen, Massachusetts General Hospital / Harvard Medical School

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

Topic Line: ATTENTION: Multisensory

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

Merit Bruckmaier, University College London; Ilias Tachtsidis, University College London; Phong Phan, University College London; Nilli Lavie, University College London

We present work testing a neurobiological account attributing perceptual capacity limits directly to limits on cerebral cellular metabolism. Following widely cited work (Clarke and Sokoloff, 1999), we hypothesised that mental task demand does not affect the overall levels of cerebral energy supply and therefore total levels of neural metabolism. Thus, an attention mechanism is required to

flexibly regulate cellular metabolism levels according to the demands on neural computation: When perceptual load in a task is increased, this should be met with increased metabolism underlying attended processing, which, importantly, needs to be balanced by reduced metabolism related to unattended processing. We tested this prediction using broadband near-infrared spectroscopy to measure the oxidation state of the mitochondrial enzyme cytochrome c oxidase (oxCCO), an intracellular marker of oxidative metabolism levels. oxCCO levels were recorded from visual cortex while participants performed a rapid sequential visual search task under either low perceptual load (feature pop-out search) or high perceptual load (complex feature-conjunction search). A peripheral, flickering checkerboard which participants were instructed to ignore was presented on a random half of trials. Visual cortex regions responsive to the attended stimuli showed increased oxCCO levels in high compared to low perceptual load, while oxCCO levels related to unattended processing were reduced. Moreover, a negative temporal correlation of attended and unattended load effects provided additional support for the metabolism trade-off account. These results establish that attentional regulation of cellular metabolism levels in line with task demands is an important factor to consider when explaining capacity limits in perception.

Topic Line: ATTENTION: Nonspatial

B5 Failing to Integrate Feature Representations During Visual Search

Junha Chang, University of Massachusetts Amherst; Kyle Cave, University of Massachusetts Amherst; Lisa Sanders, University of Massachusetts Amherst

In difficult visual searches, a mental representation of the target guides attention. Observers can flexibly modify this target representation to meet task demands, and search performance can improve with more precise target information. We investigated whether observers create a single integrated target representation when searching for the conjunction of two separately presented target features. In the split-cue condition, participants searched for a color-orientation conjunction target after seeing a simultaneous color cue and an orientation cue. In the integrated-cue condition, color and orientation were shown together as features of the same cue. Conditions were blocked, with order balanced across participants. If participants formed a single integrated target representation from the separately presented features, search performance would improve. To test for evidence of feature integration, we measured Contralateral Delay Activity (CDA) during the interval between presentation of the cue and presentation of the search array. CDA, defined as the difference in amplitude over parietal-occipital regions contralateral compared to ipsilateral to the cue display, reflects the number of items in Visual Working Memory. The split-cue condition resulted in slower response times and larger CDA amplitude compared to the integrated-cue condition. Participants did not integrate the features and instead held two separate representations. These results have implications for how untrained observers typically search, as well as for training that could improve search under real-world conditions.

Topic Line: ATTENTION: Other

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

Kohei Fuseda, Kwansei Gakuin University; Jun'ichi Katayama, Kwansei Gakuin University

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

Topic Line: ATTENTION: Other

B7 Bilingual adults engage similar processes when verifying spoken multiplication facts in each of their languages

Vanessa Cerda, University of Texas San Antonio; Paola Montufar-Soria, University of Texas at San Antonio; Nicole Wicha, University of Texas at San Antonio

Most bilinguals learn math facts, like multiplication tables, through verbal rehearsal in one language, and typically prefer to do math using that language. Behavioral studies have shown that bilinguals are faster and more accurate at retrieving arithmetic facts in the language in which they learned them (LA+) than their other language (LA-). Although bilingual children exhibit this language bias in behavior, brain indices reveal that they engage the same cognitive process in both languages to access multiplication facts from memory. It is possible that an adult lifetime of favoring one language may lead to differences in processing across languages that are not observed in childhood. Event-related potentials (ERPs), response times and accuracy were measured as Spanish-English bilingual adults verified the correctness of spoken single-digit multiplications presented in LA+ or LA-. In Experiment 1, correct solutions elicited a larger positive-going ERP component than incorrect solutions, a P300 reflecting target detection of correct solutions. This effect was present in both languages and did not differ in amplitude or timing. Additionally, no differences in behavior were observed across languages. In Experiment 2, interstimulus intervals were shortened to increase difficulty and promote differences in processing across languages. Compared to Experiment 1, participants showed a similar but 79ms slower correctness effect, yet brain and behavioral measures again showed no difference across languages. Thus fluent bilingual adults, like children, engage similar processes for multiplication verification in both languages. These findings are inconsistent with the argument that bilinguals can only do math in one language.

Topic Line: LANGUAGE: Semantic

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

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

Transcranial direct current stimulation (tDCS) over the right ventrolateral prefrontal cortex (rVLPFC) has been used to influence a number of cognitive functions, including attention. Across tDCS studies, a number of factors have been shown to moderate the effect of tDCS, and research is still trying to parse how these factors interact with stimulation to sometimes produce contrasting results across subjects. The goal of the current study was to explore the

interaction between baseline individual differences, as measured by tasks associated with the rVLPFC, and the application of anodal and cathodal tDCS. Using discovery learning, participants were trained to classify pictures of European streets into two categories while receiving 30 minutes of 2.0 mA anodal, cathodal, or sham tDCS over the rVLPFC. The pictures were classifiable according to two separate and arbitrary rules. Subjects were grouped according to the rule they used to classify the pictures, with all subjects only learning 1 of the 2 rules. A multinomial logistic regression was fit to predict rule learning using baseline measures. The overall model showed a classification accuracy of 75.9% in predicting rule learning. Of the baseline measures, tests of visual orienting, convergent creativity, and state anxiety were significant predictors of rule learning. These results indicate that individual differences at baseline can influence attention and subsequently affect tDCS mediated learning.

Topic Line: ATTENTION: Spatial

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

Uri Hasson, University of Trento; Cemal Koba, IMT School for Advanced Studies Lucca; Giuseppe Notaro, University of Trento

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

Topic Line: ATTENTION: Spatial

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

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

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

Topic Line: ATTENTION: Spatial

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

Jiaqi Wang, Shanghai Jiao Tong University; Jianan Wang, Shanghai Jiao Tong University; Junfeng Sun, Shanghai Jiao Tong University; Shanbao Tong, Shanghai Jiao Tong University; Xiangfei Hong, Shanghai Mental Health Center

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

Topic Line: ATTENTION: Spatial

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

Naama Mayseless, Stanford University School of Medicine; Allan Reiss, Stanford University School of Medicine

Humor is crucial for social development. Humorous encounters encourage playfulness, and are important for development of joint attention and understanding of other's emotional attitudes and expectations. The main aim of the current study was to characterize the neural basis of humor in young children. While there are many studies conducted among adults, there are only a few with children. In the current study, 35 healthy children (6-8 years old) watched funny and neutral video clips while undergoing functional near infrared spectroscopy (fNIRS) imaging. We examined activation patterns in response to humorous content as well as functional connectivity. We observed activation increases in left temporo-occipito-parietal junction (TOPJ), inferior-parietal lobe (IPL), dorsolateral-prefrontal cortex (DLPFC) and right inferior frontal gyrus (IFG) and superior parietal lobe (SPL) regions. Activation in left TOPJ was positively

correlated with age while activation in right IFG and SPL was negatively correlated with IQ levels. In addition to activation patterns, we conducted a coherence analysis to examine functional connectivity related to humor appreciation. We found that coherence in bilateral frontal-parietal network increased in humor viewing compared to neutral content. This effect was different for boys and girls in the right frontal-parietal network. While boys exhibited stronger coherence between frontal and parietal regions for the humor condition, girls did not show a difference between conditions. These results expand our understanding of the neurodevelopment of humor by highlighting the effect of age on the neural basis of humor appreciation as well as emphasizing different developmental trajectories of boys and girls.

Topic Line: EMOTION & SOCIAL: Development & aging

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

Psyche Loui, Northeastern University; Grace Wilson, Simmons College; Valerie Goutama, Northeastern University; Maiya Geddes, Harvard Medical School; Suzanne Hanser, Berkeley College of Music; Manoj Bhasin, Emory University

Music therapy research has established the significant influence of music-based interventions on mood and management of stress. Several randomized controlled trials have shown benefits of listening to familiar music on cognition, mood, perceived stress, and quality of life in people with mild cognitive impairment (MCI) and Alzheimer's disease (AD), but this evidence is not yet well established, due to small sample sizes and large inter-subject variability. This underscores the need for a unified mechanistic understanding of music-based interventions. We hypothesize that listening to familiar, self-selected music may increase activity in the reward system. Here we report effects of a music listening intervention. Older adults with and without MCI participated in a similar 8-week music intervention, facilitated by a board-certified music therapist. The intervention consisted of focused, daily listening to playlists of preferred music for relaxation and enjoyment for one hour each day, accompanied by weekly processing over the phone with the therapist. We collected neuropsychological measures and fMRI before and after the eight weeks. Preliminary neuropsychological results showed decreased stress and loneliness, increased pleasure, and increased musical sophistication after the intervention. When listening to self-selected music, compared to unselected music, fMRI responses showed activity in the auditory-motor network (STG, STS, SMA) and a reward region (VMPFC). After the 8-week listening intervention, the same contrast showed increased VMPFC and decreased SMA activity ($p < .05$ FWE-corrected, within-subjects). Results suggest that the auditory-motor and reward/valuation networks may be neural targets for effects of focused music listening as a therapy for older adults.

Topic Line: EMOTION & SOCIAL: Development & aging

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

Paulo Graziano, Florida International University; Dea Garic, Florida International University; Megan Hare, Florida International University; Anthony Dick, Florida International University

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

Topic Line: EMOTION & SOCIAL: Emotional responding

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

Hsuan Chi Liu, National Taiwan University, Taipei, Taiwan; Jin Mei Hu, Chinese MBSR Service, Taipei, Taiwan; Chuan Yueh Hsu, Chinese MBSR Service, Taipei, Taiwan; Zenas C. Chao, The University of Tokyo, Tokyo, Japan; Joshua Oon Soo Goh, National Taiwan University, Taipei, Taiwan; Chien Te Wu, National Taiwan University, Taipei, Taiwan

Mindfulness and cognitive reappraisal are two common but rather different strategies to downregulate emotional and stress-related responses. While cognitive reappraisal help downregulate emotion through reinterpreting the context, mindfulness does so through focusing on the awareness and acceptance of emotions. In the present study, we evaluated how a mindfulness training program might differently change the neural processes associated with these two different emotion regulation strategies. We recorded EEGs of fifteen novice participants aged from 28 to 55 (13 females and 2 males) while they were performing an emotional regulation task on positive/negative emotional pictures from the International Affective Picture System (IAPS) before and after an 8-week Mindfulness-Based Stress Reduction (MBSR) training program. During the task, participants were instructed to experience the emotional pictures using either a mindfulness or cognitive reappraisal strategy. Passive viewing of emotional pictures and scramble-pixelated pictures were included as control conditions. Analysis of event-related potentials (ERP) revealed that the late positive potential (LPP) (0.5~1s) averaged at CP1, CPZ, CP2 showed significant interaction between Strategy and Time (i.e., pre- vs. post-training) ($F=14.02$, $p < 0.001$). Post-hoc analysis further indicated LPPs significantly decreased from pre- to post-training for the Cognitive Reappraisal condition ($p<0.025$), reflecting neural changes in emotional arousal regulation using this strategy. However, no training-related LPP differences were observed for passive viewing and mindfulness conditions, suggesting that short-term MBSR minimally influenced these regulation strategies. Our findings provide neurophysiological evidence for the effect of MBSR on emotion regulation and point to cognitive reappraisal as the primary target cognitive mechanism in novices

Topic Line: EMOTION & SOCIAL: Emotional responding

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

Maeve Boylan, University of Florida; W. Matthew Friedl, University of Florida; Harold Rocha, University of Florida; Andreas Keil, University of Florida

Mental imagery is a critical factor in the etiology and maintenance of many psychiatric disorders, as well as a component in gold-standard treatment options. The neural underpinnings of mental imagery are however poorly understood. At the level of hemodynamics, research has demonstrated that mental imagery activates emotion networks of the brain. Scalp-recorded EEG has also shown an increase in endogenous activity in the alpha band during mental imagery tasks. To define the neurophysiology of mental imagery, we combined the information from blood oxygen level-dependent (BOLD) signals with concurrently recorded EEG alpha-band power during a visual script-driven

mental imagery task in a sample of 20 healthy participants. Ongoing analyses demonstrate that established BOLD activation patterns during mental imagery were replicated with the addition of EEG recordings: BOLD was selectively enhanced during emotional, compared to neutral imagery, in medial prefrontal cortex, precuneus, and cerebellum. These changes were associated with alpha-power changes, assessed on a trial-by-trial basis, as well as related to the level of alpha-power change across trials. Together, findings suggest that alpha-power changes in the scalp-recorded EEG may represent a sensitive index of emotional imagery.

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

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

Keith Bush, University of Arkansas for Medical Sciences; G. Andrew James, University of Arkansas for Medical Sciences; Clint Kilts, University of Arkansas for Medical Sci

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

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

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

Eleanor Schuttenberg, McLean Hospital, Harvard Medical School; Julia Cohen-Gilbert, McLean Hospital, Harvard Medical School; Jennifer Sneider, McLean Hospital, Harvard Medical School; Emily Oot, McLean Hospital, Harvard Medical School; Anna Seraikas, McLean Hospital, Harvard Medical School; Sion Harris, Boston Children?s Hospital and Harvard Medical School; Lisa Nickerson, McLean Hospital, Harvard Medical School; Marisa Silveri, McLean Hospital, Harvard Medical School

Adolescence is a distinct period of development marked by substantial brain remodeling, particularly in networks subserving inhibitory control that are susceptible to stress. This study evaluated network activation during performance of an emotional Go-NoGo task and associations between network activation and stress. Functional magnetic resonance imaging data were acquired at 3Tesla from 45 (25 female) adolescents (13-14yrs). NIH Emotion Toolbox was used to measure perceived stress and rejection (PS, PR), and pediatric Maltreatment and Abuse Chronology of Exposure (MACE) assessed peer emotional abuse (PEA). Network template spatial activation maps derived from HCP data were projected onto brain activation for negative>neutral inhibitory (NoGo) trials to generate a subject-series of activation strengths for each network/participant. Activated networks for this contrast included central executive, salience, dorsal attention, and default mode networks (DMN). Higher perceived stress was associated with increased impulsive errors (p=.003). Perceived stress, rejection and peer emotional abuse were negatively associated with activation of a ventromedial PFC network (PS p=.01, PR p=.008), and two sub-networks of the DMN: medial temporal DMN (PS p=.01, PR p=.02, PEA p=.009) associated with autobiographical recall, and prefrontal DMN, associated with theory of mind (PS p=.005, PEA p=.03). These findings suggest internalized stress may alter engagement of networks related to emotion regulation and social cognition during response inhibition during negative relative to neutral emotional distraction. Findings could reflect increased impulsivity and self-reflective processing elicited by both negative and neutral stimuli that could serve as an early marker for later mental health problems (increasing depressive/anxiety symptoms).

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

B19 Testing whether the social N400 effect indexes integration- or inhibition-process

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

Previous studi des found effects of the presence of a confederate on the event-related potentials (ERPs) elicited by meaningful stimuli: the small amplitude of the N400 ERP evoked by semantically primed words was enhanced when participants knew the confederate did not receive the priming information. We tested whether or not this enhancement indexes an inhibition of that priming, inhibition that would be performed to fit the social context of the uninformed confederate. We examined whether both N300s and N400s would be smaller when what should be inhibited cannot be determined. This indeterminacy was created by using an unknown social context, i.e., by placing a stranger next to participants and by using a task that did not require much inhibition: an image memorization task. Amplitudes of N400s and N300s were largely smaller than those of participants who were alone. In contrast, relative to these alone participants, these amplitudes were modestly increased by the presence of a friend, and thus when the social context was better known to participants and when what had to be inhibited to fit this context could be determined. We also found that this modest increase was significantly bigger for the participants who 'Felt Together' in the presence of their friend (FTs, n =46) than for those who 'Felt Alone' despite that presence (FAs, n =41). The timing and scalp distribution of these modest differences were similar to those of the large differences found between participants who were alone and participants who were with a stranger.

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

B20 Neural Correlates of Aesthetic Engagement with Literature

Yuchao Wang, Haverford College, Penn Center for Neuroaesthetics; Franziska Hartung, Penn Center for Neuroaesthetics; Marloes Mak, Radboud University Nijmengen; Roel Willems, Radboud University Nijmegen; Anjan Chatterjee, Penn Center for Neuroaesthetics

Literary stories contain artistic value in what is said and how it is said. Reading literature typically affects readers emotionally: they may experience empathy, suspense, and even physical sensations like chills because of the wording used.

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

Topic Line: EMOTION & SOCIAL: Emotion-cognition interactions

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

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

Topic Line: EMOTION & SOCIAL: Other

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

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

Topic Line: EMOTION & SOCIAL: Other

B23 A Functional Neuroimaging Investigation of Moral Foundations Theory

Maria Khoudary, Duke University; Eleanor Hanna, Valassis; Vijeth Iyengar, Administration for Community Living; Scott Clifford, University of Houston; Felipe De Brigard, Duke University; Walter Sinnott-Armstrong, Duke University; Roberto Cabeza, Duke University

Moral Foundations Theory (MFT), an influential conceptual framework in the social sciences, posits that humans make judgments about the rightness and wrongness of particular acts based on a set of discrete moral foundations. A number of behavioral dissociations suggest that these foundations can be grouped into superordinate categories of binding (purity, authority, and loyalty) and individualizing (harm and fairness) that reflect the social level at which an act is performed. Despite robust behavioral evidence of this hierarchical organization, there has yet to be an investigation into the neural processes that generate these patterns of responses. Here, we use spatiotemporal partial least squares (PLS) analyses on fMRI data from 32 participants to investigate whether brain activity during MFT judgments exhibits a response profile similar to behavior. A mean-centered PLS analysis returned two significant latent variables (LVs). LV1 ($p < 0.002$, 24.95% of crossblock variance) dissociated authority, fairness, loyalty, and liberty from physical harm and purity, with the former engaging the cingulate gyrus and precuneus, and the latter engaging the inferior frontal gyrus and amygdala. LV2 ($p<0.034$, 18.73% of crossblock variance) dissociated fairness, liberty, loyalty, and purity from amoral social norms, with the former engaging cingulate and angular gyri, and the latter engaging the inferior parietal lobule (bilaterally) and the precuneus. However, recognition memory for individualizing scenarios was better than memory for binding scenarios, suggesting that mnemonic processes mirror the structure of MFT judgments. Taken together, these preliminary results indicate a dissociation between the cognitive and neural implementation of Moral Foundations Theory

Topic Line: EMOTION & SOCIAL: Other

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

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

Topic Line: EMOTION & SOCIAL: Person perception

B25 Pupil size during authenticity recognition in laughter and crying

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

Topic Line: EMOTION & SOCIAL: Person perception

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

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

Topic Line: EMOTION & SOCIAL: Person perception

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

Clifford Workman, University of Pennsylvania; Geoffrey Aguirre, University of Pennsylvania; Anjan Chatterjee, University of Pennsylvania

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

disgust. These findings contrast with the pathogen-avoidance account and suggest a candidate neurocognitive mechanism for moral disgust that may underpin the anomalous-is-bad stereotype.

Topic Line: EMOTION & SOCIAL: Person perception

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

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

Topic Line: EXECUTIVE PROCESSES: Development &aging

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

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

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

Topic Line: EXECUTIVE PROCESSES: Development &aging

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

Dillan Cellier, University of Iowa; Marco Pipoly, University of Iowa; Kai Hwang, University of Iowa

The ability to adjust one's actions according to changing contexts is essential to goal-directed behaviors. For example, while an individual might answer their ringing cell phone while alone in their home, they are unlikely to do so while in the middle of an important business meeting. This flexibility in using context-dependent information to guide action is thought to be supported by the rostral-caudal organization of the prefrontal cortex (Badre and Nee, 2018). However, the neural oscillations involved in context-dependent task-switching remain a subject of open inquiry. We recorded electroencephalography (EEG) while subjects performed a task which required them attend to a context cue and either to switch between two contextually-defined task-sets (Extra-Set Switch condition), switch between two task-rules within a context (Within-Set Switch condition), or remain on the same task rule (Stay condition) from trial-to-trial. Critically, we held the working memory load constant across conditions. We found that ESS trials elicited the longest reaction times and increased theta-band power (4-8 Hz) 220 milliseconds after the onset of the context cue, relative to WSS and Stay trials. Taken together, these results suggest that task switching between contexts (ESS condition) is more cognitively taxing than switching between rules within the same context, or not switching task rules at all. Additionally, theta band oscillatory activity might index cognitive control processes related to switching between task-sets under different contextual conditions. These findings further suggest that phase- and amplitude-specific patterns of theta-band activity could be one mechanism that support cognitive flexibility.

Topic Line: EXECUTIVE PROCESSES: Goal maintenance & switching

B31 Contributions of fatigue and automatic processing to cognitive flexibility

Michael Imburgio, Texas A&M University; Joseph Orr, Texas A&M University

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

fatigue. Future work should attempt to dissociate practice effects from fatigue as well as assess how other bottom-up biases change with fatigue.

Topic Line: EXECUTIVE PROCESSES: Goal maintenance & switching

B32 Working memory representations are reformatted to match the identity of upcoming test stimuli

David De Vito, Florida State University; Jacob A. Miller, University of California, Berkeley; Derek E. Nee, Florida State University

Although working memory is essential for guiding future thoughts and actions, most studies of working memory function examine mechanisms underlying retaining the past. Here, we contrast the retrospective and prospective nature of working memory. While being scanned with fMRI, participants followed a five-location star-shaped sequence of stimuli on the left and right side of the screen. On each trial, a cue indicated the currently-relevant side. Then, following a delay period, a memory probe was presented that tested the identity of the stimulus that followed the previously-presented item in the sequence on the cued side. We investigated the contributions of retrospective and prospective representations to working memory signals in visual cortex and intraparietal sulcus using multi-variate techniques. We observed a transition from retrospective to prospective representations in both areas from the probe to delay period. Prospective representations encoded not only the next item in the sequence, but a probability-weighted distribution of possible probe stimuli. Our data suggest that delay period activation is a reflection of future expectations rather than the past or cued items per se. Our findings reflect that working memory 'works' to prospectively guide thoughts and actions.

Topic Line: EXECUTIVE PROCESSES: Working memory

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

Xinyi He, MGH Institute of Health Professions; Yael, Arbel, MGH Institute of Health Professions

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

Topic Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

B34 Withdrawn

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

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

Higher body mass index (BMI) has been associated with slower response times (RT) on inhibitory control (IC) paradigms, e.g., Stroop task. There is limited research examining associations between BMI and brain activity in regions supporting IC. This study examined whether BMI is related to Stroop task performance and brain activity in individuals with overweight or obesity. We hypothesized higher BMI would be associated with worse Stroop task performance and lower activity in brain areas supporting IC. We analyzed baseline data from 124 adults with overweight and obesity (average age=44 years, average BMI=32.46kg/m2) enrolled in a weight loss intervention. Participants underwent event-related fMRI while completing a color-word Stroop task. Using a whole-brain analytical approach, we identified activation patterns related to BMI and further examined these regions with respect to RT. All analyses controlled for sex. BMI was not significantly related to RT during any task condition (all p-values>0.52). However, higher BMI was associated with less of a difference in activation between the incongruent and congruent conditions in the right frontal pole, precuneus, and middle temporal gyrus (p <.01, cluster thresholding). Differences were driven by greater activity during the congruent condition for individuals with a higher BMI, suggesting that more neural resources were expended for easier task conditions. Activation patterns were not significantly associated with RT. Results suggest that individuals with higher BMI may use executive and attentional control brain regions less efficiently than those with lower BMI. Additional research is needed to determine behavioral and clinical implications of these findings <.05). This aligns with our hypothesis and suggests that WM training influences theta-band oscillations, which suggests enhancement of neural activity that supports WM performance."

Topic Line: EXECUTIVE PROCESSES: Monitoring & inhibitory control

B36 Trainability Differences of Electrical Brain Metrics in EEG Neurofeedback: Implications for Modulating Language Function

Paul, Fillmore, Baylor University

Recent work on recovery of language function following adult brain injury (e.g. stroke, TBI) has focused heavily on the importance of brain networks for language, rather than on isolated 'language areas'. However, relatively few direct methods exist for strengthening connections between the parts of these networks. Electroencephalographic (EEG) neurofeedback (NF) is one method that has significant potential both as a clinical and experimental tool for modulating brain networks, but its ability to address language network deficits directly has not been well explored. One difficulty in studying the potential of NF for treatment of adult language disorders is that there is high individual variability in the ability to effectively change brain activity with neurofeedback, which may operate differently across various EEG metrics. Currently, there is no good assessment of individual NF performance across metrics, which could distinguish 'responders' from 'nonresponders'. Here, we present a proposed assessment, which tests several common EEG metrics (absolute power, amplitude asymmetry, coherence and phase lag) for their relative ability to be trained successfully via NF. The current version of the assessment uses the Theta brain rhythm at locations specific to the language network (e.g. Broca's & Wernicke's areas, left lateral motor cortex). We present preliminary findings from the initial tests of this protocol (n=14), which suggest that there are indeed key differences in trainability of the EEG based on the measures examined and the

methods employed, and we discuss the implications for clinical uses of NF in language treatment following brain injury.

Topic Line: METHODS: Electrophysiology

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

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

Topic Line: EXECUTIVE PROCESSES: Other

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

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

Topic Line: EXECUTIVE PROCESSES: Other

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

Nicholas Reilly, Old Dominion University; Jessica Prebor, Old Dominion University; Jacquelyn Moxey, Old Dominion University; Eric Schussler, Old Dominion University

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

Topic Line: EXECUTIVE PROCESSES: Other

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

Madeline Gregory, State University of New York at Buffalo; Thomas Covey, State University of New York at Buffalo; Janet Shucard, State University of New York at Buffalo; David Shucard, State University of New York at Buffalo

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

Topic Line: EXECUTIVE PROCESSES: Working memory

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

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

Topic Line: EXECUTIVE PROCESSES: Working memory

B42 A Novel Task to Parametrically Manipulate Episodic Memory Load

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Numerous episodic memory studies have found that, compared to memory for single items, participants are worse at remembering which pairs of items were previously presented (Recognition) or which pairs of items were previously presented together (Associative Memory). However, to our knowledge, no studies have probed effects of higher memory loads. In the present study, twenty-one young adults (18-21 years) completed a novel task that parametrically manipulated episodic memory load. At study, participants viewed pairs, triplets, or quadruplets of words (set size) and were asked if they could make a sentence using all of the words. At test, participants viewed repeated, recombined, and novel word sets and had to judge whether the exact set was ('old') or was not ('new') previously presented. Results revealed a significant main effect of set size for Recognition ('old'|repeat - 'old'|novel; $p < 0.05$), with better memory for previously presented word pairs than quadruplets. There was also a significant main effect of set size for Associative Memory ('old'|repeat - 'old'|recombined; $p < 0.01$), with better memory for previously presented items within word pairs than triplets or quadruplets. These findings demonstrate that our novel paradigm effectively manipulated demands on episodic memory load. Future studies will assess the neural basis of these episodic memory load effects, building on preliminary fMRI data that revealed greater activity in caudate as a function of set size for Recognition ($p < 0.06$).

Topic Line: LONG-TERM MEMORY: Episodic

B43 Cingulate theta activity reflects the quality of memory representations in visuospatial working memory

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

Topic Line: EXECUTIVE PROCESSES: Working memory

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

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Many of us have watched a locked door close just as we realize our keys, and not other unimportant objects, remain inside. This example reflects our ability to shift attention among items held in working memory based on their utility or value. Here, we examined interactions between working memory, attention and reward value using a change detection retro-cue paradigm. On each trial, four visual stimuli briefly flashed and only after the maintenance period did a valid or neutral retrospective cue appear. A recognition memory probe followed a second brief delay and reward feedback was provided at the end of each trial. Reward associated with a correct response (trial value) was manipulated on a block-by-block or trial-by-trial fashion whereas stimuli could have similar (colored target)

or different (American coins) reward associations. As expected, across experiments there was a retro-cue benefit such that performance was superior on valid compared to neutral trials. Trial value has no effect on retro-cue benefit but when assigned on a trial-by-trial basis caused slower RT when the value was higher. Examining the effect of stimuli with previously learned reward values, we found performance to be superior for the lowest and highest value coins and significantly worse for the middle two items. These results indicate attentional bias for the best and worst stimuli and resemble overweighting of the best and worst outcomes in evaluating mixed gambles. Overall, our results provide evidence for non-trivial effects of reward values on shifts of attention among items in working memory.

Topic Line: EXECUTIVE PROCESSES: Working memory

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

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

Topic Line: EXECUTIVE PROCESSES: Working memory

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

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

Topic Line: LANGUAGE: Development & aging

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

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

Topic Line: LANGUAGE: Development & aging

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

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The frequency of exemplars in the speech input is a critical cue for early language development (Maye, Werker, & Gerken, 2002; Kuhl, 2004). However, it is unclear whether and how the neural sensitivity to frequency of distributional cues in speech changes from childhood to adulthood. To address this question, we recorded electroencephalography (EEG) from 30 healthy adults and 13 typically developing children (Mean age = 8.5 years, SD = 1.3 years) in an auditory oddball paradigm, while they watched a silent cartoon movie. We

manipulated the domain of deviant stimuli (syllable or voice) and how frequently each type of deviant occurred (rare vs. frequent). We found adults showed an overall greater mismatching negativity (22-180 ms) compared to children ($p = 0.004$), indexing an overall greater oddball effect. However, compared to adults, children showed larger negativity elicited by the rare deviants than the frequent deviants (significant group by frequency interaction, $p = 0.008$) in the late time window (324-500 ms). Our results provided novel evidence for the sensitive period theory of language development. Even though statistical learning behavior has not been found to decline with age, our findings suggest that the neural sensitivity to fine-grained frequency information of speech exemplars seems to decline across the lifespan.

Topic Line: LANGUAGE: Development & aging

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

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

Topic Line: LANGUAGE: Lexicon

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

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The present study aimed to test the hypothesis that processing a second language (L2) activates the sound, but not the spelling, of native language translations (Wu & Thierry, 2010). For this purpose, event-related brain potentials (ERPs) were recorded while native speakers of Mandarin heard or read pairs of words in their L2 (French). Participants were asked to assess whether the word pairs were semantically related or not. Critically, half of the non-related pairs had Mandarin translation equivalents that presented either a) phonological overlap or b) orthographic overlap. This interference is attested by one behavioral marker (i.e., percentage of error) and one electroencephalographical marker (the lexical N400 effect). Preliminary behavioral data show that the bilinguals made more errors for only the pairs presenting a spelling link in Mandarin translation equivalents. This result suggests that lexical activation of L2 words might be influenced by orthographic representations from the L1 lexicon. Moreover, the ERP data suggest that both phonological and spelling links in Mandarin may cause interference in processing of French pairs, as suggested by the N400 effect. Further statistical analyses will allow us to determine which linguistic (i.e., proficiency in the L2, language dominance, L2 frequency of use) and extra-linguistic factors (i.e., selective attention, interference control) may be the best predictor of the variation of the inter-lingual interferences. Taken together, the present findings contribute to precise the modeling of how co-activated languages may interact in real time while processing a second language.

Topic Line: LANGUAGE: Lexicon

B51 Neural Indices of speech processing of consonant cluster word onsets in English, Korean, and Spanish listene19

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

Topic Line: LANGUAGE: Other

B52 Acoustic and visual parameters underlying word-shape sound symbolism

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Sound symbolism refers to a non-arbitrary mapping between the sound of a word and its meaning. The most commonly studied mapping is that of sound to shape in which people assign auditory pseudowords like 'maluma' and 'takete' to rounded and pointed visual shapes, respectively. However, it is unclear which properties of the pseudowords contribute to their perception as rounded or pointed, generally considered visual attributes. Here, we compared perceptual ratings of the roundedness/pointedness of large sets of pseudowords and shapes to their acoustic and visual properties using a novel application of representational similarity analysis (RSA). Representational dissimilarity matrices (RDMs) of the auditory and visual ratings of roundedness/pointedness were crossmodally correlated. The auditory perceptual RDM was correlated with

RDMs of the spectral tilt, the power spectrum of temporal frequency and the speech envelope. Conventional correlational analyses showed that ratings of pseudowords transitioned from rounded to pointed as many measures of vocal variability or roughness (harmonics-to-noise ratio, pulse number, fraction of unvoiced frames, mean autocorrelation and jitter; but not shimmer or pitch standard deviation) increased. The visual perceptual RDM was correlated with RDMs of global indices of visual shape (the simple matching coefficient, silhouette, image outline and Jaccard distance) but not the power spectrum of spatial frequency. Crossmodally, the auditory spectral parameters were related to the global indices of visual shape. Our work establishes the utility of RSA for analysis of large stimulus sets comprising multiple measures per stimulus and offers novel insights into the stimulus parameters underlying sound symbolism.

Topic Line: LANGUAGE: Other

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

Sarah Phillips, New York University; Liina Pylkkänen, New York University;

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

Topic Line: LANGUAGE: Other

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

Kyle Rupp, University of Pittsburgh; Fernando Llanos, University of Pittsburgh; Madison Remick, University of Pittsburgh; Bharath Chandrasekaran, University of Pittsburgh; Abel Taylor, University of Pittsburgh

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

Topic Line: LANGUAGE: Other

B55 An EEG Study of Aphasia Recovery in Bilinguals

Jennifer Segawa, Stonehill College; Meredith Adams, Stonehill College; Alexis, Medeiros, Stonehill College

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

Topic Line: LANGUAGE: Other

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

Junqing Chen, The Graduate Center, City University of New York; Natalie Kacinik, Brooklyn College, City University of New York

Conceptual Metaphor Theory (Lakoff & Johnson, 1980, 1999) claims that people use more concrete knowledge to represent abstract concepts through metaphorical mappings. We have been investigating how English and Chinese monolingual and bilingual speakers conceptualize emotions by metaphorical connections with colors (Chen, et al., in prep.) Results from a series of automatic experimental tasks showed that color-emotion metaphors specific to each culture (e.g., Sadness Is Blue in English, Happiness Is Red in Chinese) are also mentally represented in speakers of the corresponding language. In addition, Chinese-English bilinguals were found to automatically activate metaphors learned from their native L1 Chinese (Happiness Is Red) in either language context. The current study involves measuring ERPs to investigate the underlying neural activity, specific timecourse and degree to which late Chinese-English bilinguals activate the metaphorical systems in each language.

Participants were asked to judge if target words conveyed the emotions of Happiness or Sadness. The data collected so far (N=12) indicates a significant font color (red versus blue) by emotion (happiness versus sadness) interaction with the N400 in the Chinese context. Happy words presented in blue evoke a greater N400 effect compared to red; while Sadness words show the opposite pattern. However, this color by emotion N400 interaction is not significant in the English context. This demonstrates that metaphorical representations can at least be automatically activated in the L1 context regardless of whether they come from L1 or L2 experiences.

Topic Line: LANGUAGE: Semantic

B57 Psychophysiological correlates of novel meaning processing in bilingualism

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

Topic Line: LANGUAGE: Semantic

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

Ran Li, Boston University; Tyler Perrachione, Boston University; Jason Tourville, Boston University; Swathi, Kiran, Boston University

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

Topic Line: LANGUAGE: Semantic

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

Yanina Prystauka, University of Connecticut; Stephanie Chinwo, University of Connecticut; Gerry Altmann, University of Connecticut

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

Topic Line: LANGUAGE: Semantic

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

Meng-Huan Wu, University of Rochester; Andrew Anderson, University of Rochester; Robert Jacobs, University of Rochester; Rajeev Raizada, University of Rochester

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

other words in an analogy question (one-sided t-test, p = 0.01, 0.001 and 0.05 respectively). In summary, this study demonstrated that analogy questions can be solved with addition and subtraction of fMRI patterns, and that, similar to word embeddings, this property holds for domain-general patterns elicited when participants were not explicitly told to perform analogical reasoning.

Topic Line: LANGUAGE: Semantic

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

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

Topic Line: LANGUAGE: Syntax

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

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

Topic Line: LONG-TERM MEMORY: Development & aging

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

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

Topic Line: LONG-TERM MEMORY: Development & aging

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

Rachel Van Boxtel, Boston College; Jaclyn Ford, Boston College; Elizabeth Kensinger, Boston College

Healthy aging is associated with a characteristic decline in working memory and ability to learn new information. This could be due to age-related degradation of the prefrontal cortex (PFC)(Raz et al., 1997), and that engagement of the lateral PFC- which is typically associated with successful memory and recall in younger adults- becomes less efficacious with age (Grady, 2008). Recently, it has been argued that the degraded lateral regions may be bypassed by engaging the mPFC in older adults (MacPherson, Phillips, & Della Sala, 2002). Prior work indicates that the mPFC can be strategically activated to better encode and retrieve memories of socioemotional relevance (Gutchess & Kensinger, 2018), and may be involved in an association between memory and music (Janata, 2009). Based on this evidence, an online memory study (n=750, with 525 participants age 55+) was conducted which incorporated a behavioral manipulation, either prior to encoding or retrieval, to test the effects of priming

the mPFC using a self-reference, autobiographical memory, or music task. A secondary analysis examined the interaction of the behavioral manipulation with cognitive ability of older adults, assessed using the N-back test. We found unexpectedly high memory performance in older adults compared to young adults in this sample, leading to questionable generalizability of the findings. This memory enhancement appears specific to the memory task, as 2-back performance was predictably reduced with age. Unexpectedly, memory performance was not reliably influenced by involvement in any behavioral manipulation conditions, even when controlling for age or individual differences in 2-back performance.

Topic Line: LONG-TERM MEMORY: Development & aging

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

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Felicia Chaisson, Louisiana State University; Lauryn Burleigh, Louisiana State University; Steven Greening, Louisiana State University; Lucas Heather, Louisiana State University

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

Topic Line: LONG-TERM MEMORY: Episodic

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

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

Topic Line: LONG-TERM MEMORY: Episodic

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

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Brief periods of recovery sleep following acute sleep loss can restore normal performance abilities on basic cognitive tasks (e.g. vigilance, working memory, spatial abilities). Emotion perception, a complex cognitive process that is both socially and psychopathologically relevant, is also negatively impacted by total sleep deprivation (TSD), yet virtually no studies have explored if a nap post-TSD can restore this ability. In the present study, participants categorized and rated the intensity of a range of emotional faces (Happy, Sad, Angry, Neutral) at baseline (2100), at 0900 following a night of TSD, and at 1400 following either a 90-minute nap opportunity (nap group) or continued wakefulness (wake group).

Vigilance testing revealed that all participants committed more omission errors at 0900 following TSD [t(37)=2.8, p=0.008], but both groups returned to baseline levels of vigilance by 1400. Emotional categorization was impaired in all participants after TSD [t(39)=5.5, p

Topic Line: LONG-TERM MEMORY: Episodic

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

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

Topic Line: LONG-TERM MEMORY: Episodic

B70 Enhancing object-location associative memory through reward

Evan Grandoit, Northwestern University; Michael S. Cohen, University of Pennsylvania; Paul J., Reber, Northwestern University

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Gerrit Höltje, Saarland University; Axel Mecklinger, Saarland University

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

Topic Line: LONG-TERM MEMORY: Episodic

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

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

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

remembering were further reduced during if spikes occurred during the 1000-2000 ms of encoding or retrieval. Hippocampal spikes seen during the 1000-2000 ms of encoding were followed by a decrease in ripple rate. Our results suggest that spikes impair associative memory in a regionally and temporally specific manner, potentially via decreasing hippocampal ripple rate.

Topic Line: LONG-TERM MEMORY: Episodic

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

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

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

Topic Line: LONG-TERM MEMORY: Episodic

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

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lSchizophrenia is a mental disorder that affects approximately 1% of people. Cognitive changes, specifically impairments of memory, are widespread in schizophrenia. Such memory impairments are also seen in first-degree relatives, who are at risk for developing the disorder (i.e. 10-16%). Other risk factors include having a first-degree relative with schizoaffective and/or bipolar disorder (i.e. high-risk) and having ADHD and/or anxiety disorders (i.e. mid-risk). To further elucidate the nature of this impairment in young individuals at-risk for schizophrenia, we employed a word-list based free recall task. Twenty-nine first-degree relatives and non-relatives between the ages of 9-16 years-old were recruited for the current study. Participants were categorized into one of three groups (high-risk, mid-risk, and low-risk). We hypothesized that higher levels of risk would predict worse free recall performance. Preliminary analyses show worse performance in the high-risk group (M = 4.6), relative to the mid-risk (M = 5.6) and low-risk (M = 6.4) groups. Additionally, we decomposed free recall performance by examining serial position functions, first-recall probability, and interresponse times. These preliminary analyses suggest that, despite all groups showing primacy and recency effects, the high-risk group appeared to commence retrieval from the middle-end of the list more often than the mid- and low-risk groups. Finally, no slowing of the interresponse times throughout the recall period was observed. These preliminary findings may reflect a cognitive disorganization that has been previously detected in at-risk individuals in other cognitive domains, including working memory and executive functions.

Topic Line: LONG-TERM MEMORY: Episodic

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

Alex Kafkas, University of Manchester; Nanne Kukkonen, University of Manchester; Daniela Montaldi, University of Manchester

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

Topic Line: LONG-TERM MEMORY: Episodic

B76 Computational accounts for memory in reinforcement learning

John Ksander, Brandeis University; Christopher Madan, University of Nottingham; Angela Gutchess, Brandeis University

It seems intuitive that rewarding experiences may be remembered differently from unremarkable ones. Moreover, our decisions would benefit by remembering salient experiences. Episodic memory in value learning has become a recent focus in decision?making research, however the existing literature shows a complicated relationship between reward and memory. The current study provides a computational account that unifies mixed results from several experiments. Here participants first learned reward values associated with words through two-alternative forced choice tests. Participants were then asked to recall as many words as they could remember. Crucially, differences in the value learning procedure produced three qualitatively different results: linear, U-shaped, and attenuated relationships between reward and memory. Prior work interpreted these mixed results in terms of additive psychological processes (e.g. reward, salience, and boundary effects). The current results demonstrate these

results can be explained by assuming a memory's strength depends on its contextual utility. That is, memory strength depends on how much mnemonic information changes reward expectations. This concept is distinct from assuming people merely remember highly rewarding experiences better (i.e., strictly linear relationship between reward and memory). We modeled our hypothesis within a reinforcement learning framework, and simulated participants' learning and memory behavior during these experiments. The model successfully reproduced all three reward-memory relationships observed in these experiments, without requiring additional psychological processes. This result provides a more parsimonious explanation for the data in this literature.

Topic Line: LONG-TERM MEMORY: Episodic

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

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

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Kevin P. Madore, Stanford University; Anna Khazenzon, Stanford University; Anthony Norcia, Stanford University; Anthony Wagner, Stanford University

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Axel Mecklinger, Saarland University; Gerrit Höltje, Saarland University; Lika Ranker, Saarland University; Kathrin Eschmann, Cardiff University

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

Topic Line: LONG-TERM MEMORY: Episodic

B80 Interactions between categorical and temporal structure during retrieval

Daniel Rubinstein, Thomas Jefferson University; Christoph Weidemann, University of Pennsylvania; Nora Herweg, University of Pennsylvania; Ethan, Solomon, University of Pennsylvania; Kahana Michael, University of Pennsylvania; Michael Sperling, Thomas Jefferson University

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

Topic Line: LONG-TERM MEMORY: Episodic

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

Xinxu Shen, ; Vishnu Murty, Temple University; David Smith, Temple University

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

Topic Line: LONG-TERM MEMORY: Episodic

B82 How is Intentional Forgetting Reflected in Implicit Eye Movements?

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

Topic Line: LONG-TERM MEMORY: Episodic

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

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

Topic Line: LONG-TERM MEMORY: Other

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

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

Topic Line: LONG-TERM MEMORY: Other

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

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

Topic Line: LONG-TERM MEMORY: Priming

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

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

Topic Line: LONG-TERM MEMORY: Semantic

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

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

Topic Line: LONG-TERM MEMORY: Skill Learning

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

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

Topic Line: LONG-TERM MEMORY: Skill Learning

B89 An Automated Method For Correcting Ocular Artifacts In EEG

Brian Kraus

A critical aspect of electroencephalography (EEG) pre-processing is treating ocular artifacts. One of the most popular methods for correcting ocular artifacts is the regression-based method proposed by Gratton et al., (1983). This method

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

Topic Line: METHODS: Electrophysiology

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

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

Topic Line: METHODS: Neuroimaging

B91 Behavioral and ERP Measures of Conflict Adaptation in Working Memory

Eva-Maria Hartman, Catholic University Eichstaett-Ingolstadt; Miriam Gade, Medical School Berlin; Marco Steinhauser, Catholic University Eichstaett-Ingolstadt

WM is conceived as a system for short-term maintenance, updating and manipulation of representations required for goal-directed action. Conflict adaptation refers to the finding of flexible adjustments of control processes in face of conflict, as reflected by two phenomena: (1) Conflict on the previous trial leads to a higher level of cognitive control on the current trial (congruency sequence effect, CSE). (2) A higher proportion of conflict-evoking stimuli leads to a higher level of cognitive control (proportion congruency effect, PCE). The present study considered behavioral data and event-related potentials (ERPs) to investigate whether conflict adaptation is elicited by conflict during WM retrieval in a modified Sternberg paradigm. In a series of experiments participants had to perform either a recognition or a recall task on two differently colored memory lists with four digits each (i.e., 2 5 7 1 and 4 5 9 1). Each list contained two congruent items (the same digit at corresponding positions) and two incongruent items (different digits at corresponding positions). Incongruent items are supposed to evoke retrieval conflict as retrieving these digits from WM is subject to interference from the corresponding digit in the alternative list. Behavioral data indicated stable conflict adaptation effects reflected by CSE and PCE across experiments. In ERPs, conflict adaptation in WM was associated with a modulation of a frontal slow wave. These results demonstrate that conflict in WM retrieval leads to an adaptation of control processes and link the respective mechanism to WM-related neural activity.

Topic Line: EXECUTIVE PROCESSES: Working memory

B92 Developmental Changes in Motor Performance are Mediated by Right Parietal Beta Oscillatory Dynamics

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Numerous recent studies have sought to determine the developmental trajectories of motor-related oscillatory activity. However, most of this work has relied on simple movements, which limits our ability to link changes in neural activity with maturational improvements in motor behavior. In this study, we recorded magnetoencephalography (MEG) during a complex finger-tapping task in 107 healthy youth aged 9-15 years old. The relationships between region-specific neural activity, age, and behavioral performance metrics were then examined using a structural equation modeling. We found robust developmental effects on beta oscillatory activity during the motor planning period, as well as on behavior. There were also strong relationships between planning- and execution-related beta activity within the entire motor network. However, when all factors were assessed, we found that only beta activity within the right parietal cortex mediated the relationship between age and motor performance. These data suggest that strong beta activity that is sustained from planning and execution within the right parietal cortex enhances motor behavior, and that this oscillatory pattern develops through late childhood and into early adolescence.

Topic Line: PERCEPTION & ACTION: Motor control

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

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

Topic Line: METHODS: Neuroimaging

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

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

Topic Line: METHODS: Neuroimaging

B95 Modeling of Mood States Using Multimodal Biometric Data

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

Topic Line: METHODS: Other

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

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

Topic Line: NEUROANATOMY

B97 Macroanatomical morphology of superior temporal lobe in adults with dyslexia

Alexandra Kapadia, Boston University; Gabrielle-Ann Torre, Boston University; Terri Scott, Boston University; Yaminah Carter, Boston University; Tyler Perrachione, Boston University

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

Topic Line: NEUROANATOMY

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

Jairo I. Chavez, Cognitive Science; Daril Brown, Electrical Engineering; Pablo Tostado, Bioengineering; Derek Nguyen, Bioengineering; Kadwory Adam, Bioengineering; Zeke Arneodo, Biocircuits Inst; Bradley Voytek, Cognitive Science; Timothy Gentner, Psychology, Vikash Gilja, Electrical and Computer Engin.

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

Topic Line: OTHER

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

Shiraz Mumtaz, Boston University School of Medicine; Shiraz Mumtaz, Boston University School of Medicine; Marina Ritchie, Boston University School of Medicine; Karin Schon, Boston University School of Medicine

Parkinson's disease (PD) is a progressive neurodegenerative disorder driven by loss of dopaminergic neurons in the substantia nigra. While this loss of function is typically associated with motor impairments, individuals with PD also experience non-motor symptoms. Although PD treatments have focused on increasing intracerebral dopamine through pharmacologic intervention, there is anecdotal evidence suggesting micro-current stimulation may help improve both motor and non-motor symptoms. The goal of this pilot study was to use Bio-Electro Stimulation Therapy with the e-Tapper TT-R1 and apply micro current stimulation to either the 'Head Point' (HP) or 'Leg Point' (LP) of an individual's hand. Baseline quality of life, sleep quality, and cognitive data were collected in 15 older adults (mean age 62±6.18) with PD (HY stages I-III). Participants were randomized into HP or LP groups and underwent a 6-week e-tapper intervention in which they self-administered the intervention twice daily for 30 min. Assessments identical to those administered at baseline were completed post-intervention. Paired samples t-tests demonstrated increased performance on delayed visuospatial memory for LP compared to HP group participants following the intervention, but no effects for spatial cognition, divided attention or verbal learning. Paired samples t-tests also demonstrated increased perceived quality of life and perceived sleep quality in HP compared to LP group participants following the intervention. These results suggest subjective increase in quality of life and sleep quality following the HP intervention and potentially indicate that further exploration of alternate treatment modalities such as Bio-Electro Stimulation Therapy for PD with objectively measured outcomes is needed.

Topic Line: OTHER

B100 Dissecting the pathophysiological circuit substrates of reward and anhedonia subdomains

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

behavioral measures were found in somatomotor, attention and frontoparietal networks for the NAcc, hippocampus and VTA. Clinical and behavioral measures of anhedonia mapped unto different parts of the functional networks.

Topic Line: OTHER

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

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

Topic Line: PERCEPTION & ACTION: Audition

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

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

Topic Line: PERCEPTION & ACTION: Audition

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

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

Topic Line: PERCEPTION & ACTION: Audition

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

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

Topic Line: PERCEPTION & ACTION: Audition

B105 The Development of Neural Responses to Faces in Infancy

Stefania Conte, University of South Carolina; John Richards, University of South Carolina

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

Topic Line: PERCEPTION & ACTION: Development & aging

B106 Flickering light stimulation to promote brain gamma connectivity in aging

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

Topic Line: PERCEPTION & ACTION: Development & aging

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

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

Topic Line: PERCEPTION & ACTION: Motor control

B108 Decoding Multisensory Speech Deficits in Autism

Michael Crosse, Albert Einstein College of Medicine; Aida Davila, Albert Einstein College of Medicine; Egor Sysoeva, Albert Einstein College of Medicine; John Foxe, University of Rochester; Sophie Molholm, Albert Einstein College of Medicine

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

Topic Line: PERCEPTION & ACTION: Multisensory

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

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

Topic Line: PERCEPTION & ACTION: Multisensory

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

Stevenson Baker, York University; Stevenson Baker, York University; Ariana Youm, University of Toronto; Yarden Levy, McMaster University; Morris Moscovitch, University of Toronto and Rotman Research Institute; R. Shayna Rosenbaum, York University and Rotman Research Institute

Perceptual judgments of faces with great featural overlap typically recruit the perirhinal cortex. Recent evidence, however, hints that discrimination and identification of highly confusable faces may be related to pattern separation mediated by the dentate gyrus of the hippocampus. Prior knowledge may also be a factor. To test whether the hippocampus is implicated in identifying and discriminating among highly similar faces, we tested healthy controls and BL — an amnesic person with a lesion selective to the dentate gyrus. We used morphed images of famous and nonfamous faces in a standard categorical perception (CP) experiment with morphs of two faces varying from 0 – 100%, and tested identification and discrimination. Controls and BL exhibited predicted nonlinear identification of famous faces with a typical category boundary. Newly learned nonfamous faces were identified with lesser fidelity by controls, though the category boundary along the performance continuum was at the expected threshold of maximum ambiguity (50% morphs). In contrast, BL revealed an idiosyncratic shift in his category boundary that was significantly different from that of controls (p<.001). In the subsequent discrimination phase, participants were presented with equally spaced face pairs. Controls showed typical CP effects of better between-category than within-category discrimination, but only for famous faces. BL, meanwhile, showed extreme within-category "compression," reflective of his overactive tendency to pattern complete in the face of poor pattern separation and noisy stimuli. We provide the first evidence that pattern separation and completion mediated by the hippocampus contribute to CP of faces.

Topic Line: PERCEPTION & ACTION: Other

B111 Somatosensory stimulation during REM sleep produces changes in dream content

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

Topic Line: PERCEPTION & ACTION: Other

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

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

suggesting an overall and general embodied effect of liking and individual preferences during action observation. Together, these results suggest sensorimotor simulation may be differentially engaged depending on preferences, and highlight the importance of an embodied mechanism underlying aesthetic appraisal and aesthetic judgments.

Topic Line: PERCEPTION & ACTION: Vision

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

Nicholas Blauch, Carnegie Mellon University; Marlene Behrmann, Carnegie Mellon University; David Plaut, Carnegie Mellon University

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

Topic Line: PERCEPTION & ACTION: Vision

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

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

Topic Line: PERCEPTION & ACTION: Vision

B115 Serial processing of multiple identities in single faces

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

Topic Line: PERCEPTION & ACTION: Vision

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

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Dance expertise modulates sensorimotor responses during observation of familiar movements. Recent behavioural and physiological studies have shown how expertise with the observed action enhances visual and emotion sensitivity (ability to discriminate actions/emotions) on familiar movements. This study investigates if the enhanced expert emotion sensitivity is domain specific (i.e. only related to emotion expressed on familiar movements) or general to other forms of emotional expressions (i.e. facial expressions). We compare neural responses to facial expression (happy, fearful, neutral) in two groups of participants (professional dancers/experts and non-dancers/controls). To explore activation in cortical regions related to embodied emotion (somatosensory/sensorimotor cortices), we measured Visual Evoked Potentials (VEP) and Somatosensory Evoked Potentials (SEP -by applying an irrelevant touch 105 ms over the fingertip after visual onset), while participants performed a visual emotion or a gender task on emotional faces, as described in (Sel, Forster and Calvo-Merino, JoN, 2014). In line with previous work, results show an overall main effect of emotion over somatosensory cortex (80-100ms) over

and above visually-driven carry-over effects. Importantly, we also find an interaction between group and emotion (80-120 ms) in the SEPs, suggesting a differential embodied response to facial expression between experts and non-experts. Taken together, this data talks in favour of an enhanced general emotion sensitivity in experts, that is reflected beyond the observation of their motor acquired skill but onto general and everyday emotional expressions. Finally, these results point towards new venues for emotional sensitivity training based on engaging motor and artistic knowledge.

Topic Line: PERCEPTION & ACTION: Vision

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

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

Topic Line: PERCEPTION & ACTION: Vision

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

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

Topic Line: PERCEPTION & ACTION: Vision

B119 ERP Measures Of Human Cortical Long-Term Depression

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

Topic Line: PERCEPTION & ACTION: Vision

B120 Neurophysiological correlates of purchase decision-making

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

Topic Line: THINKING: Decision making

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

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

Topic Line: THINKING: Decision making

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

Avijit Chowdhury, National University of Singapore; Rongjun Yu, National University of Singapore

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

Topic Line: THINKING: Decision making

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

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

Topic Line: THINKING: Decision making

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

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Imagine you are at the doctor's office, recently diagnosed with a life-threatening disease, and you have two treatment options. The traditional treatment offers a 50% success rate, while a newly designed drug has a success rate somewhere between 30% and 80%. Which drug would you take? Economists describe the traditional drug as a risky option because you know the probabilities of success and the new drug as ambiguous because the outcomes probabilities are unknown. It is well established that, across types of decisions, people find ambiguity more aversive than risk even when the ambiguous choice has a higher expected value (Ellsberg, 1961). It has been shown that arousal to a choice predicts ambiguous but not risky choices (Feldmanhall et al., 2016) and that activation of the amygdala is uniquely observed to ambiguous choices (Levy et al. 2010). Building on these correlational findings, we explored whether arousal, incidental to the choice, causally impacts ambiguity preferences via two independent experiments. One study manipulated incidental arousal via an acute psychosocial stressor and the other induced an anticipatory threat response. The efficacy of the manipulations were confirmed via salivary cortisol response and pupil dilation, respectively. Participants made choices between a guaranteed $5 option and a lottery with either a known (risky) or unknown (ambiguous) probabilistic outcome. Consistent with previous findings, participants were risk and ambiguity averse. However, in contrast to our hypothesis, we found no evidence of a causal relationship between incidental arousal and ambiguity preferences.

Topic Line: THINKING: Decision making

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

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

Topic Line: THINKING: Decision making

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

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

Topic Line: THINKING: Other

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

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

Topic Line: THINKING: Problem solving

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

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Previous research has linked prefrontal and posterior parietal cortices (key hubs of the Frontoparietal Network; FPN) to analogical reasoning performance. Past theory and research have suggested that connectivity within the FPN may be important for analogy performance including its development. However, aside from Morrison and colleagues' (2004) computational study of frontotemporal lobe degeneration, the evidence linking brain networks to analogical reasoning performance has thus far been correlational. Here we applied transcranial alternating current stimulation (tACS) at theta frequency (6 Hz) to nodes in dorsolateral prefrontal cortex (DLPFC) and posterior parietal cortex (PPC) to investigate the causal role of FPN connectivity in both visual and verbal analogical reasoning. 94 participants (collected across two sites) participated in a between-subjects, double-blind design with three conditions: 1) 0-degree in phase 'synchronized' theta tACS (N=32), 2) 180-degree out of phase 'desynchronized' theta tACS (N=28), and 3) sham stimulation (N=34). Contrary to previous evidence that 'synchronized' theta tACS to DLFPC and PPC enhances working memory (Polania, 2012), we found that 'desynchronized' stimulation led to enhanced visual analogical reasoning compared to both the sham and 'synchronized' stimulation conditions (F=4.31, p=.016, ?p2 = .086), even when controlling for baseline intelligence and vocabulary. In addition, we found no differences in performance on forward digit span (working memory) or the verbal analogy task between the three different stimulation conditions. These findings support a causal role of the FPN in visual analogical reasoning, and call into question whether 180-degree out of phase stimulation truly 'desynchronizes' cortical oscillations between brain regions.

Topic Line: THINKING: Reasoning

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

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

Topic Line: THINKING: Reasoning